

The Proceedings of 19th International Symposium on Logistics (ISL 2014)

Designing Responsible and Innovative Global Supply Chains

Ho Chi Minh City, Vietnam 6 – 9th July 2014



Organized by



Supported by

The International Academy for Marine Economy and Technology, The University of Nottingham Ningbo
Campus, China

&

The Institute for Advanced Manufacturing, The University of Nottingham, UK

Editors: K S Pawar & M Nkhoma

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INTRODUCTION

We would like to welcome our friends and colleagues to the 19th annual International Symposium on Logistics (19th ISL). It is 22 years since the first Symposium on Logistics was held in Nottingham and it is now considered as the premier international event in the field of Logistics and Supply Chain Management. As in previous years many members of the ISL community look forward to meeting, sharing and exchanging their research ideas and results in both the formal and informal settings which the symposium provides.

The concept of alternating the symposium every year between Europe and the rest of the World is now well established. This year's event in Ho Chi Minh City, Vietnam continues this tradition, following the very successful and rewarding event held in Vienna, Austria last year.

The chosen theme of the 19th ISL is "*Designing Responsible and Innovative Global Supply Chains*". This theme reflects the changes taking place in recent years resulting in increased risk, complexity and uncertainty in supply chains. Factors like the debate on outsourcing vs insourcing, rising raw material and energy prices and the economic and political uncertainty have placed additional pressure on designers and planners of supply chains. Equally, the society calls for more sustainable and socially responsible business practices to avoid unintended consequences within the supply network. The combination of these factors means that managers and supply chain designers are faced with bringing resilience into their supply chains to address these issues of uncertainty and risk. Thus the challenge is to proactively transform traditional approaches into responsible and innovative supply chains which are competitive and sustainable yet give due consideration to consumers and society. These changes have big implications for logistics and supply chain configurations, representing a dynamic and interesting area of research and practice for both academics and practitioners alike. With this in mind, the 19th ISL has assembled experts from around the globe to focus on how leading firms and academics are responding to these challenges and debate what this will mean for the future of global supply chain management. Papers in the proceedings represent the latest in academic thinking, as well as case examples of successful practices and innovative approaches to counter act the current situation.

Potential authors were invited to submit an abstract to the Symposium Chairs. All abstracts were reviewed by two experts from the International Advisory Committee and final papers were further reviewed by an International Panel of Reviewers. This book of proceedings of the accepted papers has been organised according the following categories:

- *Supply Chain Design and Planning*
- *Responsible Supply Chains*
- *Services and the Supply Chain*
- *Complexity, Risk and Uncertainty*
- *Inventory and Warehouse Management*
- *Customer-Supplier Collaboration and Relationships*
- *Supply Chain Costs*
- *Supply Chain Performance Assessment*
- *Sustainability in Logistics and Supply Chains*
- *Transport and Distribution*
- *Port Logistics*
- *Supply Chain Skills, Capability and Education*

We would like to take this opportunity to express our sincere thanks to all the presenters, delegates, reviewers, Advisory and Programme Committee members, local organizing partners and guest speakers for their interesting and valued contributions. This year we changed the paper submission and management process to an online Conftool. This, as you can imagine, posed numerous challenges and has been competently handled and managed by Abhijeet Ghadge, Helen Rogers and Christos Braziotis. We would also like to express our gratitude to the events team at RMIT for their support and help in organizing this event. Also sincere thanks are due to Helga Nagy and Jaime Calbeto for their help in organizing industrial visits and their all-round support. The help and support provided by Meng Feng Gong in preparing the proceedings is also deeply appreciated. Finally, our special thanks go to Lesley Gray for stepping into Alison Parrett's shoes to provide administrative support for the event. Alison has taken a well-deserved retirement and on behalf of everyone involved with ISL, we would like to put on record our thanks for her valuable contributions over the past 22 years.

Professor Kulwant S Pawar and Dr Mathews Nkhoma – July 2014

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Section 1: Supply Chain Design and Planning

FORECASTING E-COMMERCE SALES FOR BETTER SUPPLY CHAIN MANAGEMENT AND LOGISTICS PLANNING

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ABSTRACT

Thanks to the fast development of Internet technologies, e-commerce is taking more and more market shares from physical store sales. This emerging retail model also affects the existing supply chain and logistics services, e.g., alongside of the warehouse-to-store shipping in the traditional logistics model, more courier services including warehouse-to-customer and store-to-customer shipping are in compelling need for online sales. Sales volume forecasting is important in supply chain management. Since e-commerce introduces higher workload for logistics services, sales forecasting in e-commerce becomes even crucial. Traditional sales forecasting methods, which focus on physical stores, are no longer effective, because e-commerce brings in more factors such as the Internet capacities that affect the sale volume. In this paper, we aim to design a new causal model for e-commerce sales forecasting. Specifically, we identify the particular factors affecting e-commerce sales and take them into account to build causal-based forecasting models. We use the US e-commerce data in our study, and compare the causal model with the standard time-series analysis model to show the performance difference. We also discuss the trade-off of the two classes of models in utility. Our research can be a guideline for the supply chain management in the e-commerce industry for sales forecasting.

INTRODUCTION

In 2013, the Chinese e-commerce giant Alibaba and its online shop portals, including Taobao.com and Tmall.com, hosted transactions worth \$5.8 billion, on the Chinese Bachelor's Day (November 11th). This number nearly triples the estimated \$2 billion recorded by U.S. online merchants on the Monday after Thanksgiving (aka Cyber Monday) in 2012 (Shinal, 2013). This breaking news marked the new era of e-commerce in China, and also indicated the great potential of e-commerce relying on the fast growing Internet technologies globally.

It is no doubt that this emerging commercial model highly impacts the existing supply chain and logistics services. For example, alongside of the warehouse-to-store shipping in the traditional logistics model, more courier services including warehouse-to-customer and store-to-customer shipping are in compelling need for online sales. This fact greatly promotes research attentions and efforts in urban logistics (Quak, 2011 and de Souza, 2013), and also breeds new courier giants such as SF Express¹ with 3.5 billion USD revenue in 2012.

Precisely forecasting sales is essential to the management of supply chain and logistics services. However, the existing forecasting models for physical store sales are no longer effective in e-commerce. The online sales is not only confined to customer needs, but also restricted by the development of Internet technologies, the scale of online stores, the shift of customer buying habits and many other factors. For better supply chain management and logistics planning in e-commerce, new sales forecasting models are desired.

¹ <http://www.sf-express.com>

In this paper, we aim to design new forecasting models for e-commerce sales, by considering particular factors that affect the sales in e-commerce industry. We use the US e-commerce market data in our study. Theoretically, the methodologies and models proposed in this paper are adaptable to different e-commerce markets in any other countries. In particular, we first examine the possibility of extending the direct sales forecasting method for physical store sales, e.g., auto-regression, onto online sales. Taking this result as a baseline, we train a regression causal model which considers more e-commerce related factors in online sales forecasting, and compare the performance and the utility of the two classes of models.

Our research findings can be referenced and used by different players in an e-commerce supply chain. For example, based on forecasted demand, the manufacturer can control the production, the online market service provider can prepare sufficient system capacity, the online shops can raise different promotions, the couriers can be prepared for high delivery volume, etc.

RELATED WORK

Sales forecasting is important for supply chain management. This problem has been studied in various industries, e.g., some reports since 2010 include convenience store (Lee et al, 2011), fresh food (Chen et al, 2010), fashion products (Yu et al, 2011), high-tech products (Decker et al, 2010), wood industry (Oblak et al, 2012), magazine and newspaper (Yu et al, 2013) and many others. The common aspect of the existing works is that they all focus on physical store based sales. Thus there are many similarities in their forecasting models. In this paper, we focus on the e-commerce sales, which introduce more factors, such as the Internet development, other than those considered in the existing reports,.

Regarding the analysis techniques, there are generally two approaches, i.e., time-series analysis approach and causal analysis approach. In the first approach, only historical sales data are considered, and the evolving trend will be discovered and used for forecasting. The typical time-series analysis method is the Box-Jenkins method using ARIMA model (Box and Jenkins, 1970). In the second approach, rather than the time effect, more factors that may affect the sales volume will be considered. For example, on contrast to the auto-regression in the time-series analysis, causal analysis will consider many more affecting factors as features to do regression.

For the detailed classes of models, regression is the typical and the simplest class. Besides regression, there are also many other classes of models including Support Vector Regression (SVR), Artificial Neural Network (ANN) and so on. SVR (Wu et al, 2009) is an extension of Support Vector Machine (SVM) for regressions for continuous variables. ANN (Franses et al, 1997), on the other hand, simulates brain neurons that can compute values from inputs of features by feeding information through the network. For all these classes of models, if only the historical sales data are used in training, they would be time-series analysis models. However, if more features are considered, which are affecting the sales volume, the models are causal models. With respect to the performance, it is generally believed that SVR and ANN perform better than the traditional regression (Yuan et al, 2011).

In this study, we do not focus on finding a good causal model. Instead, we are interesting in comparing causal model with new affecting factors in e-commerce sales with the time-series model, to see whether the new factors in e-commerce is significant for sales volume forecasting. Thus, in this paper, we use the simple

regression model to represent the causal model. Other models such as SVR and ANN can also be used in our study.

DATA AND SOFTWARE TOOL

E-commerce is taking more and more market share from physical store sales globally. Especially in many Asian countries with high population density, such as China and Singapore, this emerging industry is developing very fast in recent years. However, in these upstart e-commerce markets, there is a lack of rich and stable historical online sales data for a machine to train a good forecasting model. On the other hand, the US as the IT pioneer country and the world's No. 1 e-commerce market, has the earliest and most mature e-shopping environment, and maintained the most comprehensive online sales data for reference and study. Thus, in our research, we take the US e-commerce market data for forecasting model construction. It is believed that as time passes, all e-commerce markets will accumulate enough data for forecasting model training.

The dataset contains the e-commerce online sales records (in millions of USD) from Quarter 4 of 1999 to Quarter 2 of 2013. However, since other factor data, which are used in the causal model we are going to train, do not include the information about 2013 (too recent), the last two records in the dataset, i.e., for 2013 Q1 and Q2 are omitted in the analysis. Finally, the US online sales data used in our analysis are visualized as in Figure 1.

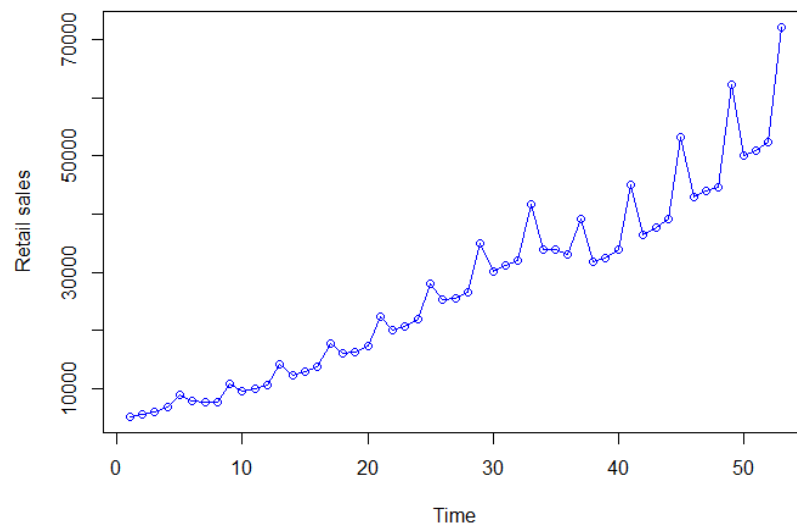


Figure 1. Plot of US e-commerce sales data

It can be clearly observed that the plot displays an increasing trend and the quarterly seasonality with increasing variation.

To serve the modelling with causal method, some potential factors that affecting the amount of online sales can be identified from common background knowledge, such as the factors related to IT development, including the total number of Internet users and broadband users, and the factors related to citizens' purchasing power, such as the GDP per capita. A few raw datasets on these factors are also collected.

The software tool used in our study for analyzing data and building models is R (with relevant packages) (R Core Team, 2013).

BOX-JENKINS MODEL

In this section, we apply the typical time-series analysis method, i.e., Box-Jenkins method, to build a forecasting model. In Box-Jenkins method, an AutoRegressive Integrated Moving Average (ARIMA) model is trained based on the only dataset, the online sales data in our case. This approach is widely adopted in sales or demand forecasting for traditional physical store sales.

As observed from Figure 1, there is an obvious seasonal trend, but the variation of the seasonal changes increases. Thus the raw data is not stationary. Since ARIMA method only deals with stationary data, we need to make the dataset stationary. In the pre-differencing step, we apply the natural logarithm to the dataset. The new data after pre-differencing is shown in Figure 2.

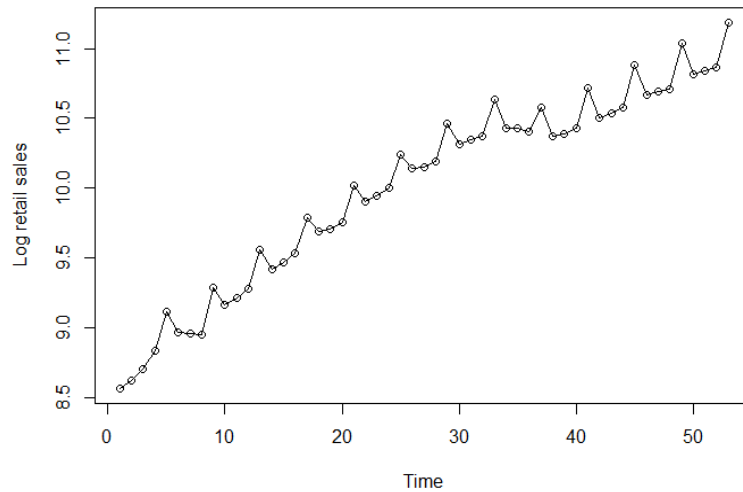


Figure 2. Log-scaled sales data after pre-differencing

After observing the SAC and SPAC (not shown in this paper) that are generated from the software, we choose the parameters to fit the ARIMA model, which will be further used for forecasting.

To test the ARIMA model, we divide the dataset into two parts, i.e., the training part and the testing part. The first 45 quarters are used for training, while the last 8 quarters are used for testing the model. Figure 3 shows the comparison between the true sales values and the predicted sales values for the last 8 quarters.

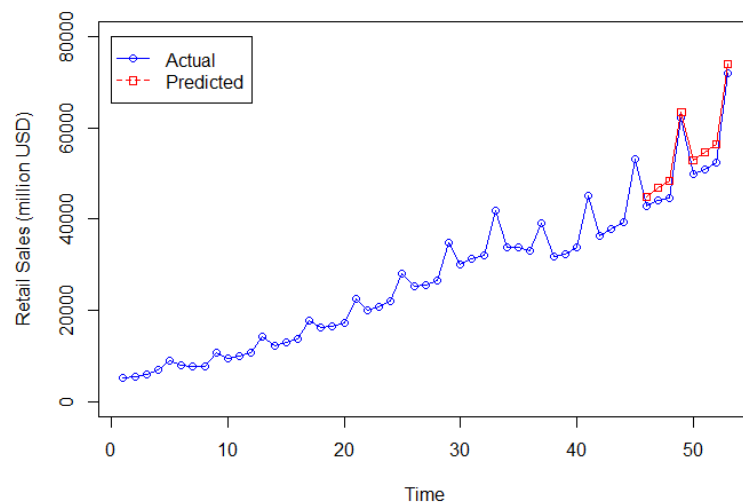


Figure 3. Comparison between predicted values and actual values using the ARIMA model.

In Figure 3, the blue curve represents the actual sales values, and the red curve for the last 8 quarters represents the predicted values. It can be observed that the ARIMA model does capture the time-series trend and seasonal trend, and the predicted values are not too bad, though a little bit higher than the actual values. We will quantify the performance of the model later, when we do the model comparison.

CAUSAL MODEL

As stated, the Box-Jenkins model is widely used in sales forecasting, and as illustrated in the previous section, it performs good in handling online sales data as well. However, the core of this paper is to look at the possibility to design a better model that incorporates the factors in e-commerce into sales forecasting. In this section, we will use causal model to approach the target.

For the causal model, we consider several factors as features during the supervised learning. The raw features include:

- Percentage of Internet users. Apparently, the number of Internet users determines the development of e-commerce. E-commerce is growing only if more people are using Internet.
- Percentage of broadband. The bandwidth is another important factor to the e-commerce development. High Internet speed would promote more people to do online shopping.
- Internet security level. From the study (Kuzic et al, 2002) in Australian finance industry, the security is ranked as the No. 1 success factor to the e-commerce. The security level directly affects the confidence of Internet users to the online merchants, when they pay goods online with their credit cards. In our study, we take the number of secure servers on the Internet as the indicator of the Internet security development.
- Per-capita GDP. Per-capita GDP indicates the economy condition of each year. It is normal to assume that when the economy is good, there will be more shopping transactions, and vice versa.
- Dummy variable of Q4. There is an obvious seasonal trend for the US e-commerce sales. The last quarter of each year attracts most transactions, compared to other quarters. To reflect this seasonal trend, we need to add in a dummy variable.
- Time effect. There may be other factors that we ignore. Thus we use a variable of time to represent them. Note that all the above mentioned factors are also related to time. As a result, during regression, we need to handle the covariance among all the features, by adding interaction terms, i.e., the combination of two features.

Since many features are correlated to each other, we also introduce new features that are combined by the existing features, to reduce the correlation effect. We further use the step-wise method to choose the most effective features. Finally, we train a linear regression model with Adjusted R-squared value of 99.64%, which means the model is quite good in terms of forecasting performance.

Similarly, we validate the causal model by using the data from the first 45 quarters in training and the data from the last 8 quarters for testing. The curves of predicted sales values against actual values for the 8 quarters are shown in Figure 4.

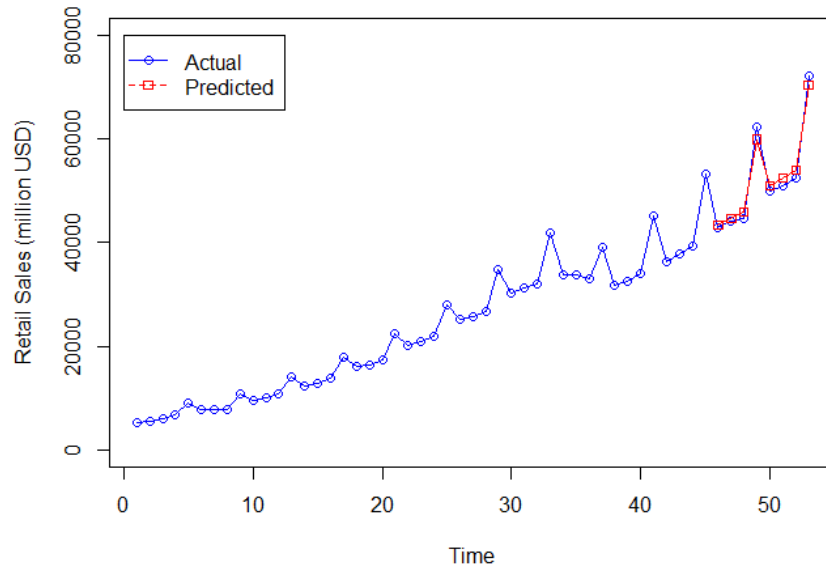


Figure 4. Comparison between predicted values and actual values using the causal model

Again, the forecasted values are very close to the actual value, which validates that our model is a good model. Since the model is very data-specific, it makes no sense to show the detailed parameters of the model. For different datasets, e.g., the e-commerce data in Singapore or China, the parameters will be different, but the methodology and the process to build the model remains.

COMPARISON BETWEEN BOX-JENKINS MODEL AND CAUSAL MODEL

In this section, we comprehensively compare the two types of models, i.e., the Box-Jenkins model which only makes forecasting based on historical values, and the causal model which considers different causal factors to do regression.

Performance Comparison

We first compare the performance of the two models. As we can observe from Figure 3 and Figure 4, although the two models are both good in capturing the time trend and seasonal trend of online sales, the causal model is better in terms of errors. We quantify the comparison by using Root Mean Squared Error (RMSE) and Mean Absolute Deviation (MAD) values, as shown in Table 1.

Model	Box-Jenkins Model	Causal Model	Causal / BJ
RMSE	2916.86	1455.2	49.9%
MAD	2760.13	1323.6	48.0%

Table 1. Performance comparison between Box-Jenkins model and causal model

It can be seen that the causal model is much better than the Box-Jenkins model in performance. The causal model has nearly half of RMSE and MAD (errors) than the Box-Jenkins model. This is because the Box-Jenkins model only considers the time to discover the trend of online sales, but the causal model considers many factors that may affect the online sales, including the time factor. Thus the causal model can capture more information during forecasting, and then return better result than the Box-Jenkins model.

Utility Comparison

Although the Box-Jenkins model is not as good as the causal model, it requires minimum information to do forecasting. Only given the historical data, the Box-Jenkins model can return a good forecasting result. On the other hand, the causal model requires much more information on the related factors. In some cases, these factors can be easily predicted, but in some other cases, to accurately predict the factors is a challenging task.

On the other hand, if the related factor can be predicted, the causal model will be much more useful than the time-series model. For example, in Figure 1, the data point from No. 35 to No. 40 represent the period of 2007 to 2009, when the US was suffering from financial crisis. Based on the Box-Jenkins time-series analysis, given the data points from the No. 1 to the No. 34, which are clearly increasing in value according to the time, the Box-Jenkins model cannot forecast the value decrease for the points from No. 35 to No. 40, and onwards. However, if the forecasting uses causal model, which takes GDP or other economics-related factors into account, the sales decrease can be predicted.

CONCLUSION

Due to the new impacts in supply chain and logistics management brought in by e-commerce, online sales volume forecasting is rather significant. The existing sales forecasting models for physical stores do not consider the Internet-related factors, thus they are not effective for e-commerce sales forecasting. In this paper, we try to identify a set of features that are specifically related to e-commerce and take them into account to build forecasting models. We compare this kind of causal model to the straightforward time-series analysis model, to show the trade-off in performance and utility. We conclude that the causal model with comprehensive factors into consideration has better performance, whereas also requires more resources to do forecasting.

ACKNOWLEDGEMENT

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ANFIS EXPERT SYSTEM FOR CARGO LOADING AS PART OF DECISION SUPPORT SYSTEM IN WAREHOUSE

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ABSTRACT

Purpose

In this paper, an ANFIS Expert System (ES) model has been developed that serve as Decision Support System (DSS) for application in one of the brewing company, in the Republic of Serbia.

Methodology

Methodology is based on synthesis of expert knowledge with fuzzy logic and neural networks. Fuzzy logic and neural networks, served as a tool for "capturing" expert knowledge and its transformation to a logical connections. Presented ANFIS model is a nonlinear regression of influencing parameters on the process of selecting the number of forklifts in the warehouse cargo loading operation.

Findings

Fuzzy logic and neural networks are excellent tool for transforming the human intuitive knowledge in numerical values, for the purpose of further use in decision making. Warehouses are exactly places where many business activities are based on empirical and intuitive estimations, thus they are a good area for the application of these methodology. Therefore, further researches should be directed towards the holistic approach of implementation neuro-fuzzy systems in warehouses, with aim of optimizing all logistic operations in warehouses.

Value

Novelty approach for determining the number of forklifts in cargo loading operation of warehouse.

Practical implications

Warehouse efficiency directly affects the efficiency of the entire supply chain, and it is necessary to pay special consideration to optimization of warehouse operations. One of the most important and time demanding warehouse operation is cargo loading. We approached to this problem by developing the model which is simple, and easy to understand, efficient, and it is practically applicable tool for determining the number of forklifts which should be deployed in the process of cargo loading

Keywords

Expert system, case study, ANFIS, cargo loading, forklifts, warehouse

1. INTRODUCTION

“Essentially, all models are wrong, but some are useful”

George Box

While creating presented paper, we were guided with aforementioned statement of George Box- pioneer in quality control, and tried to make model that is highly usable for experts and workers, and which has small deviations from the real system. Model tries to approximate decision making process of warehouse expert, when deciding about the forklifts engagement in loading operation in brewery warehouse.

Determining the number of forklifts which will be deployed in loading zone of warehouses, is a very important task that is usually in practice entrusted to the warehouse experts. Depending on the number of forklifts that are deployed in the cargo loading, depends how many of the remaining forklifts will be deployed to other company activities. Therefore, decisions regarding the deployment of the forklifts, directly affects the efficiency of whole logistics system of the company. In particular brewing company decisions made by an expert, are based on his long experience, without the help of any DSS. There is a substantial amount of empirical evidence that human intuitive judgment and decision making can be far from optimal, and it deteriorates even further with complexity and stress (Druzdzel and Flynn, 2002), and that is one of the main reasons why experts should have some DSS, as support tool in decision making. ES are computer programs within a specific domain, involving a certain amount of Artificial Intelligence (AI) to emulate human thinking in order to arrive at the same conclusions as a human expert would (Olson and Courtney, 1992). An ES component is ideal to assist a decision maker in an area where expertise is required (Turban, 1995). They can either support decision makers or completely replace them, and they are most widely applied & commercially successful AI technology. One of the justifications of building an ES is to provide expert knowledge to a large number of users (Kock, 2003). According to Turban (1998), ES are considered as a part of the DSS. DSS exist to help people to make decisions. Usually it means different things to different people, hence there is no universally accepted definition of DSS (Turban et al., 2005). Turban et al. (2005), also stated that DSS is sometimes used as an umbrella term to describe any computerized system that supports decision making in an organization. Importance of DSS in logistics is presented in a series of papers that are pointing out increase in the productivity level of the logistics system after the implementation of DSS (examples like Citgo Petroleum Corporation, Natural Gas company, etc.) (Min and Eom, 1994, Eom and Lee, 1990, Eom et al., 1998, Eom and Kim, 2006). Proper application of decision making tools increases productivity, efficiency, and effectiveness and gives many businesses a comparative advantage over their competitors, allowing them to make optimal choices for technological processes and their parameters, planning business operations, logistics, or investments (Druzdzel and Flynn, 2002). According to survey (Liao, 2005), neural network and fuzzy logic are one of the widely used ES methodologies, and has variety implementation areas (fault diagnosis, optimal power flow, decision making, alarm processing system, etc.). Fuzzy logic and neural networks are excellent tool for transforming the human intuitive knowledge in numerical values, for the purpose of further use in decision making. In our paper we used a combination of fuzzy logic and neural network (ANFIS), as a tool for “capturing” expert knowledge, regarding warehouse loading operation.

The logistics strategy sets the overall structure of the supply chain, including the role of warehouses. Warehouses are an essential part of most supply chains and they have to contribute to the logistics strategy (Waters, 2003). Usually, warehouses occur as a weak spots of the entire supply chain, and to avoid this phenomenon, special attention should be given into optimization of warehouse activities. Warehouse activities are various and complex. McGillivray and Saïpe (1996) in their survey found that forklifts were by far the most widely used equipment for moving materials in warehouses, being used by 94% of companies. To our knowledge, there isn't any proposed model in literature, which deals with optimizing the number of dispatched forklifts in loading operation in warehouses.

Therefore, bearing in mind that warehouse efficiency affects the efficiency of the entire supply chain, and that forklifts are the dominant warehouse machinery which directly affect the efficiency of the warehouse, in this paper we are dealing with development of the model for the selection of the optimal number of forklifts in the loading operation, as a one of the most important warehouse operation.

2. FUZZY INFERENCE SYSTEM (FIS)

The basic elements of fuzzy inference system are: input variables, fuzzification, rules, inference machine, defuzzification and output variable (E. 1).

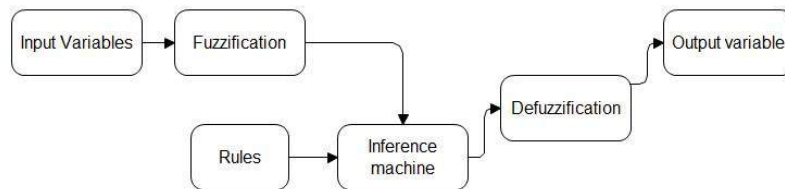


Fig. 1. Basic elements of fuzzy inference system
Source: adapted from (Tedorovic and Selmic, 2012)

Input variables of fuzzy inference system can be either numeric or linguistic. Zadeh (1975) presented the concept of linguistic variables and approximate reasoning, which allowed implementation of linguistic variables in managing, which have great magnitude in areas as logistics and warehousing. Fuzzification role in the FIS is to perform the mapping of input variables to fuzzy sets. In order to determine the value of fuzzy variables, usually in practice we need to perform measurement, observations or estimate value of variable by experience and knowledge of expert. Fuzzy rules in practice represent expert knowledge, by which certain processes are managed, or rules by which expert is executing some activities. Fuzzy rules are usually created by interviewing experts (Tedorovic and Selmic, 2012). Beside mentioned, the formation of the fuzzy rules is also done by observing and studying the expert decisions, with aim to determine rational reasons why some decisions were made and to extract the essence of expert "kind of thinking". Fuzzy reasoning (approximate reasoning) is a transformation of the fuzzy rules in the fuzzy relations to get a result. Fuzzy reasoning is reasoning from assumptions when linguistic terms are characterized by fuzzy sets. Machine reasoning, reflects the way that rules are combined (Mendel, 1995). The last step in the algorithm of approximate reasoning is defuzzification, i.e., the choice of one numerical value, of the resulting fuzzy set, as the final output of the system.

3. ADAPTIVE NEURO FUZZY INFERENCE SYSTEM (ANFIS)

Modeling problems are traditionally solved in the context of mathematical modeling using algebraic, differential or difference equations. Modeling problems arise due to the fact that most of the algorithms have been sufficiently developed for linear systems while most real processes are nonlinear and can be approximated by linear models only locally or, with simplifying assumptions (Riid, 2002). As we have already mentioned fuzzy systems can be seen as multidimensional approximators of input-output relation between the variable $y = f(x_1, x_2, \dots, x_i)$. Several authors (Wang, 1992, Kosko, 1994, Castro, 1995) have proved that given enough rules, the system can approximate any real continuous function to any given accuracy.

$$\forall x \in X, |F(x) - f(x)| < \varepsilon \quad (1)$$

where $F(x)$ is the function to be approximated. With this scientific results it is shown that the fuzzy systems are successful in modeling and represent a powerful tool for modeling real nonlinear system. The reason why the fuzzy logic and neural networks are selected, for the foundation of presented model, is because neural networks are excellent tool for mapping the human knowledge in numerical values (Zadeh, 1975, Jang, 1993, Mendel, 1995, Wang, 1997). In observed warehouse, operation decisions are realized on the basis of expert knowledge, and for that kind decision making activities, neural networks are very

good choice for business modeling. When defining the FIS there are two approaches in practice. The first approach is based on expert estimation of relations between different variables, while the second relies on supervised learning techniques for determining the relations between the input and output variables. In this approach of forming the rule base for FIS, training data is required, which is collected by observing certain phenomena that is modelled. Historically, fuzzy systems grew out from the context of human machine interface. Older identification algorithms have therefore quite modest approximation properties compared to the methods developed more recently (Riid, 2002). Important step towards new methods in fuzzy modeling is introduction of Takagi & Sugeno inference system, together with the method of least squares estimation for consequences parameters (Takagi and Sugeno, 1985). Takagi & Sugeno inference system is the most frequently used form of FIS in the ANFIS structure. ANFIS structure with Takagi & Sugeno inference (Fig. 2), is first presented by Jang (1993), and it represents combination of neural networks and fuzzy logic.

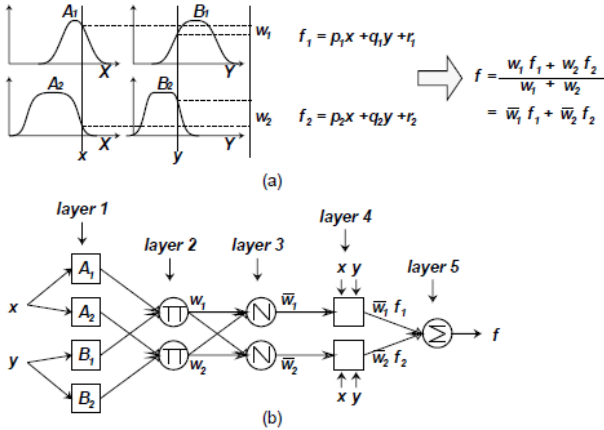


Fig. 2. a) Sugeno fuzzy model of first order **b)** corresponding ANFIS structure
Source: (Jang, 1993)

Fig. 2 a), shows FLS based on Sugeno reasoning, which consists of two rules:

- Rule 1: *If* x is A_1 and *if* y is B_2 , *then*: $f_1 = p_1x + q_1y + r_1$
- Rule 2: *If* x is A_2 and *if* y is B_2 , *then*: $f_2 = p_2x + q_2y + r_2$

Fig. 2 a) also shows the inference mechanism, i.e., the method of calculating final function $f_{(x,y)}$ depending on input vectors $[x, y]$. "Firing strengths" ω_1 and ω_2 are mainly determined by the appropriate T norms. It is common that "firing strengths" are calculated as the product of the corresponding membership functions for each rule separately. Output function f is a weighted average, which involves output functions of each rule f_i and "firing strengths" of each rule individually ω_i . Constructed neural network (Fig. 2 b) is functionally equivalent to fuzzy logic system shown in (Fig. 2 a). Fig. 2 b) shows the structure of ANFIS network, for presented Sugeno model with two input variable. From the Fig. 2 b) it is clear that network consists of the multiple layers, within which there are a different number of nodes, depending on the purpose of a particular layer. Nodes with square form, represent nodes that are adaptive during training of ANFIS network (layer 1 and layer 4), while nodes labeled with circle, represent fixed nodes during training of system.

4. CASE STUDY

The case study was carried out on the example of the brewing company. The particular beer company has 30 forklifts. Forklifts are engaged in the various tasks inside the factory, not only in activities of the warehouse sector. When dispatching finished products from the warehouse, warehouse expert determines the number of forklifts which will be deployed in the loading zone. Since remaining forklifts should be deployed to the other operations in factory, their number is directly related with the number of forklifts that are already send to the loading zone. A common problem that occurs with deploying remaining forklifts, results from the fact that some of the forklifts that are needed are already deployed in the

loading operation. Previously mentioned expert decisions, are in most cases good, but even experienced expert can make wrong decisions. If the number of deployed forklifts is larger, than the actual need, then the expenses occur, due to inadequate utilization of company resources. On the other hand, if expert engages smaller number of forklifts, than the actual need, company's reputation is decreasing, since defined time for cargo loading is exceeded and the company is obliged to pay the penalties for the delay in delivery. Also company is currently facing with increasing competition by other brewing companies in the region, and one of the company's goals is to keep current retail network in the region, where dispatching the finished products on time and in right quantity is very important for keeping their sales revenue and current distribution network.

4.1. Database sampling in warehouse

In order to create ANFIS forklifts model, the database was formed. The base contains expert decisions, obtained by interviewing expert and following the expert decision making process, while deciding how much forklifts will be engaged in particular situation. The database contains 624 input-output pairs, i.e. 624 expert decisions. In order to make better ANFIS model, total database is randomly divided in data for training, testing and validation. Training data contains 303 input-output pairs, testing 301, and validation includes 20 input-output data pairs. During the data sampling special attention was focused on collecting a sufficient number of input-output data pairs (expert decisions). Aim was that collected database should be good foundation for model, and as we mentioned in introduction, purpose of the model is to model real system with minimal possible errors. By good foundation, we mean that database should adequately reflect real system, and should include all the important features of modelled system. Also database should contain sufficient enough data pairs, in order to create valid model. According to the Jang et al. (1997), for a system with two input variables, it is recommended that a minimum of 100 input-output data pairs is needed, for creating a valid model. For presented model with two input variables, the total number of data points for fitting single input is 17.4, since $\sqrt[3]{303} = 17.4$, which represents sufficiently large amount of data from which ANFIS can perform system mapping (Jang et al., 1997). In consultation with an expert, the most influential variables for determining the number of forklifts in loading operation are determined. By expert opinion and experience, they are: defined loading time and amount of cargo that needs to be loaded. Input-output data pairs are constructed from expert answers on the basic logical principle of **IF-THEN** rules: *IF* (your time for loading is (**x**)), and *IF* (number of pallets you have to load is (**y**)), *THEN* (how much forklifts would you use (**z**))? For the input variable time (time specified for loading), observed interval is from 15 to 135 minutes, due to the fact that this interval is the most common interval for defined loading time. Observed range of second input variable (amount of cargo) is interval from 15 to 225 pallets. The reason for this range is because one truck has capacity of 30 euro pallets, and by expert claims in peak season they have a maximum of seven trucks that are simultaneously on the loading operation, and usually the minimum request for loading is half truck. So, the most common number of trucks that requests loading at the same moment is usually between half and seven trucks. For that reason, after consultation with warehouse expert, it is determined that the amount of cargo that needs to be dispatched from the warehouse should be presented through palettes, with range from 15 to 225 pallets.

4.2. ANFIS forklifts model

The purpose of the presented ANFIS model is to extract the essence of expert thinking, with aim of making similar decisions, like experienced expert. The presented model is a MISO system (multiple input, single output). In which, the number of forklifts is the output variable from the system, and the time (for which it is necessary to complete loading), and number of pallets (which need to be loaded), represent input variables of the system (Fig. 3). Described MISO system was created using the MATLAB R2012a software.

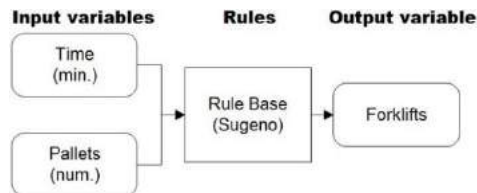


Fig. 3. MISO structure of the modeled system

Flow of activities required for creating ANFIS forklifts model is shown in Fig. 4. Training of ANFIS model is stopped after 700th epoch, since due to overfitting. Adopted root mean square errors (RMSE) are 0.282451 for training, and 0.301288 for testing data. Usually we use the testing error as a true measure of the model's performance, therefore the best model that we can achieve is one with minimal test error (Jang, 1996).

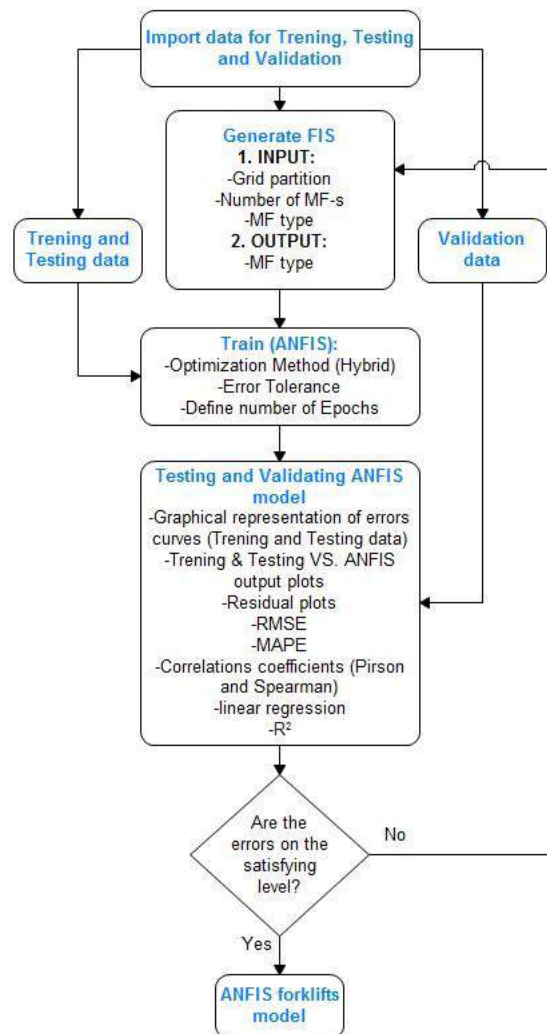


Fig. 4. Process flow for creating ANFIS model

Accordingly, the testing error was adopted as a measure for further evaluation of model performance. The total number of parameters in the neural network is 45, of which 18 are nonlinear parameters, i.e. premise parameters (parameters of the generalized bell function), while the remaining 27 are linear parameters of consequent part (first order polynomial). In order to achieve good generalization, the number of input-output pairs should be several times greater than the total number of parameters being evaluated. Training data set consisted of 303 input-output pairs, and the ratio between data and parameters is $303/45 = 6.73$ data/parameter, which is a very good level. Each input variable is assigned with three membership functions (MF) (small, medium, large).

Generalized bell function is chosen for the shape of MF, because it provided the smallest training and test error of model.

Input variables		Rule	If (time is $\mu_t(t)$) and If (pallets are $\mu_t(p)$) then forklifts		
time	pallets		IF		THEN
			time	pallets	f_i
$\mu_s(t) = \frac{1}{1 + \left[\left(\frac{x + 0,7462}{33,09} \right)^2 \right]^{1,356}}$	$\mu_s(p) = \frac{1}{1 + \left[\left(\frac{x - 0,0176}{56,29} \right)^2 \right]^{1,327}}$	1	small	small	$f_1 = 0,1604x + 0,1548y - 1,984$
		2	small	medium	$f_2 = -1,042x + 0,1537y + 13,74$
		3	small	large	$f_3 = -1,894x + 0,1615y + 22,75$
$\mu_m(t) = \frac{1}{1 + \left[\left(\frac{x - 63,35}{40,43} \right)^2 \right]^{4,264}}$	$\mu_m(p) = \frac{1}{1 + \left[\left(\frac{x - 112,4}{56,28} \right)^2 \right]^{1,49}}$	4	medium	small	$f_4 = 0,02234x + 0,01823y - 2,319$
		5	medium	medium	$f_5 = -0,107x + 0,01449y + 14,32$
		6	medium	large	$f_6 = -0,206x + 0,001561y + 29,73$
$\mu_l(t) = \frac{1}{1 + \left[\left(\frac{x - 133,6}{35,09} \right)^2 \right]^{3,686}}$	$\mu_l(p) = \frac{1}{1 + \left[\left(\frac{x - 224,9}{56,42} \right)^2 \right]^{1,408}}$	7	large	small	$f_7 = -0,000982x - 0,0445y + 0,9209$
		8	large	medium	$f_8 = -0,01459x - 0,0076y + 8,501$
		9	large	large	$f_9 = -0,0584x + 0,00496y + 15,43$

Table 1: Rule base and output functions

The final combination of rules, numerical interpretation of the rules (f_i) and the MF ($\mu_i(x)$), are shown in Table 1. Table 1 is the most important part of ANFIS forklifts model, because it represents expert knowledge "caught" and transformed into numerical and logical connections.

4.3. Verification of model

In order to determine the possibility of application of the presented model in practice, it is necessary to test model output results. For visual testing of the model outputs, descriptive statistical tools were used: correlation coefficients (Pearson and Spearman), RMSE, mean average percentage error (MAPE) Eq. (2).

$$RMSE = \sqrt{\frac{1}{N} \sum_1^N (A_t - F_t)^2}; \quad MAPE = \frac{1}{N} \sum_1^N \left| \frac{A_t - F_t}{A_t} \right| \cdot 100; \quad r = \frac{\sum_1^N (A_t - \bar{A}) \cdot (F_t - \bar{F})}{\sqrt{\sum_1^N (A_t - \bar{A})^2 \cdot \sum_1^N (F_t - \bar{F})^2}}; \quad r_s = 1 - \frac{6 \cdot \sum_1^N d_i^2}{N^3 - N}; \quad (2)$$

Where $\bar{A} = \frac{1}{N} \sum_1^N A_t$; $\bar{F} = \frac{1}{N} \sum_1^N F_t$; A_t – actual (desired), F_t – fitted (predicted), N is number of observations, r – Pearson correlation coefficient, r_s – Spearman correlation coefficient $d_i = x_i - y_i$; d_i – differences between the ranks of data base (x_i) and ANFIS predictions (y_i). To prove the validity of the model, it is necessary that RMSE and MAPE errors are low, and that there is a high correlation (r and r_s) and determination (R^2), between model predictions and expert decisions (especially for validation data). The reason for this is in the fact that the ANFIS model is built on training data, and it is expected that the model is capable to adequately predict training set (Jang and Gulley, 1995, James et al., 2013). The most important indicator of model validity is linear regression function of ANFIS and expert decisions, which should be as close as possible to the function $y = x$. Reason for this is because we empirically know that $y = x$ would be the ideal case of a matching the decisions made by the experts and ANFIS model.

DATA	ERRORS		Coefficients			ANFIS vs Expert (Regression)
	RMSE	MAPE (%)	Pearson (r)	Spearman r(s)	Determination R^2	
Training	0,2824	/	/	/	/	/
Testing	0,3012	7,63	0,99877	0,974848	0,9975	$y = 1,0008x - 0,0076$
Validation	0,3317	8,18	0,99803	0,992481	0,9961	$y = 1,0109x - 0,1108$

Table 2: Model errors

Observing the Table 2 we can make conclusion about model validity. Model has high correlation and determination on the validation and testing data. Which shows that model is capable to mirror 99% of the time decisions made by expert. Model has small forecasting errors and MAPE errors for testing and validation data are smaller than 10%, and according to the classification made by Lewis (1982), models that have MAPE forecasting error less than 10% are considered as highly accurate forecasting models. Also, linear regression functions (Table 2, coloum 7) have little deviation from the ideal matching case, $y=x$, which

is consistent with the coefficients of correlation and determination. Previously mentioned tests confirmed the accuracy of the ANFIS model, from which it is concluded that the ANFIS model makes similar decisions as expert in the same organization situations.

5. DISCUSSION

Based on the previously trained input variables, rule base and first order polynomials (Table 1), FIS graphical interface emerges (Fig.5), as the visual output of the model. FIS interface allows operators to simply and easily make decision about number of forklifts which will be employed, depending on the time defined for the loading and the number of pallets which need to be loaded.

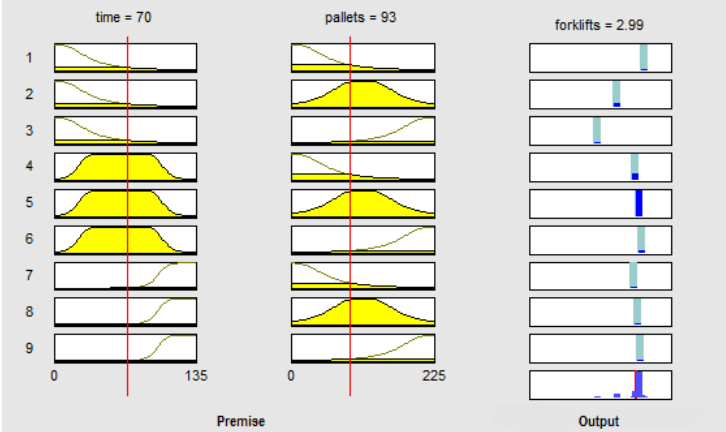


Fig.5. FIS interface (premise, output)

Depending on the values of the input variables, model predicts different values for the number of forklifts needed to be send to loading operation. Fig.6 shows the 3D surface of number of forklifts, depending on the input variables, time and pallets. From the picture is easy to see that the number of forklifts grows exponentially when the variable time is inside the interval $x = (0,40]$ min, while the number of employed forklifts linearly increases with increasing the amount of pallets for loading.

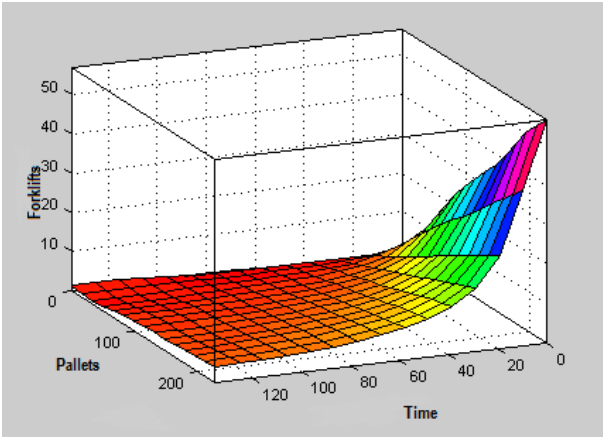


Fig. 6. Dependence of output variable (forklifts) from input variables (time and pallets)

The observed linear trend of increasing forklifts with increasing number of pallets is shown in Fig. 7 and numerically expressed by the interpolation curve:

$$y = 0,2586x + 0,1642 \tag{3}$$

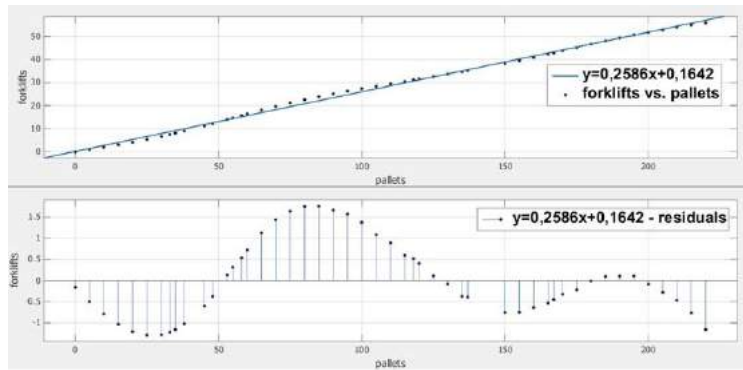


Fig.7. Interpolation curve of dependence between forklifts and pallets

Also, the exponential increase in the number of deployed forklifts with decreasing time defined for loading, is shown in Fig.8 and numerically expressed by the interpolation curve:

$$y = 54,6 \cdot 0,95^x + 4,64 \cdot 0,99^x \quad (4)$$

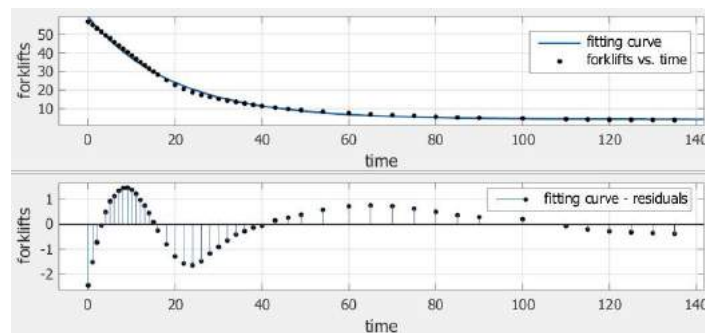


Fig. 8. Interpolation curve of dependence between forklifts and time

Interpolation curves (Eq. (3) and Eq. (4)) are created based on the output values of FIS interface (Fig.5). The purpose of creating interpolation functions is in deeper analysis of influence of time and pallets, on the number of deployed forklifts. These functions allow experts to critically examine the impact of each variable and perform a more detailed analysis of the factors affecting variables time and pallets, and therefore that affects on the number of forklifts. Observing Fig.7, we get the conclusion that if number of deployed forklifts grows linearly with increasing number the pallets, all forklifts, in observed company, have homogeneous technical and exploitation properties (speed, load capacity, etc.). If there was higher heterogeneity between forklifts, by technical and exploitation characteristics, the increase trend, expressed by Eq. (3) and Fig.7, certainly wouldn't be linear! Also, observing the Fig.8, we conclude that the expansive increase in the number of deployed forklifts, comes with delivering the order for loading large amounts of cargo in small intervals. To avoid this phenomenon it is necessary to have in mind dynamics of the shipment from the warehouse. As a preventive to expansive increase in the number of deployed forklifts, experts should strive to more balanced dispatch with medium amounts of goods, with the extended deadlines for loading the same, and to pre-schedule shipments, if that is feasible in observed distribution network. In addition to these factors, to the appearance (Fig.7 and 8), and shape of interpolation curves (Eq. (3) and Eq. (4)), direct impact have physical arrangement of goods in a warehouse, the length of the paths that forklifts cross, average cycle time, topology and typology of warehouse and so on. In the literature, there is a noticeable absence of papers that deals with the impact of the above mentioned factors, on the process of engaging forklifts in the loading operation. Therefore, future researches should be directed towards quantification of the impact of mentioned factors, and on determining the optimum combination of factors that lead to the engagement of a smaller number of forklifts in the cargo loading. Beside mentioned, our another future research direction, for optimizing forklifts usage in brewing industry, will be focused to upgrading the presented model with another model which will give answer to users which forklifts should be picked. Presented model provides users with information of

how much forklifts should be used for particular situation, not which ones, from group of 30 forklifts! So combination of these two models would round up all necessary information for decision makers in brewery warehouse, and allow much more reliable decision making, regard to forklifts engagement on loading operation.

6. CONCLUSION

In this paper ES model is presented, as a part of DSS for the selection of the number of forklifts in the process of cargo loading. Model is based on fuzzy logic and neural networks, and case study was conducted on warehouse of brewing company. Model provides safer and more accurate decision making, regarding the engagement of forklifts in the cargo loading. The main aim for creating the model was to "capture" the "way of thinking" of warehouse expert, in order to extract experts experience into numerical data and measurable correlations between influencing factors (Table 1, Eq. (3) and Eq. (4)). Model shows excellent interpolation properties when constructing new data points within the range of a discrete set of known data points (Fig.6), which allows deeper analysis of interdependence between factors. The validity of created model is demonstrated through a series of statistical tests (Table 2). Statistical tests have shown that model has small forecasting error, and that there is a significant correlation between desired (expert decisions) and model predicted values, which is a direct proof that model could be reliable substitute for expert.

The practical application of model is in the simple user interface, which is very important characteristics of DSS models. ANFIS models have high flexibility which allows them to mirror the modeled system with great precision (Table 2). But, on the other hand ANFIS has a low degree of interpretability, making it difficult to understand how and in what way an individual variable affects on the output from system (Table 1). What is the causal-effect relationship, because with the increasing of model flexibility comes reduction in model interpretability (James et al., 2013). The way in which ANFIS compensate reduction in model interpretability is the graphical user interface (Fig.5), which is one of the significant advantages of ANFIS models in comparison with a competitive models. Cumbersome, unclear, or user interfaces that require unusual skills are rarely useful and accepted in practice (Druzdel & Flynn, 2002). ANFIS user interface allows quickly and easily understanding of the connections between inputs and output of the model, and what is more important, it allows very easy, cheap and efficient training of workers to work with the presented model, which is not always the case with comparative models. Presented model, with its simple user interface, allows that the number of deployed forklifts can easily be selected by simply entering values in the FIS interface (Fig.5). On that way, problem of expert absence from work is solved, because any worker in warehouse can enter numerical values for time and pallets, and FIS editor will express the number of forklifts. For experts model has a dual role, as a tool for support and control when making decisions, and as a tool for a deeper analysis of the impacts (technical, economic and other parameters), by considering the dependence in (Eq. (3) and Eq. (4)). In this way, using the ANFIS ES model as DSS, the decisions have much larger foundation and the possibility of errors are reduced.

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SUPPLY CHAIN INNOVATION FOR CHANGING BUSINESS ENVIRONMENT: EMPIRICAL EVIDENCE FROM PRC

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Abstract

Through the external environment analysis including policy, economic, social and technology, the main status and trends of the PRC economy, society, reform and consumer behaviors were pointed out. Based on supply chain visions in PRC and the required capabilities of supply chain, supply chain performance was selected. The innovative Supply Chain Model was set up, considering the resilience and flexible of the supply chain, to respond to risk. In the innovative Supply Chain Model, a conceptual model and a supply chain tactic database were provided.

Keywords: Supply Chain Model, PEST Analysis, Innovation Model, Trends Forecast, Supply Chain Tactics

Paper type: conceptual paper

1 Introduction

In the first decade of the 21st century, with the improvement of Chinese business environment, some multinational corporations have invested in china, such as INTEL, APPLE etc. Those firms bring completion and opportunities to local middle and small-sized enterprises (their supplier, manufacturer). So supply chain in PRC is becoming a vast and complex super-network. In the other hand, after joining the World Trade Organization (WTO), Chinese economy get rapid and stable development, which achieves Chinese consumers become more complex and uncertain which leads to demand variability and forecast errors. Finally, the quick expansion of information technology and green regulations also make new challenges for supply chain management in china. Obviously, all of above illustrate the significance of supply chain management innovation for PRC business. Organization must to innovate in respond to the changing customer demands and dynamic marketplace and in order to capture the chance offered by technical progress.

This paper suggests an innovative conceptual supply chain model based on an analysis of the trends and leading opinions about business environment covering economy, polity, marketplace, consumers and transportation infrastructure.

This article is structured as follows. First, we conduct a brief literature review, reflecting on supply chain environment, supply chain innovation and supply chain conceptual model to illustrate the similarities and differences. In the second section we analyze the background of PRC business covering political, economic, social and technological environment, main trends of external environment are pointed out. On this basis, the paper used graphic modeling method to build a three-hierarchical supply chain model of strategic level, tactic level and operational level. At last, we conclude the study in section 5. The research process showed as Fig.1.

2 A Brief Literature Review

2.1 Supply chain environment

Today, more than ever before, enterprises are facing with complex task, uncertain consumers' demand and competitive environment. Supply chain is facing unprecedented challenges too. Furthermore, with the development of globalization, business environment become more and more important for business success. To sum up, if organizations want to obtain better performance, firms must better

understand the environmental uncertainty and how those factors will drive future supply chain changing.

In general, environmental uncertainty involves four dimensions of supply uncertainty, supply uncertainty, customer uncertainty (demand uncertainty), competitor uncertainty and technology uncertainty (Sakun Boon-itt, Himangshu Paul, 2008). In addition, Study shows that force within an institutional environment may pressure local enterprises to retain traditional channel systems which are suboptimal from the perspective of supply chain innovations (Daniel C. Bello, Ritu Lohtia, Vinita Sangtani, 2004). Characterized by the elaboration of rules and requirements to which individual organizations must conform in order to receive legitimacy and support, the institutional environments consists of various building blocks of a national setting and context. Specifically, researcher recognizes three elements composing the institutional environments: regulative, normative, and cultural-cognitive (Scott, 2001). Thus, institutional environment is another significant factor which affect on the development of future supply chain.

Future business trend is a hot topic. They are changing supply chain management today. Business trend are researched by many consulting firms in whitepaper and expert in literature. By review the other people's research, there are seven key macro factor trends causing significant impact and change to supply chain design and performance:

- Complex & innovative Product
- Green Requirements
- Knowledge competition
- Next generation tech
- Scarce Resources
- Demographic: Graying and Urbanization
- Emerging market

2.2 Supply chain innovation

The claim is often heard that in today's world competition is no longer between individual companies but between SCs (Trkman et al., 2007; Li et al., 2005). Thus, companies must embrace Supply Chain Excellence as a core competency at all levels throughout the company and recognize that supply chain management is executed in many areas. With the continue changing of supply chain background, supply chain innovation (SCI) is a key source of competitive advantage for supply chain excellence.

Supply chain innovations combine developments in information and related technologies with new logistic and marketing procedures to improve operational efficiency and enhance service effectiveness (Daniel C. Bello*, Ritu Lohtia, Vinita Sangtani, 2004). There are three links in supply chain innovation, firms' knowledge sourcing activity, the process of knowledge transformation and knowledge exploitation (Stephen Roper, Jun Du, James H. Love, 2008).

Historically, many supply chain innovations that had a deep and lasting impact on SCM which provide supply chain performance breakthrough. (Dan Gilmore, 2010) concluded the top 10 supply chain innovations of all-time. the top 3 is The Toyota Production System, P&G's Continuous Replenishment and The Ocean Shipping Container.

2.3 supply chain conceptual model

Supply chain conceptual model represents entities and relationships between them that are believed to impact on or lead to a target condition in the whole supply chain. Based on different supply chain strategies, Supply chain conceptual model has been divided into risk management model, green or sustainable supply chain model, flexible supply chain model, lean supply chain model, etc. In the aspect of risk management supply chain model, disruption risk is divided into three different sources of operational contingencies, natural hazards (earthquakes, hurricanes and storms), terrorism and political instability, the conceptual framework provided that

reflect the joint activities of risk assessment and risk mitigation are the fundamental to disruption risk management in supply chains (Paul R. Kleindorfer, Germaine H. Saad, 2004). (Peter Trkman, Kevin McCormack, 2009) separated the sources of uncertainty into two different constructs of Endogenous uncertainty (involving market turbulence and technology turbulence) and Exogenous uncertainty (involving interest rates, CPI, GDP, commodity prices, terrorism, disasters, strikes). Green supply chain is sometimes referred to as closed-loop supply chain which consists of a forward chain and a reverse chain (Chan, Yin, & Chan, 2010; Yuan & Gao, 2010). The literature lists eleven drivers of green supply chain management of certification of suppliers' environmental management system (Ali Diabat, Kannan Govindan, 2011). On the IT industry's supply chain, the component parts are made up of the driving forces of green supply chain management, including environmental regulations, Brand companies, ODM/OEM themselves, and ODM/OEM's suppliers. The study thinks that collaboration with supply chain partners is the key antecedent on greening a supply chain in order to gain co-benefits (S.C.L. Koh, A. Gunasekaran, C.S. Tseng).

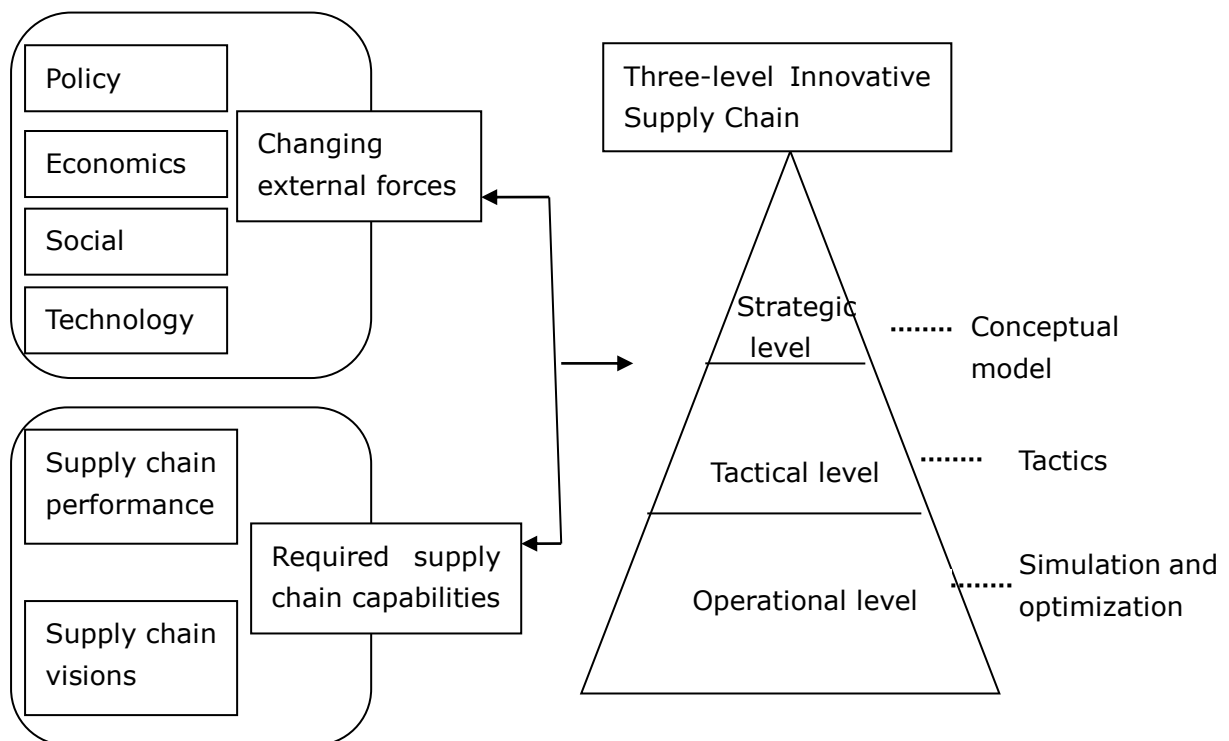


Fig. 1: Research process

3 Changing background of PRC business

In order to adapt to globalization of economy and trade, there have been great changes from various aspects in PRC business environment (shown as Fig.2). For the enterprise, relevant laws and regulations affect the performance of supply chain. China will establish more robust legal system by reforming. China is trying to join the WTO government procurement agreement (GPA). Carbon dioxide emission is established as the bounded target absorbed into the 12th five-year plan. The establishment of China (Shanghai) Pilot Free Trade Zone (CSPFTZ) is a significant measure to promote reform and opening-up in an all-round way. Chinese economy has sustained high growth. The average growth rate was around 10% from 2000 to 2011. According to World Bank's latest Global Economic Outlook and forecast by Morgan Stanley, the growth rate of Chinese economy may slow down to 7.5% to 8% in the next ten years. Among the three driving forces of economic development, namely consumption, export, and investment, the proportion of each force will be

more balanced. The proportion of the urban population has more than 50% for the first time in 2011. The middle class population is increasing accordingly with the increased income. China is entering an aging society as life expectancy rises and birth rates fall. Chinese consumer behavior trends are changing with the external environment. They have increasing demand for services and pay more attention to the environment and health. Word of Mouth, Internet Word of Mouth and Social media become important sources of consumer information. The technology is delivering positive change, such as Supply chain communications and visibility, supply chain Analytics, Dynamic routing, Risk management, cross-industry collaboration, etc.

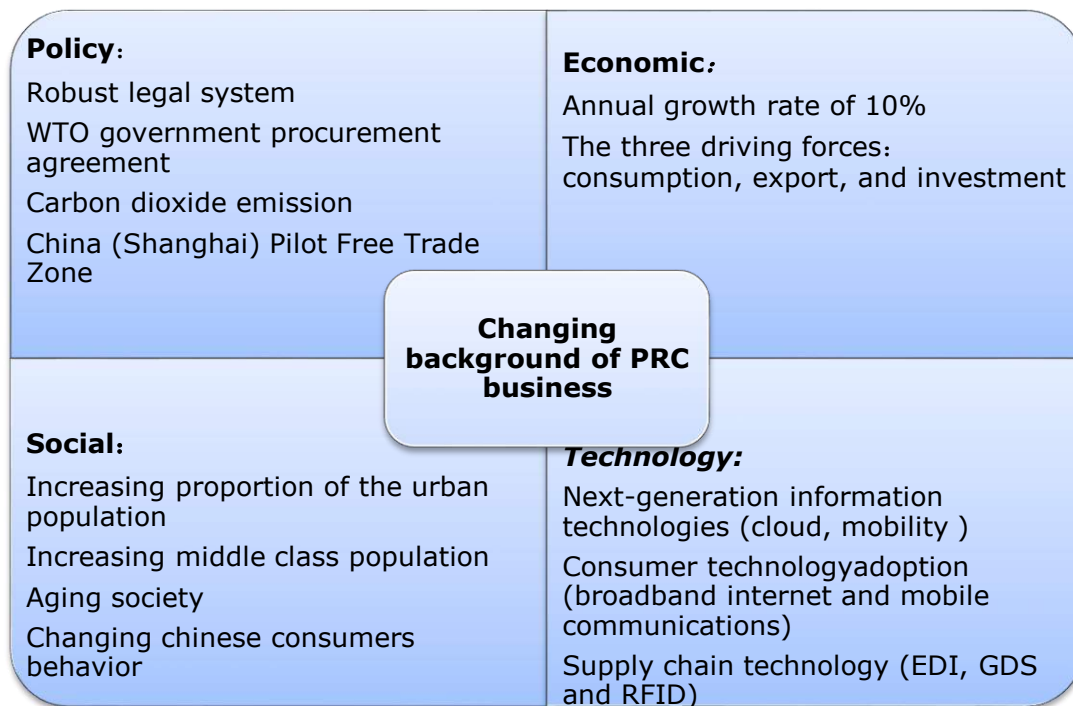


Fig.2: PEST analysis

4 Innovative supply chain model

Supply chain management is facing greater challenges with the change of external environment. The complex huge supply chain network trend becomes the main reason why the bullwhip effect is more highlighting. The trend also leads to low supply chain efficiency and high risk. In the other hand, because of competition and opportunity among global enterprises, consumer demands tend to more uncertain. Furthermore, regulatory requirements in different parts of each country increase the difficulty of supply chain operation. In addition, in big data and ubiquitous information age, it is difficult to achieve accurate data analysis and forecast to meet custom demands. In conclusion, in order to keep a lean and green supply chain and build a cost effective supply chain, an innovation supply chain model should be established to respond those challenges better. The new supply chain model is composed of three hierarchical levels, namely strategic level, tactical level and operation level, to reach defined performance

4.1 Performance measure

Several indicators can be used to measure the performance of supply chains. The proposed conceptual model can consider and suggest the use of several of them in particular, showed as table 1.

performance	interpretation
<i>Responsive time</i>	Responsive time refers to time of responding to abnormality demand of market, supplier risk, catastrophic risks, manufacturing process risks, etc. Measures of responsiveness reflect the ability of the supply chain to minimize the loss to deliver high customer service (Shepherd & Gunter, 2005).
<i>Information sharing</i>	Information sharing is of high importance to the success of collaboration, the more involvement of top management in SC collaboration results in richer overall performance (Usha Ramanathan, 2014).
<i>Flexibility</i>	Flexibility in supply chains is the possibility to respond to short term changes in demand or supply situations of other external disruptions together with the adjustment to strategic and structural shifts in the environment of the supply chain. Flexibility thus combines agility and adaptability (Lee, 2004).
<i>Transparency</i>	Transparency has become increasingly important for supply chains, as consumers, governments and companies want to know the origin of products and services. With the complexity of supply chain, enterprises could manage supply chain through transparency.
<i>Sustainability</i>	Sustainability is increasingly seen in modern business as essential to delivering long-term profitability. Sustainability key performance indicators (KPI s), including energy consumption, CO ₂ emissions (greenhouse gases), traffic congestion, water consumption, security compliance, infrastructure simplification, etc.

Table 1: defined performance

4.2 Hierarchical level

As said before, the innovative supply chain model is composed of three levels. The first level, strategically, is composed by four conceptual elements. At the second level, tactics and solutions is provided in order to achieve the strategic objectives. Detailed operation of specific function is designed at the last level.

4.2.1 Strategic level

The traditional supply chain is an entity consisting of people and organizations in each connection, while the new supply chain of this project, with information processing as the core and computer network as the tool, is a super smart body integrated of people - information - Organization. It is a low-carbon, environmental, sustainable and flexible supply chain which is able to respond to customer needs quickly, project the variation of future market exactly and cooperate with the risk timely.

(1) Space-time synergy

The highly developed information system provides conditions for the space-time synergy. The synergy makes the control process and each connection of each variable coordinate, completing the objectives and tasks multi-variable supply chain. Consumer is dominating in the new supply chain. They participate in each link of the product design and produce. So accelerating the product development and improving competitiveness can be done through the coordination and management of the consumer. In other words, space-time synergy can make the maximum utility ratio of resources and the supply chain can quickly respond to the customer's demand. With the development of data transmission, network and sensing technology, the supply chain also develops into ubiquitous information and transparentizing. Cloud computing is the core concept, showed as Fig.3.

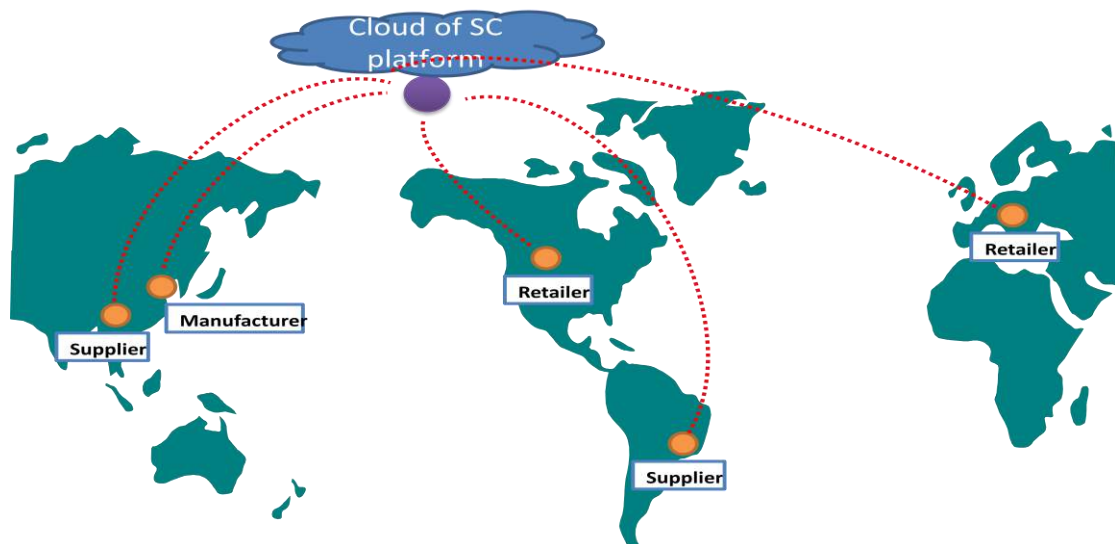


Fig.3: Cloud technology applied in supply chain management

(2) Duplex helix

The new supply chain consists of two spiral chains, one is virtual and the other is the real one. When something happened unexpected, the information will send from the real one to the virtual one, get advice from it and adopt the suggestion. The virtual chain should powerful to support the decision-making of the whole supply chain, such as set up the tactics base. The links in two chains communicate and cooperate with each other, for example, the 3D design and produce of the real line controlled by the virtual chain, man-machine coordination, managing the orders and inventory by analyzing the data of the virtual line. Such a duplex system not only keeps the supply chain's steady and safety, but also improves the supply chain and makes it evolution. The virtual line can be visualized by discrete and dynamic simulation (work mechanism of simulation model showed as Fig.4), by which could magnificently control and manage the real line. Also, any process of the supply chain can be a virtual reality, such as process of design, produce and cultivation and the produce and assembling in high precision can be done through virtual software. Furthermore, it's a duplex system that the virtual chain has a free time domain, the time rate could be sited arbitrarily so that we can forecast the operation of the real chain, make the risk of supply chain minimum, and collect the former data used to be neglected.

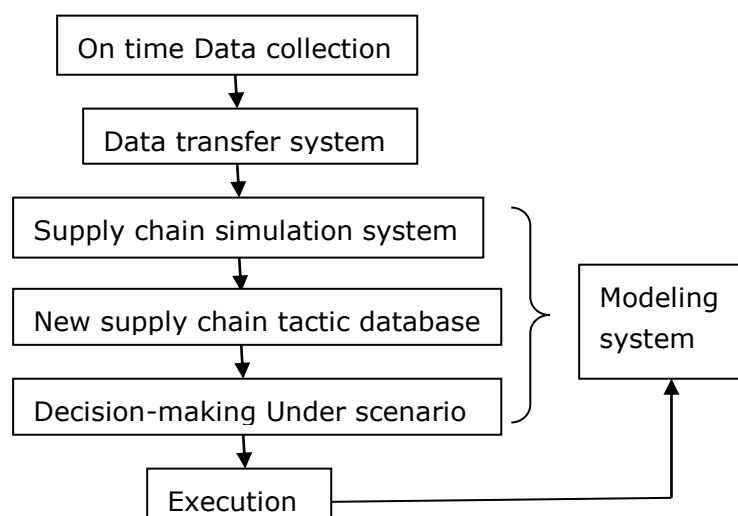


Fig. 4: Work mechanism of simulation model

(3) Continuous win-win

The new model seeks for green, and emphasizes a future sustainable development. Especially the high tech pollution of electronic product has been a big problem before. It is essential to set up a decomposer role in supply chain under the lead of core company. The new supply chain pursues a double win situation, stabilizes the supply chain by coordination contract theory and makes the effects from the external environment decrease.

(4) Meeting the demand in ubiquitous information

New technology which feature perceiving and intelligence have emerged and integrated with each other. With the development of data transmission, network and sensing technology, the supply chain also develops into ubiquitous information and transparentizing in four dimensions. Cloud computing is the core concept, and the highly sharing of the resource in the supply chain makes the cloud service possible. The cloud service reintegrates the process of the supply chain forming a highly effective supply chain and quickly response to the market. At the same time, ubiquitous information makes suppliers join in the supply chain management, raise the accuracy of the demand forecast.

4.2.2 Tactical level

Businesses make short-term decisions to achieve strategic goal involving the supply chain at the tactical level. At the strategic level, general planning begins, but processes are actually defined at the tactical level. Tactical decisions play a big role in controlling costs and minimizing risks. At this level, the focus is on establishment of supply chain tactic database, showed as Fig.5.

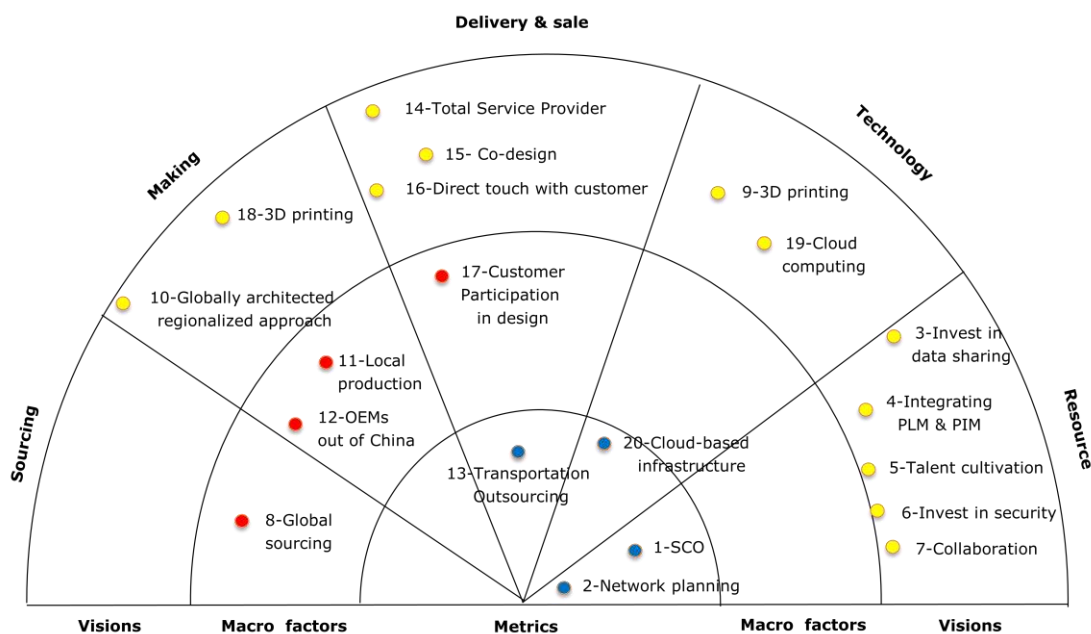


Fig.5: Supply chain tactics radar map—20 key tactics

4.2.3 Operational level

This level is specific initiatives of planning and control. Effective operational level processes are the result of strong strategical and tactical planning. Supply chain operation is Dynamic, it vary with the different situation. Some aspects of operational level management are as below:

- Daily and weekly forecasting to figure out and satisfy demand
- Production operations, including scheduling and detailed management of

- goods-in-process
- Monitoring logistics activity for contract and order fulfillment
- Settling damages or losses with suppliers, vendors, and clients
- Managing incoming and outgoing materials and products, as well as on-hand inventories

5 Conclusions

With the constant development of globalization, supply chain environment become more and more complex, especially in emerging market like China. This paper analyzed the changing environment in China in terms of policies, economy, social and technology. Overall, in the last decade, Chinese economy achieved rapid economic growth, society and technology also made a great progress. Multinational companies invest in China also confirm this. On the basis, the supply chain is facing the great challenges and opportunities. The complex huge supply chain network leads to low efficiency and high risk. In order to better respond to those challenges and reach defined performance, this paper presented a conceptual model that can quick response to unexpected change, including natural risk, supply chain risk, demand changing, supply and manufacturing risk, etc. It also can make supply chain keep green and lean. The new supply chain model is composed of strategic level, tactical level and operation level, to reach defined performance.

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SUPPLY CHAIN FOUNDATION PREDICTS PERFORMANCE: A CONFIGURATION APPROACH

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ABSTRACT

This research investigated the joint effect of the supply chain foundation dimensions on both operational and business performance, from a configuration perspective using data from the fifth round of the Global Manufacturing Research Group.

The results from cluster and discriminant analyses indicated that there appeared to be consistent three major patterns of SCF, the Realistic, the Extreme and the Lager. The Realistic gained the most benefits both in operational and business performances, while the other two groups were lag behind. The fragmented investment in SCF would not guarantee the operational performance. Firms are successful in working on both supplier information exchange and supplier strategic foundation, are also those that are experiencing higher payoffs from various improvements. In including both supply chain strategic, operational foundation and supply chain information exchange, adds greater comprehensiveness and richness to the SCI literature and enhances our understanding of the impact of SCI on performance.

INTRODUCTION

The concept of the supply chain integration (SCI) is becoming a pressing topic for supply chain professionals. However, definitions and measures of supply chain integration are diverse. More empirical research, with clear definition and appropriate measures are needed (Alfalla-Luque et al., 2013). This study attributes this incomplete definition of SCF, in particular, the tendency to develop a foundation among external partners, which in return, facilitates the implementation of information exchange and impacts on performance.

Some authors state that the integration of the organizations should start with the exchange of information (Lee 2000, Mentzer et al. 2001, Paik and Bagchi 2007). Others indicated some preparations were needed before the information exchange. De Meyer and Kim (1997) suggested that firms should begin with a rationalization of the network between suppliers/buyers, then, creating a framework for exchanging information and problem-solving. Similarly, Golicic et al. (2003) suggested engaging some degree of process alignment and information exchange to improve supply chain collaboration.

Lee (2000) and Bagchi et al. (2005) considered SC coordination and information sharing as dimensions of the SCI. However, Vickery et al. (2003) considered integrative information technologies and SCI as different dimensions. Further, Sezen (2008) established three different constructs: SCI, information sharing with suppliers and information sharing with customers. Similarly, Tan et al. (2002) considered an information sharing construct separately from SCI. Thus, the views from researchers were not consistent in what were needed for an effective SCI, which concerned more with coordination and joint activities in resources allocations and sharing risks and rewards throughout supply chains (De Meyer and Kim, 1997). This study fills the gaps by developing and empirical testing a supply chain foundation (SCF) that includes information exchange (SCIE), which

enhances SC integration and performance. The research question is that what supply chain foundation (SCF) is and its relationship to supply chain information exchange (SCIE) and supply chain performance. The main premise is that the better the SCF, the stronger the SCIE and therefore, the better performance.

This study differentiates by employing statistical tests on a large-scale dataset consisting of 315 manufacturing plants from 8 countries. Practically, the findings provide insight into the true benefits of supply chain integration initiatives, and offer guidance especially for globally engaged supply chain managers. This study is organized as follow. Section 2 provides the theoretical background on the SCF dimensions and then introduces the research model of SCF and hypotheses. Section 3 describes the research method, followed by a presentation of the results in Section 4. Section 5 provides a discussion of the findings, implications, and limitations and some directions for future research.

THEORETICAL BACKGROUND

In this section, the supply chain integration (SCI) literature is reviewed to provide foundation for understanding interactions between related theories to inter organizational activities including theory of complexity, resource dependency theory and information asymmetry. This section starts with the dimensions of SCI and the research model (SCF) with hypotheses.

Dimensions of SCI and SCIE

Literature is considering supply chain information exchange as a part of SCI (Bagchi et al., 2005; Sezen, 2008) that enables supply chain collaboration (Holweg et al., 2005) and enhances supply chain communication (Paulraj et al., 2008). Complexity theories suggested that companies should rationalizing the suppliers, buyers network to reduce uncertainty level that arises from supply chain complexity (De Meyer and Kim, 1997; Nguyen and Harrison, 2004). These discussions emphasize the importance of information sharing that enables both operational and strategic coordination to provide operational and strategic benefits (Sanders 2008). Figure 1 describes the conceptual framework of Supply chain foundation (SCF) as a part of the SCI process.

Supply Chain Foundation in SCI

This foundation is similar to organizational relationship linkages in Alfalla-Luque et al. (2013); supply and customer base rationalization in De Meyer and Kim (1997) and process alignment in Golicic et al. (2003). While there is value to develop a comprehensive list of SCIE and SC foundation that affect supply chain performance, these initiatives are often related to one another and are not actually implemented independently. Fig. 2 presents supply chain foundation's components, including (1) operational foundation and (2) strategic foundation.

Setting operational foundation: This foundation level includes the ability to share common language and codes (e.g. special vocabulary, abbreviation, and technical terms); common understanding about the same concepts (e.g. good, clean, qualify, quality) and develop common values and culture (Wu et al., 2010; Choi et al., 2011).

Strategic foundation: At this stage, firms in supply chains are expected to develop common understanding about what best for their relationships; learning knowledge (Gavronski et al., 2012) to have shared visions and values on common issues such as innovations and environmental new initiatives. These members

tend to develop similar behavioral rules and norms via executive meetings and business workshops. On another hand, due to information asymmetries and lacking of transparency about supply chain partners, their processes or policies are major barriers for identifying and assessing supply chain risks (Awaysheh and Klassen, 2010).

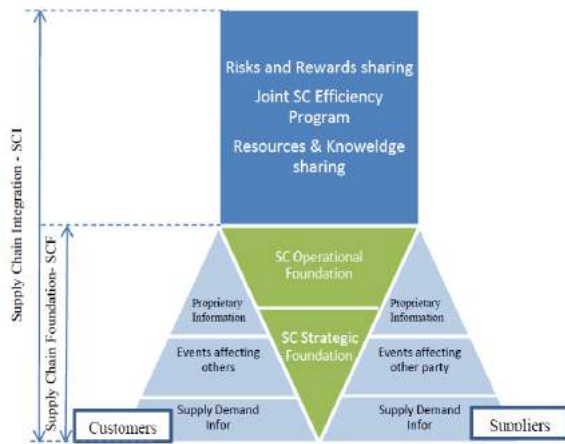


Figure 1 Conceptual framework of SCF within SCI processes (adapted from De Meyer and Kim, 1997; Alfalla-Luque et al., 2013)

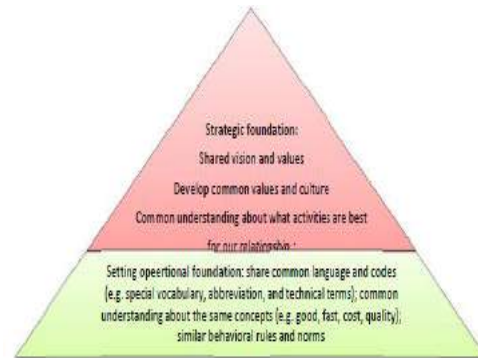


Figure 2 Supply chain foundation and its elements (adapted from Choi et al., 2011; Handfield et al., 2001; Wu et al., 2010)

Over reliance on strategic matters without willingness to work and share the operational principal pertaining to supply chain will not make the firms meaningfully connected; thus, preventing information sharing and integration. This study asserts that only firms that are capable of building both the operational and strategic aspects of information exchange will see the maximum benefits of supply chain integration (Chae et al., 2005; Fawcett et al., 2007).

Supply Chain Information Sharing (SCIE) in SCI

This research adapted three major types of SCIE including (1) supply and demand; (2) events affecting the other party and (3) proprietary information (Wu et al., 2010; Choi et al., 2011). Such level of information sharing requires frequent and intense communication between firms and suppliers. The intensity of communication constitutes high levels of cooperative behavior between supply chain partners which leads to high degree and symmetry of strategic-information flows between them (Klein et al., 2007).

RESEARCH FRAMEWORK AND HYPOTHESIS DEVELOPMENT

Figure 3 presents research framework of SCF's dimensions and the relationship with operation and business performance. The ultimate objectives of this study are to examine the association between SCF and SCIE and to identify the appropriate SCF patterns, which would differentiate the stronger competitors and performers from the weaker ones. There is a need for a taxonomy which is based on significant gaps between the groups, in order to have better insights about the relationship between SCF patterns and performance. It will be critical for decision makers to learn about company's relative positions in these SCF patterns. Thus, this study proposes:

H1. An emergent taxonomy of manufacturers can be developed, based on their patterns of supply chain foundation and supply chain information exchange.

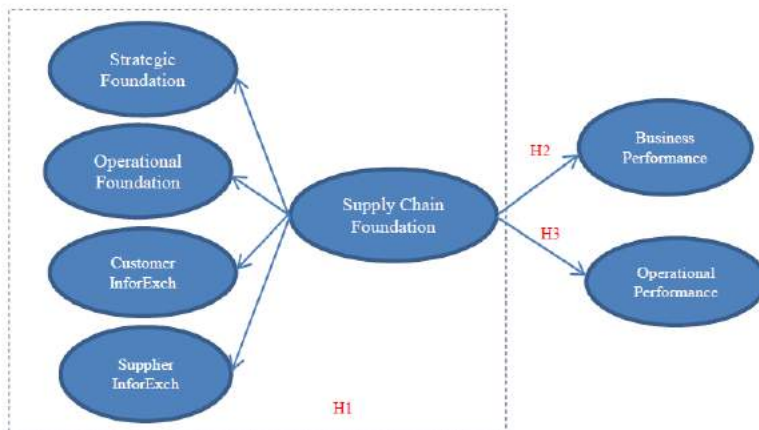


Figure 3 Research frameworks of SCF's dimensions

Impact of SCF patterns on performance

Configuration theory suggests that the emergent patterns of SCF will be related to operational performance in different ways. It argues that organizations perform better when they develop better configurations of interconnected elements (Flynn et al., 2010; Wu et al., 2014). For example, a SCF pattern which is stronger in setting SCI foundation is likely to have a stronger relationship to external partners that could lead to better information exchange and performance improvements of their SC joint initiatives, therefore:

H3. The patterns of SCF are related to the operational performance of the manufacturer within a supply chain.

Sharing goals and objectives, expectation among supply chains would help the manufacturers better understand customer requirements and better forecast customer demand, thus allowing the manufacturer to provide better quality products (e.g. environmentally innovation) at lower cost and more flexibility. These will, in turn, lead to better financial performance by the manufacturer. Furthermore the effectiveness of SCF will be related to configuration of the four SCF dimensions. Thus, this study proposes:

H2. The patterns of SCF are related to the business performance of the manufacturer within a supply chain.

RESEARCH DESIGN AND RESULTS

Data collected in the V round of the Global Manufacturing Research Group (GMRG) were used to test the research questions and subsequent hypotheses. Appendix 1 presents respondents' profile. Responses were measured in a seven point Likert Scale, where a value of 1 indicates "to no extent" or "unimportant" and a value of 7 indicate "completely" or "very important". This study employed principal component analysis, reliability analysis, cluster analysis and ANOVA procedures.

Construct measurements and research findings

As shown in Appendix 2, the composite reliabilities of all the factors exceeded 0.78, well above the threshold value of 0.7 (Hair, Anderson, Tatham and Black, 1998), indicating the existence of internal consistency. The test for convergent validity shows that all indicators load satisfactorily on the theorized constructs and the t-tests of all the loadings are at the $p < 0.001$ level, providing evidence of

convergent validity (Bagozzi and Yi, 1991). All items were subject to the factorability test and the Bartlett test for overall significance of the correlation matrix at the 0.001 levels. The Kaiser-Meyer-Olkin measure of sampling adequacy was 81.2 percent. The above procedure resulted in eight factors explaining 77 percent of the overall variance.

Configuration analysis of SCF emergent taxonomy

This section develops a taxonomy that illustrates a firm's strategic positioning along four SCF's dimensions. Similar to the methodologies used in previous studies (Frohlich et al., 1997), a two-stage cluster analysis was used to classify 315 companies along the four dimensions. A 3-cluster solution was found to be best in terms of stability, internal validity. An ANOVA procedure was used to obtain differences among the tree cluster groups (Table 1). Cluster 1 of the SCF patterns was strong in almost dimensions except for Strategic Foundation; thus we labeled these the REALISTIC pattern of the SCF and describe them as a balanced pattern. This group was especially strong in OF. Cluster 2, LAGERS, had all below average, especially in supplier information exchange. Cluster 3 was extremely strong in SF and extremely bad in customer information exchange, thus we labeled these the EXTREME pattern.

Supply chain practices and information exchange	G1-138-Realistics	G2-153-Laggers	G3-24-Extrem	F	Sig.
Operational Foundation (OF)	.535 ^[2]	-.533 ^[1,3]	.321 ^[2]	69.898	.000
Strategic Foundation (SF)	-.030	-.283	1.980 ^[1,2]	87.594	.000
Supplier Information Exchange (SIE)	.571 ^[2]	-.527	.076 ^[1,2]	39.641	.000
Customer Information Exchange (CIE)	.375 ^[3]	-.165	-1.103 ^[1,2]	45.250	.000

Note, that the cluster descriptions are based on factor scores that have a mean of zero and standard deviation of one. For instance, -0.533 (see third column, first row) indicates below average activities on Operation Foundation, while 1.980. (see second column, fourth row) indicates well above average value. Superscripts in brackets indicate the group(s) that the cluster is significantly different from using the Scheffe pair wise comparison procedures. The highest scores in each row are in bold prints.

Table 1 Cluster Means of SCF dimensions

The objective of this section is to identify the underlying dimensions, based on which the companies competed among different SCF's clusters. Two discriminant functions were derived statistically significant at 0.000. The first function had significant loadings on SCF dimension and strategic foundation for suppliers, it is called *Supplier Strategic Foundation*. Function 2 reflects SCF balance, indicated the positive loadings of supplier and customer proprietary information. It divides the patterns into those with greater (Realistic pattern) and less (Lagers and Extreme patterns) *supplier proprietary information*. Figure 4 indicates that the clusters were differentiated from each other by the discriminant functions representing SCF strength and SCF balance. Between 89.3% and 91.4% of the respondents were correctly classified, indicating a high predictive ability. Thus, these patterns of SCF are independent and are not prone to misclassification. Therefore, this study concludes that manufacturers can be clustered into groups with differing levels of SCF strength and balance, based mainly on Supplier Strategic Foundation and Supplier Proprietary Information, supporting H1.

Relationship between SCF patterns and performance

Analysis of variance was used to test the relationship between SCF patterns and performance. Table 3 indicates that there were statistically significant differences in operational performance between the SCF patterns, supporting H3 that the patterns of SCF are related to the operational performance of the manufacturer within a supply chain. Three out of six performances measures (Cost, Product and Delivery), were significantly different at $p < 0.001$. Lead Time was different at $p < 0.01$ and Product Flexibility was slightly different at $p < 0.05$.

Supply chain and information exchange	Discriminant Function	
	Strategic Supplier Foundation	Supplier Proprietary InforExchange
suppliers' vision	.514*	.096
suppliers' culture	.500*	.060
suppliers' info on forecast	.449*	.299
supplier's info on events	.448*	.318
HaveSimilarBehavioursRulesNorms	.425*	.337
Shared codesLanguage	.402*	.293
customers' vision	.368*	-.028
UnderstandingSameConcepts	.343*	.297
customers' culture	.340*	-.069
CommonUnderstanding	.336*	.283
customer's info on events	.315*	.255
customers' info on forecast	.279*	.163
Supplier's proprietary informations	-.037	.747*
Customers' proprietary informations	-.058	.639*
Eigenvalue	2.134	1.457
% of Variance	59.4	40.6
Canonical Correlation	.825	.770
Sig.	.000	.000

Pooled within-groups correlations between discriminating variables and standardized canonical discriminant functions
*. Largest absolute correlation between each variable and any discriminant function

Table 2 Standardized canonical discriminant function coefficients

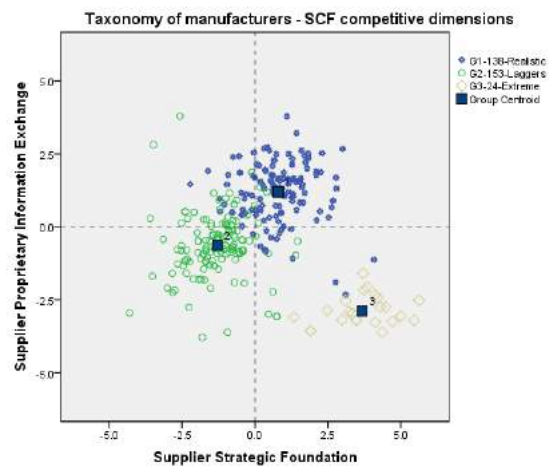


Figure 4 Taxonomy of SCF and cluster centroids

Performance	G1-138-Realistic	G2-153-Laggers	G3-24-Extreme	F	Sig.
ProductFlexibilityPer	.147 ^[2,3]	-.103	-.111	2.499	.084
BizFinancialPer	.128 ^[2,3]	-.125	-.242	2.945	.054
LeadtimePer	.243 ^[2]	-.083	.037	4.282	.015
DeliveryPer	.219 ^[2,3]	-.085	.463	5.349	.005
ProductPer	.226 ^[2]	-.220	.469	10.557	.000
CostsPer	-.104 ^[3]	-.045 ^[3]	.975	13.007	.000

Note for Table 3 and Fig 5, that the cluster descriptions are based on factor scores that have a mean of zero and standard deviation of one. The axis indicates cluster means based on factor scores that have a mean of zero and standard deviation of one.

Positive values mean that the particular characteristic of the cluster has performed well above average, and the negative values mean below average value performance. Superscripts in brackets indicate the group(s) that the cluster is significantly different from using the Scheffe pair wise comparison procedures. The highest scores in each row are in bold prints.

Table 3: Analysis of variance of SCF performance

Table 3 indicated that the Realistic pattern had all the positive operational performance, compared to the Laggers patterns. The Extreme gained significant

improvements regarding product performance, delivery and costs while recording less improvement in product flexibility, lead time measures. The Lagers patterns were recorded lowest in all performance measures, indicating a lag behind compared to the other two patterns. Both Extreme and Lagers, representing imbalanced positions companies, have well below average for customer exchange. In conclusion, the ANOVA results support that the three SCF patterns do influence differently on operational performance. Firms that focus consistently in both dimensions, SCF and SCIE, have gained significant improvement in performance than others did (see Realistic – G1).

IMPLICATIONS AND CONCLUSIONS

Based on the above findings, there is substantial evidence that manufacturers are following three supply chain foundations. While cluster analysis alone cannot definitely prove that there are only three supply chain patterns, the ANOVA for supply chain performance measures (Table 3) all lend validity to the three-cluster model. The results emphasize that the three SCF patterns differ significantly in operational performance measures and slight differentiated in market share and sales revenues.

This study confirmed that supply chain foundation provides a vital link between customers and suppliers information exchange, without which companies are unable to reap the full benefits of their integration efforts. The results from the cluster and discriminant analysis help companies define their strengths and weaknesses in each area and to make appropriate management decisions. Thus, this research reinforces the importance of supply chain foundation in improving performance since it represented by Realistic and Extreme patterns. This is an important finding, since much of the extant literature on SCF does not include supply chain foundation as a dimension of SCI.

This study extends the existing research on SCI in several important ways. First, it adds to the literature by developing SCF and empirically testing its relationship and performance. These results provide empirical evidence that the alignment of the SCF and SCIE may be useful as a holistic antecedent for firm performance. Accordingly, a possible research focus of sustainable supply chain management may shift from investigating the specific features of the supply chain (e.g. purchasing or logistics) to examining an integrated business model (Mollenkopf et al., 2010; Monczka and Petersen, 2012).

While this study makes a significant contribution to the SCI literature and has important implications for practice, there are some limitations and opportunities for future studies. First, this study uses a cross-sectional design; it will be fruitful for future research to examine the evolution of SCF patterns in a longitudinal fashion. Second, future research should examine cross-cultural differences in the relationship between SCF and performance using the GRMG. In particular, studies which compare SCF in developed versus developing economies will be of interest.

APPENDICES

Appendix 1: Countries participated in GMRG round V in 2013

Countries participated in GMRG (stage 1)	Respondents	Percentage
Australia	29	7.4
Croatia	113	28.8
Poland	79	20.2
Ukraine	50	12.8
USA	41	10.5
Vietnam	80	20.4
Total	392	100.0

Appendix 2 Measurement items and factor loadings of SCF dimensions

Variables	Measurement items	Factor loadings	Means	SD	Eigen value	Variance extracted	Cronbach Alpha	Sources
Operational Foundation	This plant and its major external partners have common understanding about the same concepts (e.g. good, fast, cost,	0.90	5.12	1.22	5.83	41.13	0.91	Subramaniam and Youndt, 2005; Choo, Linderman, Schroeder, 2007; Koufteros, Cheng, Lai, 2007
	This plant and its major external partners have similar behavioral rules and norms	0.87	4.98	1.26				
	This plant and major external partners share common language and codes (e.g. special vocabulary, abbreviation, and technical	0.80	4.83	1.37				
	This plant and its major external partners have common understanding about what activities are best for our relationship	0.76	4.98	1.19				
Strategic Foundation	Main customers have a similar organizational culture (e.g. values) to the plant	0.87	4.44	1.36	1.93	13.80	0.85	Handfield, Melnyk, Calantone and Curkovic, 2001; Pagell and Wu, 2009; Vachon and Klassen, 2008.
	Main customers share a common vision for the business relationship with the	0.85	4.56	1.34				
	Main suppliers have a similar organizational culture (e.g. values) to the plant	0.67	4.33	1.42				
	Main suppliers share a common vision for the business relationship with the	0.64	4.39	1.44				
Supplier Information Exchange	The plant and main suppliers inform each other about events affecting the other party	0.81	4.52	1.32	1.85	13.20	0.87	Wu, Choi and Rungtusanatham, 2010; Choi, Linton, 2011.
	The plant and main suppliers regularly exchange information of supply and	0.79	4.58	1.38				
	The plant and main suppliers exchange proprietary information	0.62	4.04	1.77				
Customer Information Exchange	The plant and main customers exchange proprietary information	0.85	4.01	1.78	1.07	7.80	0.94	Gunasekaran and Ngai, 2004; Zhou and Benton, 2007; Sezen, 2008
	The plant and main customers inform each other about events affecting the other parties	0.75	4.60	1.41				
	The plant and main customers regularly exchange information of supply and demand forecast	0.68	4.48	1.43				
					Total variance extracted	77%		

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INVESTIGATING MANUFACTURING SUPPLY CHAIN TRANSFORMATIONS: A SRI LANKAN CONTEXT

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ABSTRACT

This research focuses on three supply chain transformation projects carried out at multinational manufacturing companies in Sri Lanka. Supply Chain Project Management is an area which has seen very limited research been carried out under and as such this research investigates drivers, roadblocks, common practices, success factors and failure points associated with supply chain transformation projects. The research investigates the validity of "Cost Reduction" and "Competitive Action" as drivers for supply chain transformation projects. The importance of human emotions and behaviour was acutely identified as a critical factor in achieving project success and led to the identification of Change Management as a key peripheral function. The paper concludes by setting forth a conceptual framework for future project reference and research.

INTRODUCTION

Supply Chain Management and Project Management have achieved transformative statuses within Management over the past few decades. In this paper we investigate the outlook of project team-members in the manufacturing sector of Sri Lanka on Supply Chain Projects. The paper looks into the current practices in this paradigm and comes forth with possible points to improve while identifying best practices that aid the focal firms to excel in their business through these supply chain transformations.

Problem Definition

Supply Chain Project Management offers new frontiers in how business is done. Only a handful of scholars have engaged in research activities in this virgin area and the knowledge base is confined. In spite of this, Supply Chain Project Management is a formidable area which can transform an organisation/supply chain when properly implemented. Such changes can make a sound impact on a company's success (Ayers, 2004). In this research we try to understand the significance of Supply Chain Project Management at present while identifying driving factors for such projects as well as major barriers to project accomplishment.

Purpose of the Research

The research aims to answer the following

- What factors influence supply chain transformation projects in Sri Lanka?
- Do supply chain transformation projects meet organisational necessities in Sri Lanka?
- Do such projects lead to undesired repercussions that impact the rest of the supply chain?

LITERATURE SURVEY

Supply Chain Transformation vs. Business as Usual

Ayers (2009) emphasizes on having a "Structured, Collaborative and Measurable" approach to attain successful supply chain transformations by discarding the business as usual approach continuously transforming the supply chain.

TABLE 1: DIFFERENCE BETWEEN BUSINESS AS USUAL & STRUCTURED, COLLABORATIVE, MEASURABLE APPROACH IN SCPM (AYERS, 2009)

Business as Usual	Structured, Collaborative, Measurable Approach
Functional initiatives	Multi company initiatives
"Program" mentality, ambiguous goals	"Project" mentality, "make it happen"
Current market space	New market space
Narrow solutions	Broad solutions
Led by technical staff	Led by senior management
Systems first, processes later	Processes first, systems as enablers
Measured by Return on Investment (RoI)	Measured by competitive improvement
Get it done in your spare time	Dedicated resources
Launch and forget	Monitor and track

Supply Chain Project Management

Chain projects aim to facilitate Supply Chain Transformation by bridging the theory with the practical reality. Thus Ayers (2003) has coined the term "Supply Chain Project Management" to describe this embryonic field.

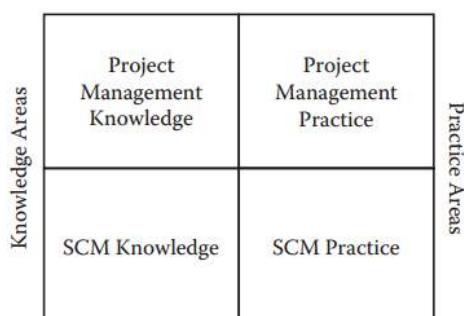


FIGURE 1: COMPONENT DISCIPLINES OF SUPPLY CHAIN PROJECT MANAGEMENT (AYERS, 2009)

Supply Chain Transformation Drivers

Ayers (2004) claims that there are 6 main drivers that affluent supply chain transformation projects. It is said that "Innovation" is the central driver of supply chain change out of the six drivers.

1. Innovation driven by PESTEL factors
2. Extended Products
3. Globalization
4. Flexibility
5. Process Centered Management
6. Collaboration

Common causes for Supply Chain Project failure

Ayers (2004) identifies five root causes that affluent project failure. They are the following:

1. Rigidity, insufficient flexibility
2. Organisation roadblocks
3. Top management abrogation
4. Inadequate technical capability
5. Misunderstood technology

Ayers (2004) also points out the importance of dividing the supply chain project into several subprojects to better achieve the desired results while advising practitioners to treat each supply chain project as a new business venture. The

rule of thumb is to minimize depth of detail, introduce shorter planning cycles and focus on strategic projects that are agile enough to respond to changing priorities in a volatile climate. Planners must satisfy and accommodate diverse interests, vocal constituents, and conflicting priorities (Deutsche Post AG, 2012).

METHODOLOGY

The research focuses on 3 supply chain projects which were underway at 3 manufacturing sector multinational companies in Sri Lanka. All three companies are market leaders of its own industry subsector, and the above selection was based upon the hypothesis that market leaders would possess supply chains of the highest caliber.

Data was collected from managerial level project team-members through structured interviews with the intention of understanding behavioural patterns and decisions pertaining to Supply Chain Projects.

Since "Cost Reduction" and "Competitive Action" are common factors in determining Sri Lankan business. As such, the research hypothesized that the above two factors are supply chain drivers in order to prove their relevance.

The information collected from the literature survey was used as a foundation in designing the guideline which was to be used for the Structured Interviews. The respondents were selected using random convenience sampling representing diverse functional backgrounds covered within the project scope.

FOCAL PROJECTS

Company A: Defining Warehousing Strategy at a Dairy Manufacturer

The focal project entails to expanding the warehousing and logistics capabilities of dairy producer to facilitate the future market growth and to facilitate increased production at lower costs. It is a project initiated from the senior management level. The project under consideration was predominantly based within the Supply Chain department with inter-departmental backing. The project will employ services of third parties for implementation. The project team consists of nine project team members.

Company B: SAP Implementation at a FMCG Manufacturer

The SAP implementation project touches the entire supply chain within the selected multinational FMCG manufacturer and is carried out to conform to company's global standards. Its Indian sister company's exploits in a similar project is used as a reference in Sri Lanka where there are about 30 project team-members assisted by consultants. This lengthy project will collaborate with its supply chain partners to some degree although main emphasis will be within the company.

Company C: Supplier Relationship Management SAP Module launch at a Cement Manufacturer

The focal project entails to extending its SAP Enterprise Resource Planning (ERP) system to incorporate its regular suppliers. The objective of this project is to minimise costs, reduce cycle times, optimise peer to peer (P2P) interaction and improve transparency along the supply chain. This project is carried out in close consultation with the company's regional sister companies and the regional head office will incorporate a team of roughly 50 personnel. This project is not restricted to one company as the company plans on getting its suppliers involved as well.

DATA ANALYSIS AND DISCUSSION

Project Objectives and Scope

The results of the interviews yielded that there was common agreement among the project team members with regard to the project objectives and scope, across all three focal projects. It was visible that the Project Managers and Board of Directors have clearly understood the importance of this united view. Upon further investigation it was revealed that all three companies had carried out detailed educational activities with regard to the project, its objectives and scope.

Relevance of Supply Chain Drivers

The respondents were asked to rate the importance of each driver on a Likert scale from 1 to 5 with 5 being the most important. It should also be noted that this rating represents the personal viewpoints of the respondents.

TABLE 2: SUPPLY CHAIN DRIVERS AND THEIR IMPORTANCE

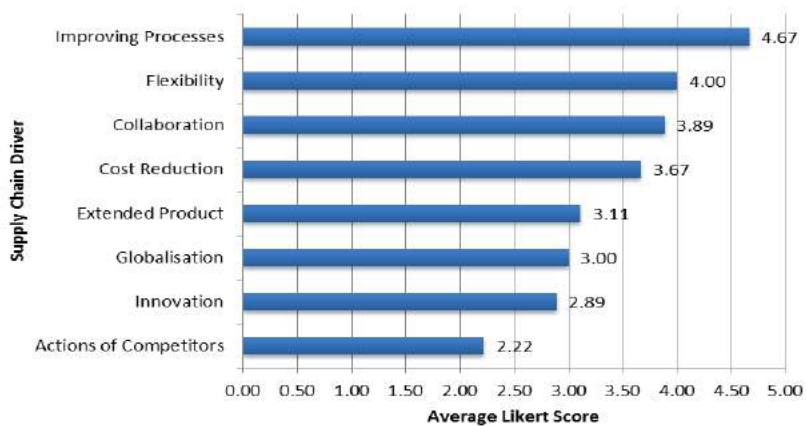


Table 2 depicts the average ratings of the interviewed supply chain drivers sorted according to descending order.

Improving process is the leading trigger for supply chain transformation projects by quite a margin. Flexibility of the supply chain and supply chain collaboration follow suit without much of a gap between them.

Hypothesis on "Cost Reduction"

The fact that "Cost Reduction" being ranked 4th with an average rating of 3.67 emphasises on the important role costs play in today's supply chain. "Cost Reduction" outperforming three established supply chain drivers of Ayers' proves that it should be taken seriously in future researches as a key supply chain driver.

Hypothesis on "Actions of Competitors"

"Actions of Competitors" have been rated the lowest by the respondents behind Extended Product, Globalisation and Innovation. Thus, this research has not yielded substantive results to establish this hypothesis. However, with an average rating of 2.22 out of a possible 5, it still cannot be completely written off either.

Project Management Practices

All three focal firms had created a project charter/blueprint in order to proceed. It was also understood that all three projects had been dismembered into small chunks for the ease of management.

Additionally the research revealed that the focal firms placed focus to identify whether the project may lead to undesired outcomes before project implementation. However, there is minimal usage of the Project Management Body of Knowledge (PMBOK) (Project Management Institute, 2000).

The research has revealed that all three focal projects have taken the time off to prepare Project Risk Management plans. However, it was revealed upon further discussion that these plans were not successful in highlighting all the risks. There were instances where some unforeseen risks have emerged and put the projects under some strain.

Supply Chain Practices

All but one respondent believed supply chain was a strategic function of his/her organisation. This indicates that a majority of employees, regardless of their business unit, growingly understand the importance of supply chain.

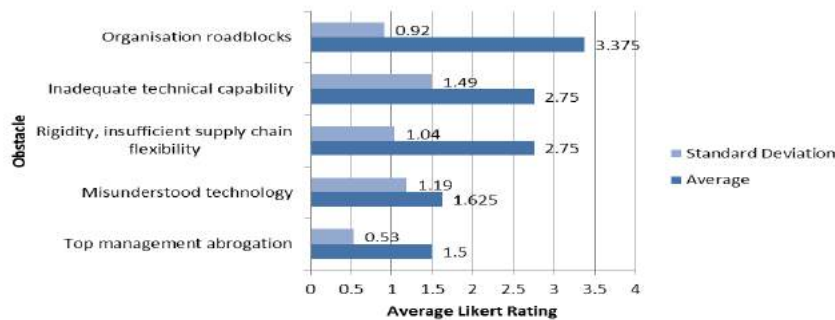
But more importantly it was evident that the company leadership (i.e. CEO and Board of Directors) at all three companies have placed strong emphasis on the supply chain function as indicated from the data gathered.

Project Obstacles

During the interview, respondents were asked to rate the degree of each obstacle introduced by Ayers (2004) on a Likert scale, 5 being the most problematic and 1 being not at all an obstacle.

When considering the data at large organisational Roadblocks such as employee distrust, lack of project acceptance seem to be the present obstacle for supply chain transformation projects. This notion is further underlined by the 0.92 standard deviation, which is the second lowest among Ayers' five common causes.

TABLE 3: AVERAGE RATING OF OBSTACLES ON THE FOCAL PROJECTS



Reactive vs. Proactive

The research data proves Ayers' claim that planning is the most important part of a project. All three focal projects indicated reasonable planning with room for improvement. However, any deviations from this had led to cost and time escalations.

Outlook on "Supply Chain" within the focal firms

Surprisingly, it was understood that the three focal firms' opinions about the term "supply chain" were still evolving. It should be pointed out that the definition of "supply chain" seemed to be different from one to the other at the three organisations with critical units been split into separate segments rather than seeing it as a holistic end-to-end process.

CONCLUSION & RECOMMENDATIONS

The data revealed consensus that "Improving Processes" was the most important supply chain driver followed by "Flexibility" and "Collaboration". Moreover, the data clearly indicated that "Cost Reduction" is a critical supply chain transformation driver although "Competitive Actions" may not possess the same impact.

It was clear that these firms were of the view that planning was the most important part of a project. In spite of that, the extent of using Project Management Body of Knowledge (PMBOK) has room to improve.

"Organisational roadblocks" stood out as the main obstacle for smooth completion of projects. The other factors had less of a weight. Encouragingly, "top management abrogation" was ranked at the cellar. This further reinforces the increasing trend among top managers to build solid supply chains to enhance their businesses.

Recommendations

MNCs have an inclination to follow the corporate decisions of its parents companies. This was also evident throughout this research.

Thus, it is imperative for the organisation to first get a rigid understanding of the supply chain and its drivers in the Sri Lankan context. The proverb "Think Global, Act Local" best fits this instance.

It is important that the project team and the top management take a lot of time and properly plan out the project before implementation using project management concepts and theories. Project communication management would also play an equally important role for project success. Any variations to the scope of the project would offset the project implementation as the team has to refocus on planning to facilitate the changes in scope.

It is also recommended to carry out informative training sessions for project team members elaborating on the drivers of the supply chain transformation project, project scope, objectives and possible risks.



FIGURE 2: RECOMMENDED MODEL FOR SUPPLY CHAIN TRANSFORMATION PROJECT PLANNING

Once this is taken care of it is highly recommended to cascade the learnings to project stakeholders using the project team members. Project team members should be given time to go and meet their subordinates and converse with them and get their opinions, suggestions and ideas with regard to the project.

The top management needs to inculcate a culture where employees think of the greater good of the supply chain rather than focusing on their individual business units. Project teams should meet regularly to come to speed about the project progress. It is imperative for the team members to have a holistic picture of the project rather than being confined to his/her business silo.

It is further recommended for organisations to keep records of supply chain projects in a work cloud to avoid “reinvent the wheel”. A simple Knowledge Management System would suffice this requirement.

Firms should properly understand the company’s technical capabilities and come to grips with project objectives during the planning stage. This should empower the company to decide whether the planned projects can be achieved and is feasible with existing capabilities of the company.

Moreover, companies should give prominence to have an employee focused approach to projects using Change Management and Human Resource Management to optimize project outcomes.

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PROACTIVE-REACTIVE INITIATIVES FOR SUSTAINABLE MANUFACTURING: EVIDENCE FROM CHINESE AUTOMOTIVE SUPPLY CHAINS

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ABSTRACT

This study utilizes a multiple case study approach involving four major upstream Chinese automotive supply chains to examine their preparedness towards environment sustainable practices. We employed partial least square modelling method and developed two models to assess relationships between proactive and reactive sustainability practices in terms of 6Rs (reduction at the source, redesign, reuse, remanufacture, recover and recycle) in the investigated firms. The results indicate that the Chinese automotive firms are reactive in carrying out reduce, redesign and recycling initiatives to achieve sustainability. With respect to proactive practices results show that firms pay more attention to practices such as reduce, redesign and recycling.

Keywords: Sustainable manufacturing; automotive supply chain; China; 6R

INTRODUCTION

The global automotive industry is facing several challenges that include overcapacity, increased competition, dwindling sales. Furthermore, the automotive industry faces severe demand for environmental protection and resource scarcity which calls for engagement in proactive sustainable activities such as reduced energy and material usage, recycling, recovering materials from end-of-life products and reduce carbon emission, amongst others (Liao et al., 2013; Amelia et al., 2009; Xiang and Ming, 2011). These are in addition to the strict adherence to sustainability policies and regulations by various governments both developed and in emerging economies (Liao et al., 2013). It is not surprising therefore that the auto industry is increasingly shifting its attention to the adoption of environmentally benign practices (Amelia et al., 2009; Xiang and Ming, 2011). The industry stakeholders have realised that addressing sustainability issues provides them greater potential for long term survival and better economic performance (Kumar et al., 2012).

China presents a unique opportunity for understanding state of automotive industry. The country is currently the world's largest automotive manufacturer and has a growing automotive market for global brands (Liao et al., 2013). Interestingly, future trends suggest the growth trend in China's automotive market will continue given the country's large population base and upward trend in its consumers' disposable incomes coupled with estimated auto production rate of 45% by 2018 (Wang and Chen, 2012; Liao et al., 2013).

The strong positive growth forecast implies that the Chinese automotive industry needs to deal with sustainability challenges due to increased utilization of scarce natural resources, global oil demand crisis, CO₂ emissions and substantial growth of end-of-life vehicles (ELVs) which is projected to be 6.4 million by 2015 (Wang and Chen, 2012; Xiang and Ming, 2011). The World Bank (2013) has identified sustainability as a major issue for China because of the intensive resource

utilization in production and associated wastage and pollution (The World Bank, 2013).

In the recent past few studies have been conducted which deal with the issue of sustainability in China (Tian and Chen, 2014; The World Bank, 2013; Xiang and Ming, 2011; Zhu et al., 2007). The World Bank (2013) study investigated sustainability in terms of resource utilization, wastes and pollution in China. Majority of the remaining studies focused on green supply chain management (GSCM) with respect to specific aspects of sustainability such as take-back and recycling of ELVs in automotive industry (Tian and Chen, 2014; Xiang and Ming, 2011). Tian and Chen (2014) examined the sustainable design for automotive products with respect to the dismantling and recycling of end-of-life vehicles. Surprisingly, so far no studies in Chinese focal manufacturing firms and their upstream supply chains based on sustainability manufacturing initiatives such as 6 Rs has been conducted.

Against the above backdrop, we investigate sustainability based on the context of developing economies such as China and, specifically, to target the automotive industry given that China is the world's largest auto producer and markets. This study examines China's major automotive supply chain preparedness towards environment sustainable practices. We focus on upstream supply chain where major production activity takes place. This study utilizes a multiple case study approach involving three major upstream Chinese automotive supply chains comprising a manufacturer, tier 1 and tier 2 suppliers. The primary objective of this study is to identify the proactive (how far a firm plan to act in the future) and reactive (a firm current level of implementation) sustainable manufacturing initiatives in China in terms of six R's (Jawahir et al., 2007; Jayal et al., 2010).

The rest of the paper is organized as follows. Section 2 provides the literature review of sustainability and six R studies. It is followed by section 3 which outlines details of the methodology used in this study. Section 4 reports the findings of the study while, section 5 provides the conclusion derived from this research.

LITERATURE REVIEW

The Chinese government is actively promoting sustainable development through the promulgation of a number of policies such as Circular Economy Promotion Law and General Requirements and Labelling for Recycled and Remanufactured products, amongst other environmental regulations (Zhang et al., 2011; Wang and Chen, 2012). These policies and regulations acts as strong internal drivers for the Chinese automotive supply chains to adopt green supply chain management and other sustainable practices (Wang and Chen, 2012; Zhu et al., 2007). Despite these efforts, however, there are key challenges that need to be overcome for firms to achieve lasting business sustainability.

Amongst such challenges is the difficulty in discovering the sustainability-related opportunities given firms' short-term profit orientation (Berns et al., 2009; Kiron et al., 2012). In this context, the firms and their products designs as well as the societal expectation embracing sustainability practice is of critical importance. For example, consumers' perception of remanufactured vehicles is a major obstacle (Amelia et al., 2009). Since consumers still question the quality of reused products, original equipment manufacturers are less enthusiastic in engaging in automotive reuse and remanufacture (Amelia et al., 2009). This is further compounded by the fact that creating a new business model that will promote the needed new perspective on sustainability by all stakeholders cost money and time (Kiron et al., 2012).

Secondly, comprehensive sustainability in the automotive industry requires radical changes and long-term return on investment (Nieuwenhuis and Wells, 2003). Partial sustainability or incremental changes are not enough and may even have unintended negative/reverse effect on the environment. For example, while there appears to be demand for alternative fuel vehicles - electric, hybrid and hydrogen cars, the lack of service infrastructures such as service and/or filling stations has constituted a significant barrier to the formation such an important market (Berns et al., 2009; Maitin and Lacy, 2011). Similarly, weight reduction of vehicle through replacing steel with light-weight materials has resulted in increased total solid waste (Kumar and Sutherland, 2008). In fact, other researchers have argued that the impact of such material substitutions on the sustainability of the recovery infrastructure is unknown (Daniels et al., 2004). Also, the increased disposition of plastics from end-of-life vehicles is putting landfill capacity under severe pressure (Duval and MacLean, 2007).

In addition to the common sustainability challenges above, there are challenges that are specific to China. Wang and Chen (2012) identify three challenges for sustainable practices such as recycling and/or remanufacturing in China to includes incomplete systems and few and small players and the lack of remanufacturing technologies/infrastructure. In particular, Gallagher (2006) reveals that China does not possess advanced technologies, but international technology transfer is limited in the absence of proper government guidance and/or effort by multinational firms. Restrictive government policies and regulations have also been cited as a major challenging sustainability practices in China (Zhang et al., 2011).

The above review suggests that the major challenge to be effective and lasting sustainable automotive supply chain is the construction of a comprehensive sustainability practices (Maitin and Lacy, 2011). This conclusion was in line with Wang and Chen (2012) suggestion that Chinese automotive industry should study how to deal with sustainable manufacturing practices such as reduce at source, redesign, reuse, remanufacture, recovery and recycle if they plan to remain competitive in the global automotive industry.

VARIABLES

The primary objective of this study is to identify the proactive-reactive sustainable manufacturing initiatives in China in terms of comprehensive 6 Rs. The variables used for 6 Rs and sustainable performance as shown in Table 1 are derived from different sources. The sources for the independent variables are as follows: reduce items (Rao and Holt, 2005; Green Jr et al., 2012; Holt and Ghobadian, 2009); redesign items (Zhu et al., 2007); reuse category (Holt and Ghobadian, 2009); remanufacture category (Hofer et al., 2012; Subramoniam et al., 2013); recovery category (Rao and Holt, 2005); recycle category (Hofer et al., 2012). The dependent variables are sustainable performance criteria which were sourced from Rao and Holt (2005) and Zhu et al (2007). The models identify the association and strength of 6Rs (independent) relationship on sustainable performance (dependent).

METHODOLOGY

This study utilizes a multiple case study approach involving four major upstream Chinese automotive supply chains that includes three members such as manufacturers, tier 1 and tier 2 suppliers. It employed model testing design in which we developed two models to assess relationships between proactive (model 1) and reactive sustainability practices (model 2). The models were tested using the Partial Least Square Path Modelling (PLS-PM) approach (Tenenhaus et al., 2005; Hair et al., 2012).

Independent variables		
R1: REDUCE R11: Solid wastes R12: Water use R13: Air emissions R14: Noise R15: Waste generated by machining fluids and metal scraps R16: Energy use R17: Consumption of hazardous materials R18: Life cycle analysis of products R19: Packaging	R2: REDESIGN R21: Disassembly R22: Disposal R23: Recyclability and reusability R24: Recovery of material R25: Environmental legislation R27: Avoid hazardous manufacturing process	R3: REUSE R31: Returnable packaging R34: Production wastewater R35: Recovered components in new product
R4: REMANUFACTURE R41: Rebuild some products with end-of-life R42: End-of-life collection designed and planned R43: Distribution of products designed and planned R44: High value core influence reman decision	R5: RECOVERY R51: Company's end-of-life R52: Capturing energy/steam/heat R53: Packaging / pallets	R6: RECYCLE R61: Internal materials R65: office materials R66: packaging / pallets
Dependent variables		
SI: Sustainability performance		
SI10: Consideration of natural reduction in manufacturing process SI111: Reduce raw material inventory SI112: Reduce lot size inventory SI113: Reduce set up time SI114: Reduce process distance with each other SI64: recycle its production materials	SI25: Design changes made to products due to environmental legislation SI28: Design of products for reduced consumption of material / energy SI32: Capturing internally generated wastes or scraps for reuse SI33: Reuse all product waste through filtering SI62: Use of waster of other companies	

Table 1: Independent and dependent variables

Data were collected through a semi structured interview and questionnaire which contained specific and technical issues that were administered during the months of July and August 2013. The questionnaire contains issues relating to sustainable manufacturing practices of reduce at source, redesign, reuse, remanufacture, recovery and recycle, to examine their importance, implementation and effectiveness in the auto firms investigated. All the items were measured on a five-point Likert- scale. Few items were modified to capture the contextual intent of the study. We obtained data and information from 65 respondents across 22 Chinese automotive firms relating to the adoption of six proposed proactive and reactive sustainable manufacturing practices.

PROFILE OF THE SUPPLY CHAINS

Most of the investigated companies are located in Nanjing and Jiangsu province in China. The companies have been in operation for between 11 to 60 years and have an average number of employees in these industries varied from a low of 100 to a high of 7,000. Table 2 shows the consolidated profiles for the supply chains members chosen for our study.

Characteristics	Manufacturers	Tier I suppliers	Tier II suppliers
Existence in years	16-20 years	16-45 years	11- 60 years
Business type	Automobile and commercial vehicles	Instrument, sensor and window regulator, Axle, automotive brakes	Plastic parts, Auto components, Stamping parts, steering gears
Annual turnover	> RMB 400 million	RMB 20 million- 400 million	RMB 20 million- 400 million
Export	0-29%	0-29%	20-49%

Table 2: Consolidated Profile of the Supply Chains

ANALYSIS AND DISCUSSIONS

We used SmartPLS software to conduct the analysis (Tenenhaus et al., 2005). This tool is more appropriate to identify the suitable relationship between variables for smaller samples. (Ringle et al., 2005). The Partial Least Square Path Modelling (PLS-PM) describes the relationships between observed or measured

variables and theoretical constructs. Our models (see Table 3) meet all critical PLS-PM condition for retaining constructs that includes satisfactory convergent and discriminant validity of factor loading above 0.6, average variance explained (AVE) above 0.5 (Fornell and Larcker, 1981), Cronbach alpha (α) above 0.7 (Tenenhaus et al., 2005), statistically significant ($p \leq 0.05$) t-statistics, high correlation of items with their designated construct (Tenenhaus et al., 2005), a correlation between items and their designated construct higher than the square root of the AVE (Fornell and Larcker, 1981), and composite reliability values above 0.7 are considered acceptable (Hair et al., 1998; Hair et al., 2012). Fit indices of the two models were found to be within the suggested cut-off values (Shah and Goldstein, 2006).

Constructs	AVE	Composite Reliability		Cronbach's Alpha		Communality	
		Reactive	Proactive	Reactive	Proactive	Reactive	Proactive
R1	0.53	0.91	0.91	0.89	0.88	0.53	0.55
R2	0.71	0.93	0.94	0.92	0.92	0.71	0.71
R3	0.52	0.76	0.74	0.62	0.62	0.52	0.50
R4	0.73	0.92	0.91	0.88	0.88	0.73	0.73
R5	0.68	0.86	0.86	0.77	0.77	0.68	0.69
R6	0.59	0.85	0.85	0.76	0.74	0.59	0.66
SI	0.47	0.90	0.91	0.88	0.88	0.47	0.56

Table 3: Reactive and proactive models characteristics

The structural model assessment through path analysis for reactive analysis (see Figure 1) indicates direct relationships from reduce, redesign and reuse initiatives to achieve sustainability are significant and positively related with the sustainable performance initiatives. Surprisingly, remanufacture, recovery and recycling do not have significant relationship with sustainable performance metrics. Hence, the analysis show that currently,, focal manufacturing firms and their tier 1 and tier 2 suppliers are more focused towards reusing good components from the damaged subassemblies, economical gains through reduction at source activities and paying attention towards redesign activities.

On the contrary it is interesting to see how proactive the upstream suppliers are with respect to 6R sustainable manufacturing practices (see Figure 2). The analysis reveals that reduce, redesign and recycling are having significant relationship with sustainable performance initiatives. It is very interesting to notice the importance paid towards recycling initiatives by the firms in the future as well there is no sign of reaction from the managers towards remanufacture and recovery. The concentration of upstream suppliers towards recycling probably may be due to strict enforcement of government legislations and stringent requirements of multinational companies and customer awareness.

The weaknesses and challenges specific to Chinese automobile firms identified in this study can be minimized through a number of approaches that includes appropriate government regulations and strict enforcement of such regulations and greater emphasis on environmentally friendly and sustainable development promotions. These should include the automotive industry promoting the 6R practices and further R&D into production and operations optimisation.

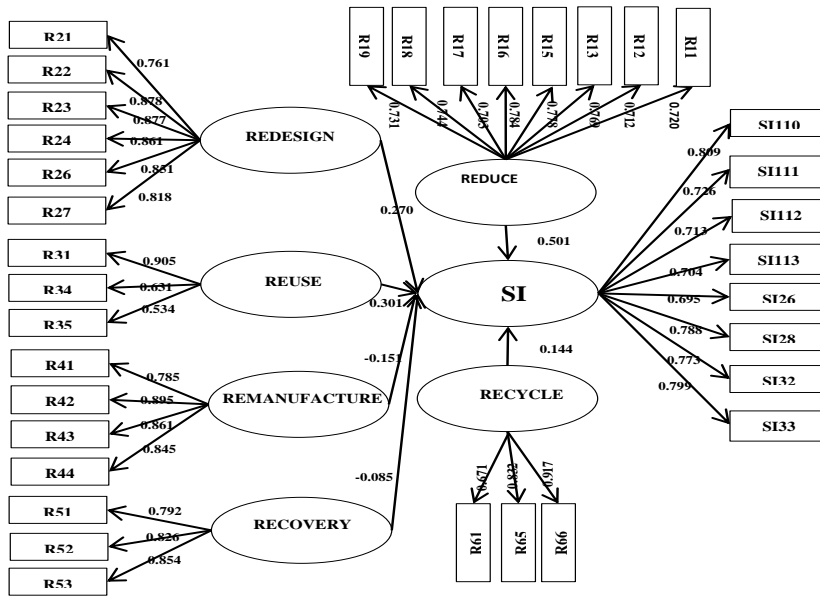


Figure 1: Structural path model for reactive sustainable practices

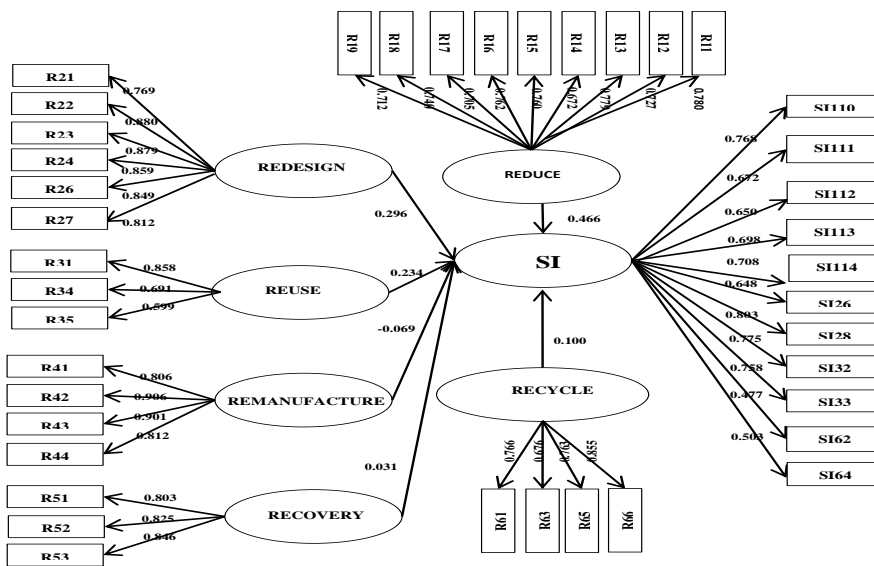


Figure 2: Structural path model for proactive sustainable practices

CONCLUSION

This study examines China’s major automotive supply chain preparedness towards environmental sustainable practices. Using partial least square modelling method two models assess relationships between proactive and reactive sustainability practices in terms of 6Rs in Chinese firms. The results indicate that the Chinese automotive firms are reactive in carrying out reduce, redesign and reuse initiatives to achieve sustainability. With respect to proactive practices results show that firms pay more importance to practices such as reduce, redesign and recycling. The study provides a useful source for practitioners and sustainability policy-makers on the potential usage of 6 R practices in upstream supply chains of Chinese auto firms.

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ON-SHELF AVAILABILITY STRATEGIES: ANALYZING ALTERNATIVE MODELS TO ASSURE PRODUCT AVAILABILITY IN HIGH DENSITY AREA

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ABSTRACT

The present work focuses on the Coffee industry aiming at improving on-shelf availability strategies for different food and coffee products. The company under investigation has successfully established itself as the premium coffee leader in China and operates an extensive distribution network seven days a week. However, in high-density locations, stores often run out of food items by midday. This study is conducted to develop alternative transportation-distribution strategies to assure availability of key items, especially food related, in stores throughout the day. Using AnyLogic simulation software, the current transportation-distribution network of the company is simulated, verified and validated accordingly. Four alternative transportation-distribution strategies are developed and simulated using the software. In addition, the impact of each alternative strategy on total supply chain cost, opportunity cost and demand fulfillment is assessed. Two alternative strategies are recommended; (i) adding a regional distribution center to the current transportation-distribution network, (ii) including an additional delivery before lunch time using the current distribution network.

1 INTRODUCTION

One of the key challenges of retailers is on-shelf availability (OSA), since going out of stock (OOS) directly results in customer dissatisfaction (Meng *et al.*, 2012). In fact, OSA is a key performance indicator for the retail industry, significantly impacting profits and customer loyalty. OOS is critical in reaching high levels of availability at the final point of sale in the supply chain, where OSA has the greatest impact on consumer behaviour.

This research focuses on the retailing activities of the coffee industry. The company under investigation is one of the coffee leaders in China. The main problem is that in high-density locations of Beijing city, stores often run out of food items before noon resulting in unhappy customers. The aim of the project is to look into options to assure availability of key items, especially food related, in Beijing stores throughout the day. Here, the main factors contributing to the problem is the current distribution and transportation system. Thus, developing a better logistic model to improve the OOS problem is the main contribution of this study.

In the rest of the paper, a review of the literature and simulation methodology is discussed. Then, the simulation modeling using the collected data from the company is explained. After that, four alternative transportation-distribution network configurations are presented. Finally, results and conclusions along with recommendations for further research are presented.

2 LITERATURE REVIEW

For around 45 years, OSA and OOS have been investigated by researchers and practitioners (Progressive Grocer, 1968; Emmelhainz *et al.*, 1991; Corsten and Gruen, 2003; Ettouzani *et al.*, 2012). However, according to Aastrup and Kotzab (2010), OOS levels have relatively stayed unchanged, which is estimated by Corsten and Gruen(2003), at around a worldwide average of 8%. Two major

categories can be identified in the current OSA and OOS literature, identifying different causes of OOS and approaches in order to deal with OOS and OSA.

In the first category, Taylor and Fawcett (2001), applied surveys and interviews to evaluate OSA performance and categorized the main roots of OOS in four groups including suppliers, retailer headquarters, distribution centers and stores. Mckinnon et al. (2007), applied surveys to analyze OSA and OOS for three categories of products and realized that factors such as poor inventory planning replenishment, transportation variability, inefficient training and so on lead to low performance. Fernie and Grant (2008) conducted a research on UK grocery retailers and found that home shopping which can contribute to high OOS.

As far as quantitative methods, Aghezzaf et al. (2006) applied nonlinear mixed integer programming for the inventory routing problem (IRP) to construct a distribution plan that minimizes fleet operating and average total supply chain costs. Mckinnon et al. (2007) introduced the following recommendations for tackling OSA: increase the accuracy of in-store inventory records, rationalize the product range, improving forecasting and ordering, improving transportation and distribution network and overhaul the shelf replenishment process. Considering minimization of total supply chain costs, Nikolopoulou, and Ierapetritou, (2012), constructed a hybrid simulation optimization approach to address the decision making problem of tactical (planning) and operational (scheduling) level. Finally, Duan and Liao (2013), developed a simulation-based optimization framework and inventory model to identify optimal replenishment policies for centralized and decentralized supply chains facing various demands.

3 CURRENT SUPPLY CHAIN SYSTEM OF THE CASE COMPANY

Today the company offers 55 SKUs clustered in four food categories (Ambient, Fresh, Frozen and Temperature control products), which are being served in 122 stores. In the current transportation-distribution network, apart from the stores, which are served by one central distribution center outside Beijing city (Beijing CDC), there are several suppliers that supply all required food items for Beijing CDC. All transportation is conducted using 3PLs (3rd Party Logistics). The current average stock-out level per store is approximately 39% every day. Almost each store is suffering from at least 11% OOS each day. It is also considerable that 87% of the stores experience stock-out levels of more than 25% each day.

In terms of the daily supply chain operations, when a customer places an order, the stores satisfy the demand unless customers' demand exceeds the inventory level (a stock-out event occurs). Stores put orders to Beijing CDC daily and receive their orders early the following day. So, this is daily ordering and daily delivery and no safety stock is available in stores. Since products are food items with expiry date of less than four days, no safety stock is available in store and they use Order-up-to level inventory model, (s, S), like in the case of the Beijing CDC. In terms of delivery time variability at Beijing CDC, there is a random lead-time for the shipment to stores, which is uniformly distributed. On the suppliers' side, the shipment time to the Beijing CDC is around twice compared to the deliveries from the Beijing CDC to stores and is also uniformly distributed.

4 SIMULATION-BASED APPROACH

Data such as stores' demand data, product types, procurement and transportation costs, delivery capacity of trucks, working procedure of the stores and Beijing CDC, current configuration of the distribution network have been collected. The conceptual model of the company is presented in Figure 1.

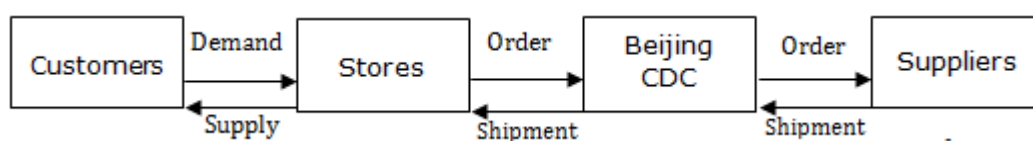


Figure 1 Conceptual supply chain model of the case company (source: author)

Demand data for 85 business days have been collected and using Easy Fit software a Lognormal distribution is identified as the distribution function of demand through the stores. With the use of a statistical analysis on demand of all 55 SKUs stores have been categorized in three groups of low (9 stores), medium (98 stores) and high demand (15 stores). Based on the analysis, average daily demand per SKU is 4, 7 and 15 units for low, medium and high demand stores, respectively. Considering all SKUs, the global average demand of all stores is about 397 orders per day with standard deviation of 197 orders.

4.1 Simulation Model

Based on the conceptual model (Figure 1) and analyzed data, the current transportation-distribution system of the company is simulated using AnyLogic Simulation software. Since the company provided 85 days of actual sales data, the simulation length is defined to be of the same duration in order for the simulation results to be easily compared to the actual data. The following KPIs are under examination (Figure 2):

- Average daily under-fulfillment rate (~40%)
- Average daily total transportation and purchasing cost (~ \$ 467,500)
- Average daily total shortage cost (~\$528,300)
- Average daily transportation cost (~\$58,400)

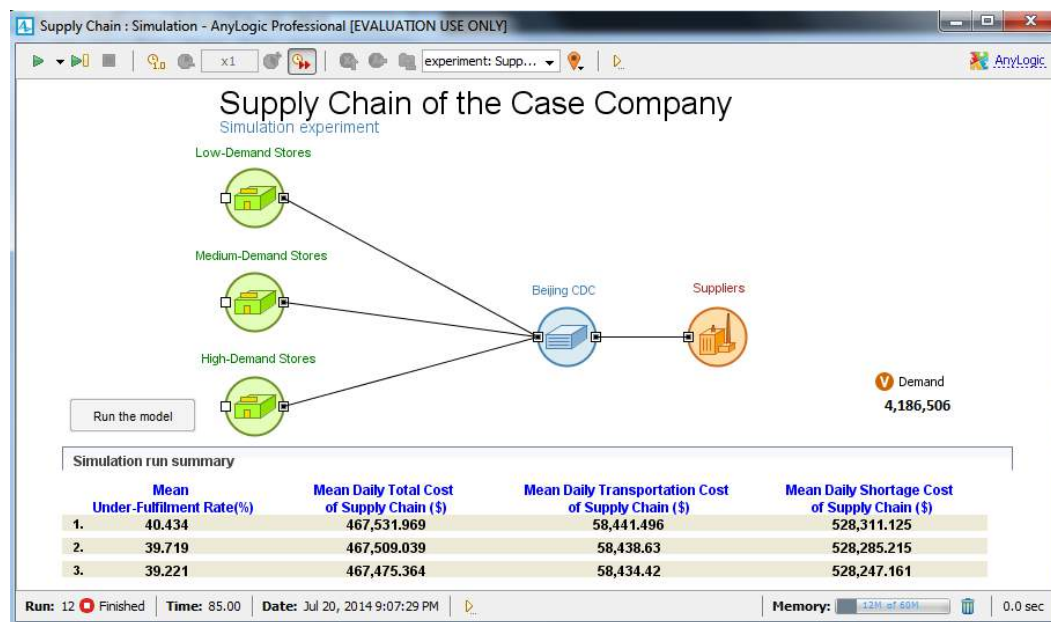


Figure 2 Simulation model of the company's supply chain (Source: Authors)

4.2 Model Verification & Validation

4.2.1 Model verification: different ways exist in the current literature for the verification of a simulation model including expert evaluation, internal evaluation, consistency test, incremental model building and more (Sargent, 2010). In this study, incremental model building is applied, where the model is initially built in a small scale and is evaluated whether it is properly coded or not. Then it is built at its full size. In this study, two stages are considered. First, the model is built for one sales day of one SKU and one store. Second, the model is extended for all SKUs and stores for the entire simulation period.

To illustrate the first stage of verification, the model is constructed for one SKU, one high-demand store, using Beijing CDC and Suppliers (Figure 3). As mentioned, the average daily demand of a high-demand store is of 15 units. Based on the simulation results, the model is checked whether the under-fulfillment rate of demand (average of under-fulfillment rate of 5 runs in Figure 3

is 39.4%) is close to the result of dividing the average number of stock-outs by the average total demand (i.e., $6/15=40\%$). Since these two numbers are approximately equal, the verification of the algorithms and the coding of ordering and demand fulfillment procedures can be assured. In the same fashion, the consistency of the mean daily cost with the fill rate is examined. Based on the simulation's output, around 40% of under-fulfillment is observed, which means approximately 60% of the demand is satisfied. The purchasing cost for the supply chain is USD14 and the respective transportation cost is USD2. Thus, for the nine fulfilled orders shown by the simulation output, the total supply chain cost be reported as $9 \times (\text{USD}14 + \text{USD}2) = \text{USD}144$. The average total supply chain cost for the five simulation runs is around USD142.8, which is almost equal to USD144. Similar to the total supply chain cost, shortage cost verification is also explored. A 40% of under-fulfillment for 15 items, would be around USD162 considering the opportunity cost of USD27 (USD18 for the store and USD9 for the Beijing CDC) for each SKU. The average opportunity cost of the five runs in the simulation output is of USD161.3, which is very close to the USD162 target. Once the model has been validate for the single SKU one store case, then the extended model is validated which includes all 55 SKUs and 122 stores. In order to achieve this, demand for 55 stores for all SKUs has been consolidated. In addition, since all SKUs belong to food categories with relatively similar demand behavior, consolidating their demand would not be harmful for comparison of the current model with alternative strategies. Figure 3 presents the final completed model of the current supply chain for all SKUs and all stores.

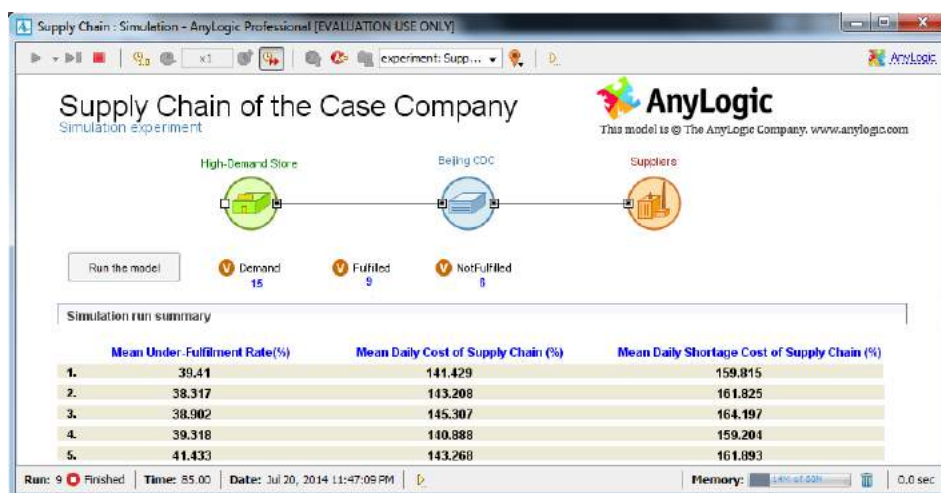


Figure 3 Verification of the simulation model (Source: Authors)

4.2.2 Model Validation: According to Sargent (2010), there are four main approaches for model validation. In this study the validation of the model is made by comparing the average demand of all stores for all SKUs during a period of 85 working days (Table 1) with the average simulated demand, for the same time period. As is shown in Table 2, the average demand of all stores for all SKUs for the period of 85 days is 4,116,890 SKUs, while the output of the simulation model is around 4,186,506 SKUs. As both numbers are very close, the model can be validated.

Average demand of each store per day	397
Average demand of all stores (122) per day	48,34
Average demand of all stores during 85 days (actual)	4,116,890
Total demand of all stores for all SKUs in 85 days (simulation)	4,186,506

Table 1 Validation data for the simulation model (Source: Authors)

5 ALTERNATIVE STRATEGIES FOR INCREASING OSA IN STORES

Four alternative transportation-distribution strategies for improving current stock-out levels are developed and simulated (Figure 4). As Table 2 shows, in the distribution network of each alternative strategy, there are a number of entities such as quantity of CDCs in Beijing, quantity of RDCs in Beijing etc. It should be noted that there is no change in the configuration or the number of suppliers since they are out of scope of this study. Furthermore, there are two more columns for each entity, "Delivery to" and "Delivery times". "Delivery to" highlights the destination of the entity e.g., from "Beijing CDC" to "stores". "Delivery times" shows the number of deliveries from each entity to each destination. For example, in the first alternative strategy, suppliers send orders to CDC once a day, Beijing CDC sends orders to stores two times a day and there is not any Regional DC in the model.

<i>Transportation -Distribution Strategy</i>	Suppliers			Beijing CDC			Beijing RDC		
	Quantity	Delivery to	Delivery times	Quantity	Delivery to	Delivery times	Quantity	Delivery to	Delivery times
Current	1	CDC	1	1	Stores	1	0	0	0
Alternative 1	1	CDC	1	1	Stores	2	0	0	0
Alternative 2	1	CDC	1	1	Stores, RDC	1,1	1	Stores	1
Alternative 3	1	CDC, RDC	1,1	1	Stores	1	1	Stores	1
Alternative 4	1	RDCs	1	0	0	0	2	Stores	1

Table 2 Alternative strategies (Source: Authors)

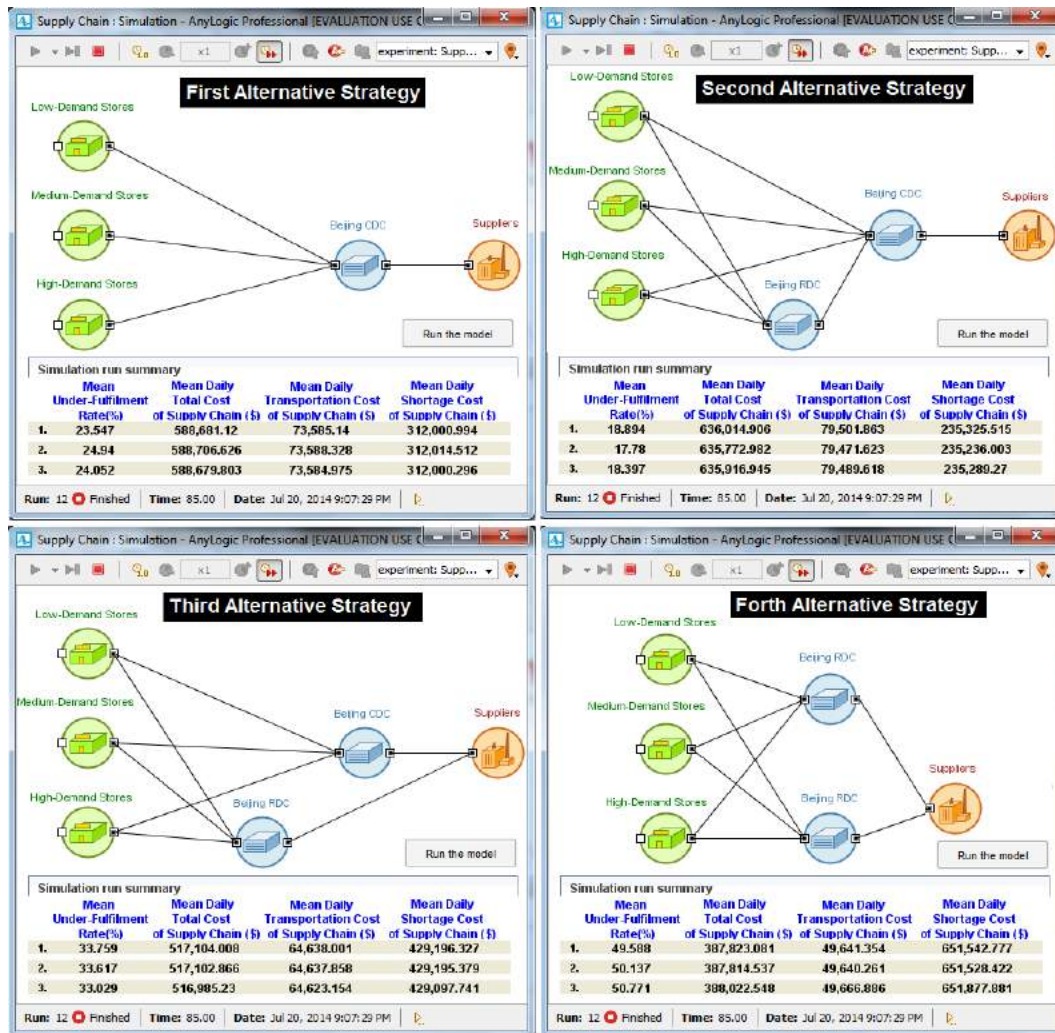


Figure 4 Simulation models of four alternative strategies (Source: Authors)
5.1 First alternative strategy: Adding one more delivery from Beijing CDC to stores before the peak demand time (lunch time)

According to the current operations, there is one time delivery to the stores every day, which is very early in the morning. This results in many stores going out of stock before noon. An alternative transportation-distribution strategy is to add one more delivery run to the stores before noon. Referring to Table 3, it is clear that applying this strategy can decrease the current stock-out levels from approximately 40% to around 24%. However, there is a noticeable increase in total supply chain cost but opportunity cost is improved significantly down to USD312,000. In this scenario, the main advantage is that there is no need to change the configuration of the supply chain network. However, its disadvantage is increasing the total supply chain cost.

5.2 Second alternative strategy: Adding one Regional Distribution Center (supplied by CDC) to the current supply chain network

The second alternative strategy is built based on developing a Regional distribution center (Beijing RDC) between Beijing CDC and the stores. Beijing RDC should be located inside the Beijing city to be able to deliver orders to stores responsively. In addition, the Beijing RDC is supplied only by Beijing CDC. This configuration would be easier to manage since the company is the only entity that supplies and manages orders from Beijing CDC to Beijing RDC. Furthermore, more consistency in average delivery time to Beijing RDC can be achieved in comparison to the third alternative strategy since there is just one source of supply for the Beijing RDC. The delivery time from Beijing RDC to the stores is

almost half of that of the Beijing CDC. As seen in Table 3, this strategy can decrease the current stock-out levels significantly from approximately 40% to about 18%. However, there is a dramatic increase in total supply chain cost as well. Regarding shortage costs, this strategy is capable of reducing opportunity costs even further compared to the first alternative strategy (down to USD235,000). This scenario is the most effective one in terms of improving stock-out levels. However, the drawback is requiring some investment for acquiring or renting the Beijing RDC.

Transportation-Distribution Strategy	Simulation results				Analysis of results					
	Under-fulfillment rate (%)	Total SC cost (\$k)	Transportation Cost (\$k)	lost sales (shortage cost) (\$k)	Purchase Cost(\$k)	total actual & opportunity cost (\$k)	Average Demand (#k)	Revenue (\$k)	Profit (\$k)	Potential increase (decrease) in profit (%)
Current	40	467	58	528	409	995	48	783	315	0
Alternative 1	24	588	73	312	515	900	48	992	403	28
Alternative 2	18	636	79	235	557	871	48	1,070	433	37
Alternative 3	33	517	64	429	452	946	48	874	357	13
Alternative 4	50	387	49	651	338	1,039	48	652	264	-16

Table 3: Analysis of different alternative strategies (Source: Authors)

5.3 Third alternative strategy: Adding one Regional Distribution Center (supplied by CDC and suppliers) to the current supply chain network

The third alternative strategy is similar to the second one in terms of configuration. However both the Beijing RDC and the Beijing CDC can put orders directly to suppliers. Although this flexibility will empower the Beijing RDC to secure enough quantity of SKUs, it increases the average variability in delivery time, since deliveries from suppliers will take more time. In addition, since both entities (Beijing CDC and Suppliers) will be handling the orders, more variability in delivery time and cost is expected. Although using this strategy is improving stock-out levels (Table 3), the impact is not significant (only around 7%). This strategy also increases the total supply chain daily cost.

5.4 Forth alternative strategy: Shutting the current Beijing CDC down and adding two Regional DCs to the current supply chain network

The last strategy requires a fundamental re-configuration in the current supply chain network. Two RDCs are considered inside the city instead of the current Beijing CDC to supply all stores. Stores place orders independently to suppliers and get the shipments done through 3PLs. This strategy has the longest transportation lead-time, which affects fulfillment rates in a rather negative way. The forth strategy (Figure 4) is the least preferred since under-fulfillments rates are high and the total opportunity cost increase significantly (Table 3).

6 CONCLUSIONS

Aiming at enhancing the service level of one of the global coffee companies in China, this research is conducted to ensure availability of key food and coffee items in stores. Collecting and analyzing required data, the current supply chain system of the company is simulated. Four different alternative transportation-distribution network configurations are designed and simulated:

- Adding one more delivery run from Beijing CDC to the stores before the midday.
- Adding a Regional Distribution Center inside the Beijing city (Beijing RDC)
- Both Beijing CDC and Beijing RDC are allowed to place orders directly to suppliers

- Removing the current Beijing CDC and adding two RDCs inside the Beijing city which both place orders to suppliers.

Based on the results the second alternative strategy (Adding one Regional Distribution Center to the current supply chain network) has the best positive impact on reducing under-fulfillment to customers' demand while it increases the demand fill rate from 60% to almost 82%. This significant improvement comes with the highest transportation and total supply chain cost. However, since there is a good profit margin from the sold products, the revenue from increasing sales not only covers the total supply chain costs but it also increase the supply chain profitability by around 37%.

An additional key finding of this study is that even the first alternative strategy, which includes the offering of two delivery runs before noon instead of one can has also positive results for the company. Demand fulfillment is increased by 16% and profits are improved by 28%. These results are achieved without the need of any heavy capital investments to adjust the present network configuration.

Finally, an interesting finding relates to the total supply chain cost. Based on the results presented in Table 3, although the second and first alternative strategies have the highest supply chain costs, they both have the lowest shortage costs. This means that if the total supply chain cost is estimated based on the costs of transportation, purchasing and shortage (lost sales), both strategies incur the least total supply chain cost.

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PLANNING OF A NEW LOGISTICS PROJECT: A CASE STUDY ON THE DEVELOPMENT PLANNING OF SMART MATERIAL HANDLING MACHINE USING THE BOTTOM-UP STRATEGY

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ABSTRACT

Recently, the demand for the 'light weight' product such as mobile phone, lap top, semiconductor and etc has been growing rapidly. Such growth caused the need of the specific material handling machine for 'light weight' cargo. However, in most warehouses in Asia, the handling of light weight products is heavily dependent on foreign technology or the manual work which causes inefficiency. To address such inefficiency and specific requirement, the development of smart material handling machine was essential in Korea. However, identifying requirements and planning a new type of machine are not simple tasks since there are process differences in warehouse operations, too many technologies, on-going developments, user requirements and etc.

For the systematic research, this paper proposes a bottom-up strategy and defines smart Material handling machine to develop considering various factors: user requirements, process characteristics in warehouse, trends of technology, market environment and etc. The Bottom-up strategy we propose is found useful to prioritize candidate technologies and to determine key research subject. We could reflect various ideas, opinions and information during the research process.

Keywords:

Bottom-up, light-weight cargo, technical development, smart material handling machine

1. INTRODUCTION

While the research and investment of automatic material handling technologies for heavy-weight cargo has been being active the technologies for light-weight cargo has been gotten less attention in Korea. Due to the growth of ICT technology, the demand for high price light-weight cargo has been increasing and ICT products have become a big part in export volume (Korea logistics newspaper company. 2012). Since Korea has a global competitiveness in ICT industry such as semiconductor, mobile phone and electronics, the technology for handling various types of light weight cargos is more important. Typically manual works can occur damage, loss and delay of cargo, so there are need to develop new technologies for handling light-weight cargo to address such issues. In this paper, we introduce 4 types of machine which are Automatic Picking System(APS), Goods to Destination System(GDS), Erector and Palletizer to be developed in the project called "the development of smart material handling machine" funded by Ministry of Land, Infrastructure and Transport of Korea from 2013 to 2016. We define smart material handling machine as "machine that can detect various logistics situation, can have high work-speed with high accuracy, can consider safety of workers, can provide convenience for maintenance and use, can collect data of equipment status and of work processed and can react unexpected situation". Based on the definition, we developed a government project agenda for a smart material handling machine for light weight cargo using bottom up strategy.

2. METHODOLOGY

In the bottom-up strategy, the individual elements of system are specified in detail then these elements are linked together to form larger system until a complete system is formed. This is tends to be highly complex, but it is extremely accurate (A.Capsso et al.

1994). We tried to assess the needs, resources, and opportunities correctly based on statistical and metrological methods where all conceivable sources of uncertainty are systematically evaluated (Johan and Ola 2004; Leung et al. 2007)

The strategy is composed of five steps: review on the trend of technology including patent analysis, market environment and external factors; understanding the needs of research area from process analysis in the 12 companies and direction establishment; selection of candidate technologies considering various factors such as existing projects, patent analysis, capability to develop, conformity with policy; develop a matrix to evaluate technologies works; filtering and prioritizing of candidate technologies with the perspectives of SMART functional requirements such as safety, maintainability, agility, rapidity and traceability.

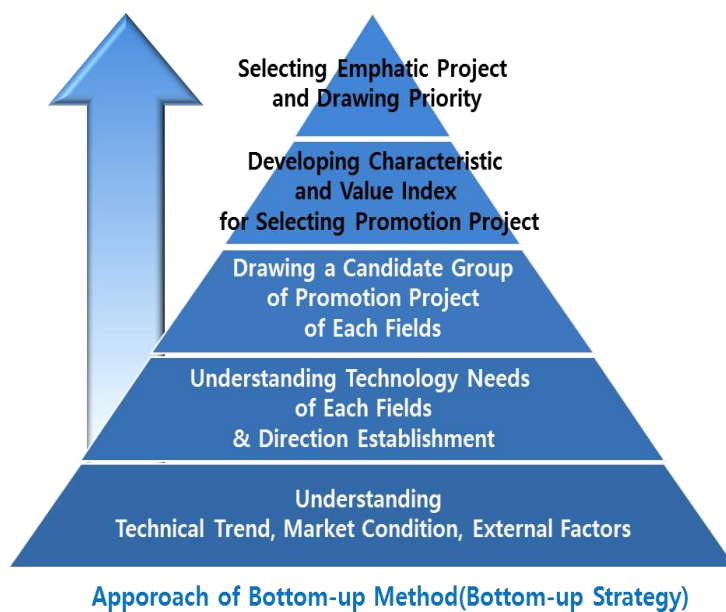


Figure 1 The bottom-up strategy

2.1. Review on the trend of technology including patent analysis market environment and external factors

As a first task, we analyzed the relevant technical trend of hardware, software and process in home and foreign countries. .

In case of hardware, we analyzed the top five companies in Korea based on sale and the top twenties' in foreign countries based on the Modern Materials Handling Magazine (2012). From the analysis, we compared differences and deduced implication for research. The result of analysis, domestic companies were small and medium size and heavily depended on the "import and assembly" types of business while foreign company is developing a unique machine with originality considering human factor, modularization and market demand.

In case of software, we investigated top twenties' in foreign countries and the top three companies in Korea. In home, most of developments were dictated by customer and such development environment causes connectivity issues with other system. On the contrary, foreign software considered the convenience of user, connectivity with various systems (i.e. ERP, WMS) standard (i.e. software framework), etc.

2.2. Understanding the needs of research area from process analysis in the 12 companies and direction establishment

In this step, on the basis of existing market and technology analysis, we identified the research needs and technical direction of smart material handling machine for light weight cargo. We suggested the direction of research needs considering five perspectives:

- S: safety & security, standard
- M: maintenance, modularization
- A: accurate & agility
- R: rapidity
- T: track & trace technology

We deduced relevant technology from the SMART point of view considering various perspectives such as material handling machine, manpower, working process and etc in the 12 companies we visited (Table 1).

Table 1. Example of Company Survey and Technology Survey

No	Companies (industry)	Process	Relevant Technology for each Process
1	A-Company (semiconductor)	Management	Integrated software technology
3		storage	Display technology of stock status board to remained subsidiary materials
4		Loading and unloading	Digital picking system
5		Loading and unloading	Technology of tracking freight location in real time
8		Transportation	Automatic guided vehicle technology
11		Safety	Technology considered for the safety of operators
107	Technology Survey	Storage / loading and unloading	Multi-Shuttle
108		Goods-to-Person(Rapid Pick System)	
110		Picking	Automated picking system
111		Packaging	Box erecting technology
115		Sorting	Automatic sorting technology
116		Inspection / Storage	Automatic Identification and Data Capture (AIDC)
119		Manage	Platform(Integrated Module) technology development (Hardware / Software)

After we reviewed processes of 12 companies and state-of-art technology trend, we have identified demanding technologies by process as in Table 2.

Table 1 Example of Demanding Technology List by Process

No	Process	examples of technology
8	Storage / loading and unloading	Goods-to-Person
18	Picking	APS-Automated Picking System
19		RPS - Rapid Picking System
34	Warehousing	Automatic Identification and Data Capture (AIDC)
39	Security	Control Technology Unauthorized Human Resource
53	Transfer	Automatic man-less Return Machine Technology

2.3. Selection of candidate technologies considering various factors such as existing

projects, patent analysis, capability to develop, conformity with policy

Candidate technology is selected considering financial, technical and political validity (Table 3). We investigated home and foreign market trend and found that packaging, picking, and storage automation have growth potential. When some candidate technologies are finally selected, to avoid overlap with other project, we checked existing projects funded by government. On this, we excluded Mini-load AS/RS, RFID technology and etc. We also analyzed patent in United State, Europe, Japan and Korea We also considered the policy target of logistics facilities, for example Ministry of Land, Infrastructure and Transport of Korea aims to improve energy consumption and loading capacity about 30% and reduce manpower about 30% compared with existing logistics facilities.

Table 2 Example Template for Candidate Technology Filtering

NO	Process	Candidate technology	Existence of government project	Patent in Korea	Existence of Domestic Technology	Existence of foreign technology	Conformance with policy	Recommendation for development
7	Storage/ loading and unloading (Picking)	Multi-Shuttle, ETV(Elevating Transfer Vehicle)		No Patent		o	Coincidence	yes
8		Goods-to-Person		No Patent		o	Coincidence	yes
9		Mini-Load AS/RS	o	No Patent		o	Coincidence	Overlap
18		Automated Picking System - APS		No Patent	o	o	Coincidence	yes
19		Rapid Picking System - RPS		No Patent			o	Coincidence

2.4. Develop a matrix to evaluate technologies works

For developing a matrix to evaluate technologies works, we considered home and foreign market growth, necessity of patent application and the result of supplier/demander survey (Table 4)

Table 3 Evaluation about Candidate Technologies Needed to Developed

C l a s s i f i c a t i o n	Process	No	Candidate technology	Value	①	②	③	④	⑤	⑥	⑦	⑧	⑨
	H a r d w a r e	Storage/ Loading Unloading	1	Integrated Machine with High Speedy & Capability for Managing Variety of Freight	6.27	1.12		1.07			1.13		
Picking		3	Rapid Picking System - RPS	4.41	1.12	1.10	1.07	1.15	1.10	1.13	1.08		
		4	Weight Lightening Smart Picking Cart Technology	4.41	1.12	1.10	1.07	1.15			1.08		
		5	Automated Picking System - APS	4.41	1.12	1.10	1.07	1.15	1.10	1.13	1.08		
Packaging		6	Technology of Attaching Label, Sealing, Inputting Freight and Erecting for Variety of Freight	6.35	1.12	1.10	1.07	1.15	1.10	1.13	1.08		
		7	Palletizer & Wrapping Technology by Unit	6.35	1.12	1.10		1.15	1.10	1.13	1.08		

S o f t w a r e	Operation (Integration)	8	Integrated Software Technology	11.41	1.12	1.10	1.07	1.15	1.10	1.13	1.08	1.04	1.10
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① Accuracy ② Variety of Cargo ③ Expandability ④ maintenance ⑤ Safety ⑥ User Convenience ⑦ Remote control ⑧ Automatic Data Collection ⑨ Temperature Management

2.5. Filtering and prioritizing of candidate technologies with the perspectives of SMART functional requirements such as Safety, Maintainability, Agility, Rapidity and Traceability

In this step, we filtered and prioritize candidate technologies as in Table 5. After prioritization, we deducted a final research.

Table 4 deduction of priority in smart material handling equipment in light freight research

Classification	Process	Priority	candidate technologies
Software	Operation	1	Integrated Software Technology
Hardware	Packaging	2	Technology of Attaching Label, Sealing, Inputting Freight and Erecting for Variety of Freight
		3	Palletizer & Wrapping Technology by Unit
	Picking	4	Rapid Picking System – RPS
		4	Automated Picking System – APS
	Storage/ Loading and Unloading	5	Management Technology of Temperature-Humidity by Cell-Unit for Protecting the loss of Freight
		6	Integrated Machine with High Speedy & Capability for Managing Variety of Freight

3. CONCLUSION

From it, we want to secure advanced-handling technology, open up a foreign market and save cost and time in light-weight cargo. The bottom-up strategy let these visions can accomplish. We selected machine to develop based on priority, and introduced an integrated software and 4 types of machine which are Automatic Picking System, Goods to Destination System, Flexible Erector, High-speed Palletizer which have been developed in the project called development of smart material handling machine funded by Ministry of Land, Infrastructure and Transport of Korea from 2013 to 2016.

The bottom up strategy is proved as systematic approach by applying at our project. The area of the project was limited to material handling for 'light weight' cargo but we strongly believe that systematic bottom-up strategy can save time and money by reducing trial and error and can be used for other research planning.

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Section 2: Responsible Supply Chains

THE PERCEIVED RISKS OF SUPPLY CHAIN INFORMATION SHARING

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ABSTRACT

Information sharing is seen as a prerequisite for successful supply chain management. However, in practice information is often hoarded and potential synergies forsaken in order to protect commercial sensitive information. The managerial perceptions of the risks associated with information sharing are examined in this research in order to explore the gap between theory and practice. A multiple-case study approach was employed, insights from 11 semi-structured interviews was combined with organisational data regarding supply chain structure and data integration. The findings highlight that interpersonal relationships and trust precede IT solutions for successful supply chain information sharing.

INTRODUCTION

Competition has evolved from inter-organisational to inter-supply chain (Christopher, 1992), thus necessitating cooperation among supply chain actors to minimise total system costs, while maximising customer satisfaction. Coordination is required along the supply chain to achieve these objectives; hence, it has become essential for organisations to share, often commercially sensitive information with their trading partners. This has contributed to the significant uptake of advanced information communication technologies (ICT) in order to facilitate real-time data transmission in an accurate and timely manner. As a result, firms have largely become depended on the quality of electronic data for decision making (Li and Lin, 2006). There are however, increased risks associated with sharing information that are hindering its exchange such as external software attacks, or misuse for malicious purposes. While managers and system administrators tend to underestimate these threats, recent disruptions due to ineffective information sharing vividly demonstrate the negative consequences on business performance (Khan and Burnes, 2007). These outcomes could include loss of profits, damage to market share, or reduction in credibility and reputation in the eyes of customers. As organisations increase the sophistication of their ICT, the risks escalate (Baker et al., 2007).

The risks of information sharing across supply chains are ill-defined and have yet to be rigorously investigated as demonstrated by the multitude of sources, types, and mitigating methods identified by various authors (Baker et al., 2007; Jüttner et al., 2003; Whitman, 2004). We believe the perceptions of managers and their interaction with other actors construct the social reality of their organizations; therefore, the perceptions of the risks associated with information sharing warrant investigation. As a result, the goal of this research is to identify how managers understand and evaluate risks or challenges in data exchange across their supply chain and the approaches they take to mitigate these risks.

SUPPLY CHAIN INFORMATION SHARING RISKS

Information sharing can be defined as the extent to which critical and proprietary information is communicated to one's supply chain partners (Kocoglu et al., 2011) or as the willingness to make strategic and tactical data available to other members of the supply chain (as cited in Mentzer et al., 2001). Data integration enables supply chains to provide enhanced value to consumers and potentially distribute the resultant benefits to all supply chain actors (Kwon and Suh, 2005). A well-established need for information sharing throughout a supply chain relates to the bullwhip effect (Levary, 2000). Mason-Jones and Towill (1997) highlight how information is a strategic asset that can be used to enrich the decision making of upstream supply chain actors. Timely demand information enables reduced reliance on forecasting and buffer stocks, thus allowing smooth and seamless supply chain operations. Therefore, it is essential that better informed downstream members of the chain share information effectively and efficiently with the lessinformed upstream members (Chu and Lee, 2006, p. 1568). Despite the many substantial benefits from information sharing, organisations are reluctant because they face a range of challenges and perceived risks relating to the reliability and security of data exchange. Zhang and Li (2006) identify three such challenges/risks as IT security attacks, information leakage, and lack of trust and commitment. Each will now be explored separately.

Many researchers (e.g., Baker et al., 2007; Smith et al., 2007) assert that ICT related risks exist in the data exchange process and have various impacts on business operations with different types of security incidents. These studies indicate a positive relationship between level of collaboration and ICT threats caused by internal security issues, employee abuse, or threats from external sources (Baker et al., 2007). Kolluru and Meredith (2001) consider ICT security solutions as the major element to assure confidentiality and privacy of shared information coupled with authorised and authenticated access to each partner's database. Arguably, data integration with different degrees of collaboration requires different levels of ICT security. Kolluru and Meredith (2001) propose a three-stage model of information sharing and associated security related issues, Table 1. At level 1, the focus is on simple communication and coping with the threats of integrity, spoofing, loss of privacy, or repudiation of transactions. On the other hand, organisations that reach level 2 and 3 with longer term partners and complex interactions face unauthorised access and denial of service risks.

	Level 1 Asynchronous One-Way	Level 2 Asynchronous & Synchronous	Level 3 Synchronous Communication
Relationship	Transaction	Collaboration	Partnership
Technologies	Simple methods: Phone, email, fax	Complicated methods: Advanced planning & scheduling, ERP	Interconnected IS: EDI, Collaborative Planning, Forecasting and Replenishment
Risks	Threats of integrity, spoofing, privacy, lost transactions, lack of trust and commitment, information leakage	Unauthorized access and denial of services, information leakage	More complex in terms of unauthorized access and denial of services in highly interconnected networks, information leakage
Risk mitigating	Identification and authentication, data confidentiality, data integrity	Access control, authorisation, auditing	Trust management, delegation of credentials across multiple tiers and across supply chain interactions

Table 1: Information sharing Levels and Types of Risks (Adapted: Kolluru and Meredith, 2001)

Information leakage is referred as the 'dark side' of data integration across a supply chain (Zhang et al., 2012, p.351). Zhang et al. (2011) define information leakage as inadvertent revelation of confidential information to unauthorised parties. Anand and Goyal (2009) posit that data disclosure means that shared information reaches unintended firms in a deliberate or unintentional way. Information disclosure occurs in two main forms: direct and indirect (Zhang et al., 2012). The former happens when confidential information may be mistakenly shared, whereas indirect disclosure relates to when sensitive business data is inferred from non-confidential and shared information because of "*the inherent engineering relationships*" among different parts of information (p.1355). Stoneburner et al. (2002) identify a number of adverse impacts on an organisation's performance due to information leakage including; loss, damage, and degradation of any three primary security goals: confidentiality, integrity, availability (p.22). Confidentiality relates to when information is accidentally or intentionally disclosed. Data integrity requires information to be prevented from unauthorised modification. This is essential to guarantee the accuracy and fairness of information in the data exchange processes throughout the supply chain. Generally, the objective of availability is to make information accessible at any nodes within the chain. Trust can be defined as "*an expectancy of positive (or negative) outcomes that one can receive based on expected actions of another party in interaction characterised by uncertainty*" (Sahay, 2003, p.556). Trust can be created and maintained based on strong commitment between two parties with confidence in the other's reliability and efforts for enduring relationships (Kwon and Suh, 2005). Kocoglu et al. (2011) emphasise that inter-organisational relationships, particularly trust and commitment among trading partners, are the most important factors for data integration. Previous studies reveal that trust and long-term partnerships positively influence the enhancement of seamless information flows within an organisation and among supply chain actors (e.g., Cheng, 2010; Kolluru and Meredith, 2001; Kwon and Suh, 2005). Even when an organisation has sufficient capability to share information, managers are unwilling to release sensitive information to their partners due to a lack of trust and commitment (Fawcett et al., 2007).

Previous research has focused on the importance and positive aspects of supply chain collaboration and information sharing (e.g., Balsmeier and Voisin, 1996; Daugherty et al., 2005) rather than on the downside. Similarly, there have been few scholarly research attempts to explore how organisations deal with specific risks related to the use of ICT applications in the data exchange process. This research intends to address this shortcoming by investigating how managers perceive the risks of sharing information with their supply chain partners? It is also necessary to identify the types of ICT used to exchange information among supply chain partners and the approaches taken to mitigate any risks.

METHODOLOGY

The research aims to investigate managers' perceptions about specific risks of information sharing across their supply chains. For the exploratory and explanatory objectives, the qualitative research approach is particularly suitable. Furthermore, research areas in supply chain management (SCM) and IT are contextually rich and complex in nature characterised by their early formative stages and rapid changes (Zsidisin, 2003). A case research strategy is ideal to obtain knowledge and experience of practitioners in these fields (Walsham, 1995).

The research consists of 11 case companies operating in various industries in New Zealand. The sample firms were not randomly selected, but using purposive sampling with theoretical replication logic. This study employed multiple data collection methods with qualitative interviews triangulated with secondary sources. The researchers conducted 11 semi-structured interviews with key managers, who were SCM decision makers who had sufficient knowledge about their firms and supply chain related operations. Interview questions were divided into two parts: Business context and information systems; Risks of information sharing and risk mitigating solutions. Along with conducting qualitative interviews, the researchers identified a number of useful secondary sources in order to appreciate the context and supply chain operations of each case company, including; annual reports, mission statements, and financial records from the companies' websites and New Zealand national databases. As a result, brief descriptions of each business and the supply chain structure for each case were developed.

The researchers applied the explanation building technique proposed by Yin (1994) to analyse the qualitative data. This technique helped to develop findings through a series of iterations. This process began with coding, presenting initial propositions, comparing them with direct quotations from the initial case, and further comparisons with notions from different respondents. Lastly, the results were displayed and compared with the current literature to see how the research findings fit or differ from other studies on the similar topics.

RESEARCH FINDINGS

Analysis of the qualitative data placed the case companies mainly at the first two stages of Kolluru and Meredith's (2001) framework: Level 1 *Asynchronous communication* and Level 2 both *asynchronous and synchronous communication*. Most of the SMEs in the sample relied on simple methods such as phone, fax, email, or face-to-face meetings to share information with their partners. Thus, these companies belonged to Level 1 of data integration with asynchronous communication. To provide in-depth understanding, participants were asked to explain their attitude towards the effectiveness of simple methods (phone, fax, email). In the SMEs, managers preferred simple methods as the best tools for their job because they did not have large amounts of data to share. Moreover, the SME managers did not think the benefits of automatic information sharing outweighed the costs of purchasing and operating advanced information systems. Simple methods tended to be cost effective and convenient in keeping in constant touch with trading partners, as highlighted by the following interviewee statement:

"In a lot of situations, I don't think it's better to share information electronically. I couldn't see any more benefits, so we'd rather keep what we are doing. We do not have a lot of information to exchange. If more information is shared, it would be different maybe." (Interviewee F)

Another reason for using simple methods is that these methods were more personal than automatic systems. Therefore, the managers could personalise messages and make sure that the right people can get correct information. As indicated as follows:

"I like the ideas of phone, fax, and email and the main reason I like them because they are more personal... If it is more electronic and automatic types of communication, it may give you good information but it's not personal and for some suppliers, electronic system is not friendly. Because we are small enough, so we choose to use more personally as much as we can." (Interviewee J)

On the other hand, large firms in the sample focused on investing and operating advanced information systems (e.g. MPR, GS1, web-based purchasing program, and video conference) to

exchange electronic data across their networks. However, these complex systems were only used to share information with key and large partners while simple methods like phone, fax, or email were used to deal with smaller trading partners. These firms can be considered at Level 2 of data integration with both asynchronous and synchronous communication. For example:

"For key suppliers, we log into their confidential portal and place our orders in their system. Half of the orders have been done electronically or maybe 60%. But for other suppliers, we do not purchase directly on their websites but emailing to them." (Interviewee C)

From explanations of these respondents, advanced and complex information stored and managed a large number of detailed data systematically. Hence, employees could access and share business data quickly and accurately. It is apparent that there is significant difference in the levels of data integration among the case companies. The large firms considered electronic IT systems as a competitive advantage, whereas SMEs had compelling reasons to continue using simple methods for data exchange across their network.

Based on an analysis of qualitative data, five major threats of information sharing occurring in the sampled firms. The first category is threats of integrity. Most of the managers explained that the main problem in exchanging data was to ensure all information from their partners was true, fair, and timely to make the right decisions at the right time. As stated by Interviewee J:

"Our suppliers, they do not provide us timely information. Some of them, when we sent the orders, they updated their price list last night and we say, "Why you didn't tell us?", so timeliness is a really big problem." (Interviewee J).

This opinion indicates that information value counts on its accuracy, fairness, and timeliness. Another risk implied by many respondents is threats of spoofing. Specifically, these threats were referred as high probability that suppliers might go directly to customers or copy the companies' designs. Consequently, firms could be bypassed in their current supply chains. E.g.:

"There is always a risk that our suppliers can go directly to our customers... So this could be a risk that we may be cut out of the supply chain... We do a lot of work with Chinese suppliers; we obviously have a risk of copy." (Interviewee B)

However, the respondents also insisted that this situation only happened with overseas or low trusted suppliers, not for key trading partners. Therefore, firms had to be careful with decisions on types and amounts of data exchanged with different partners, especially for sensitive information. Furthermore, managers had to consider the critical balance between what information should be shared and what should be kept for competitive advantages. This is also an effective approach to preventing a privacy breach. As indicated as follows:

"Market information is very important and it is your advantage over someone else... If you give too much information away, you ruin your own advantages on the market; ruin somehow your ability to buy effectively. So you have to be careful about how much and what information you share and what time." (Interviewee K)

Therefore, it is shown that decisions on shared information largely depend on levels of relationships with trading partners. The most important challenge emphasised by participants was a lack of trust and commitment among supply chain members. It is clear that this risk could lead to inconsistency of supplies or considerable fluctuations in customer demands. E.g.:

"Trust is absolutely important. If you don't trust your suppliers, you cannot share information openly. As the same, if a supplier doesn't trust me, they cannot believe what I tell them. If you don't have trust, it makes business extremely difficult." (Interviewee K)

Lack of trust and long-term relationships caused negative effects on case companies' operations. While a lack of commitment on the supply side may cause serious interruptions in production, firms faced significant changes in sales revenue due to transactional relationships with clients. Hence, the sample managers had to put great efforts to regularly contact with their partners to understand their purchasing behaviours and constantly keep an eye on the markets and new competitors. Finally, case companies were also coping with national issues in SCM, particularly in information sharing and negotiating. New Zealand has unique characteristics with an isolated location and a small-scale economy. The majority of the companies are SMEs, which have limited exposure to global industry and are slow to change. Therefore, case companies tend to have little power in negotiating and lag behind in IT application for information sharing, they cope with high uncertainty of supply sources with possible production stops. E.g.:

"I think New Zealand is very remote; SMEs have not been exposed to global shipping business because of isolation, they seem to be very slow to change." (Interviewee E)

In terms of security issues, the majority of respondents expressed their confidence in their current security levels no matter how advanced the systems were. Most companies had built up strong internal information systems with high security services. Information was shared at

different degrees among the staff and the systems were not directly connected with external partners. Managers thought that it was good to keeping information confidential, e.g.:

"Everything is protective. That's not anybody, anyone, any person, any company can do anything to attack this company. It is impossible. Nobody can touch it." (Interviewee D)

Normally, the companies simply did not exchange confidential data or only shared minimal information with those they did not trust. They retained important business data inside their companies with internal control and access. From Interviewee E's perspective:

"I don't think we have any security issues.... Only senior managers or IT people have the full access to everything. That's how we control internal security and fortunately our system is not linked to our suppliers, we don't have any reasons for any confidential breaches." (Interviewee E)

With regard to information leakage, the managers of the case companies had various experiences in the past. Some firms had serious problems with data confidentiality when sharing information with their partners. E.g. unintentional and purposive information leakage:

"Somebody gives our information to other firms all the time. Ethnically, it is wrong... A lot of people put away our prices to competitors." (Interviewee I)

"Because it is mostly verbal, for example, xxx is a quite small place so you might work over here and your sister might work for our competitor. And you might say to your sister that "we have a big order coming up". Before you know, your sister might find information about that. This is sorts of things, which are very hard to control." (Interviewee H)

These stories highlighted that information leakage did exist in the data exchange process between case firms and their trading partners. Data disclosure may happen when suppliers or customers deliberately shared the company's information with competitors. On the contrary, sensitive information could be disclosed by mistake due to human errors such as sending files to the wrong people or via informal conversations with 'mates' that work for competitors. Both of these types of data disclosure are difficult to prevent or control. On the other hand, some managers asserted that they had no events of direct or indirect information leakage. Their explanations for this proposition vary, depending on the managers' attitudes. For example:

"Nothing I am aware of at this point of time. Our company and suppliers have confidential agreement and we do have legal contracts as well. According to confidential agreement, if anyone breaks that contract, they would be taken to the court, so I believe that nobody would do that." (Interviewee E)

Accordingly, some of the case companies have signed legal contracts and confidential agreements with partners before sharing sensitive data. The managers therefore strongly believed that there was no information leakage in the data exchange process. However, most of the other sampled firms chose to share information based on trust without any formal agreement. From interview data, there were some evidences about information leakage and security issues occurring in the data exchange process. Nevertheless, it was implied that these issues did not cause any serious consequences on the case companies' operations.

In general, there were different ways to mitigate risks occurring in data exchange processes in the case companies. The most common and important solution was to build up and maintain good relationships with partners by frequent communication and/or via frequent visits. They were trying to work closely together and discuss everything in an honest and open way. E.g.:

"The most important thing is to have good personal relationships with the trading partners, especially personal relationships with people. Good relationship is when they come and visit us frequently many times a year." (Interviewee A)

This comment indicates that managers emphasise the importance of social factors, especially personal relationships and honesty in exchanging data to reduce specific risks of information sharing. Face-to-face communication was perceived to be more critical to solve supply chain issues than just relying on electronic systems. Interviewee C provided an insightful explanation:

"When we have challenges, we just talk to partners; we just sit down and be honest. We tell them our problems and they tell us their problems... We argue the points honestly, tell them what we want. Be consistent and always honest. Honesty is very important." (Interviewee C)

In addition, other solutions were employed to deal with the risks of spoofing and information leakage. For some firms who produced technical products managers thought it was better for them to use a number of suppliers in tandem or avoid using the same supplier as their competitors. This could be a good solution to protect sensitive business data from unintentional and purposive disclosure. Moreover, formal confidential agreements are considered as one way to reduce risks of information leakage. Otherwise, some companies simply do not share information with the partners who are not trusted. As affirmed by Interviewee J:

"Other suppliers who are not open with us, we answer them in general terms with questions related to our sales, but don't tell them who our customers are. We are in position that we can choose whether or not to tell suppliers about our customers." (Interviewee J)

Another method proposed by SMEs in the sample was to update their current information systems for effective data exchange. They had plans to use more ICT applications and train staff to standardise data transmission. However there seemed to be a limitation to what one company could do, as highlighted by Interviewee E:

“To be honest, there is nothing else that we could do. These concerns are not only us facing, it is question...it is a challenge that all New Zealand companies are coping. It is concern of the country.”
(Interviewee E)

DISCUSSION

The most popular solution for risk mitigation in information sharing was to build up collaborative relationships with the trading partners based on trust and honesty. Figure one summarizes the findings; seven perceived risks and seven inter-related mitigating strategies were identified. The loss of privacy seemed to underpin the risks of information sharing whilst the role of trust was repeatedly endorsed by the interviewees as a mitigating strategy.

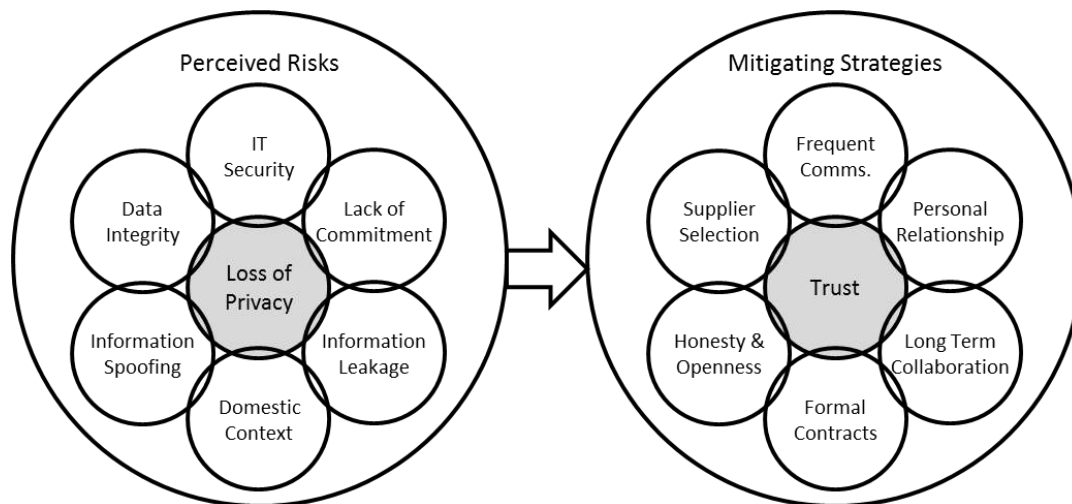


Figure 1: Theoretical Framework Based on Research Findings

This research further extends previous literature by providing insights into managers' perceptions towards the risks of information sharing along supply chains. Managers clearly recognise and understand various hazards in data integration with their partners. Furthermore, the study shows evidence of the existence of seven types of risks in the data exchange process, Figure 1. These hazards existed regardless of the type of information systems. The firms investigated had to deal with the challenges from New Zealand's unique business context, a small-scale, geographically isolated economy. To be more specific, New Zealand companies tend to have little power in negotiation and cope with high uncertainty of supply and associated potential production interruptions. This finding is in line with the conclusions by Basnet et al. (2006) in the context of New Zealand's manufacturing industry. The findings also indicate that a majority of the case firms were still at Level 1 (asynchronous communication) and Level 2 (asynchronous and synchronous interaction) based on the framework of Kolluru and Meredith (2001). There is incompatibility of information systems between the large and small case companies in the supply chain with various levels of data integration. Given these facts, it is nearly impossible for these New Zealand firms to get all trading partners using an integrated IT system.

Previous research indicates that the effectiveness of risk mitigation actions depends on managers' perceptions and levels of preparation (e.g., Jüttner et al., 2003; Khan and Burnes, 2007). The research findings affirm the above studies by highlighting the critical role of key personnel in applying appropriate methods to reduce the negative the effects of specific risks in data exchange processes. According to the interviewed managers, they were trying to work closely with the partners and discuss everything in an honest and open way. This is an effective way to recognise risks and solve problems quickly and effectively. In this situation, frequent communication is more important than electronic systems in creating successful information sharing. This result counters the argument of Kocoglu et al. (2011), who emphasises ICT related solutions as a major element to ensure confidentiality and privacy of shared information.

The study shows that trust is not only the prerequisite of data integration but also a significant facilitator for open and honest information sharing. This result supports the conclusions of previous published studies (e.g., Kolluru and Meredith, 2001; Kwon and Suh, 2004). Additionally, the study has further extended the current literature in explaining how to develop trust with trading partners. Specifically, trust can only be built via personal relationships over the long term by working together honestly and truthfully rather than simply signing confidential agreements or legal contracts. Through social interactions, firms understood both the strengths and weaknesses of their partners, so that they can find synergies. In this case, information should be shared freely across the chain based on mutual trust. This in turn enables companies to build a competitive advantage via effective data interchange towards win-win situation.

CONCLUSION

The majority of New Zealand firms use asynchronous communication with limited synchronous interactions with their supply chain partners, this places them at a relatively immature level of ICT usage. Based on rich case data several perceived risks of information sharing were identified; threats of integrity, threats of spoofing, risks of losing privacy, and lack of trust and commitment. The subsequent analysis showed that the New Zealand managers interviewed had a clear understanding of their specific risks of data integration. The research highlights the important role of personal communication and trust for effective information sharing. Therefore, creating and maintaining trust and long-term relationships with trading partners were considered as the most important solution to dealing with the risks of data exchange.

The research findings would help entrepreneurs understand and evaluate different kinds of threats in information sharing. From analysing these risks, they could make appropriate decisions relating to data transmission as well as develop suitable solutions to mitigate any risks. Based on a review of the current literature, only a small and limited amount of work has focused on perceptions of managers towards risks or challenges to information sharing. This study has attempted to fill this gap and provide a first look at the social aspects of inter-organisational information sharing. This research shows that SMEs are reluctant to invest in IT applications for information sharing because the managers do not consider the benefits of electronic systems outweighing the costs for their business scenario. This creates incompatibility of information systems between SMEs and larger companies in a network. This hinders the development of integrated information systems, thus leading to ineffective information sharing and unavailability of live data throughout the supply chain. Arguably, large companies should play a leading role in data integration by building up a common platform or centralised database for all supply chain members (Johnson, 2008). This will facilitate real-time data transmission and joint decision making.

The findings of this research are based on a small sample size with only eleven New Zealand cases. Therefore, the conclusions cannot be said to be generic or necessarily transferable. In addition, the study was conducted in one region of New Zealand contained a limited range of products and ICT application for SCM. Consequently, the findings could not be generalised for all New Zealand companies or to other countries. The initial objective of the research was to conduct in-depth interviews with one or two key personnel in each case company. However, each firm could not offer more than one interviewee due to time constraints. As a result, the research had limited information about risks in data interchange processes from different departments, thus opinions were only from a single perspective rather than from multiple viewpoints. In order to verify the exploratory insights of this research we recommend the application of a large scale survey to verify our findings. The objective of a subsequent survey would be to discover the impacts of risks/challenges of information sharing on business outcomes and supply chain performance. Researchers could also further investigate the correlation among firm size, industry type, levels of partnership, and degree of data integration. Lastly, future research could concentrate on examining information sharing across the supply chain in one particular industrial sector in order to provide in-depth causal understandings within a specific sector.

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A CASE STUDY ON DE-RISKING PLANS FOR STRONGER SUPPLY CHAIN RESILIENCE

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ABSTRACT

Recent risk incidents, such as 911 attacks, financial crisis, catastrophic disasters like earthquakes and floods, etc. have added challenges and susceptibility for business operations. In encountering more frequent and unpredictable risks than before, many companies adopt risk management systems and redesign their supply chain (SC) structures for stronger SC resilience as well as quicker recovery speed. In this paper, we present a case study of a large semiconductor packaging and testing company in Taiwan, AKH, in confronting risk incidents and the plans they implemented to strengthen the SC resilience to assure more reliable supply of their products and services to the customers worldwide. AKH executed several de-risking plans, which can be divided into four Rs - resourcefulness, redundancy, robustness and rapidity. Many of the de-risking plans rely on the E-Hub system the company implemented a few years ago for SC information visibility. After carrying out the de-risking plans, AKH found that the suppliers and customers as well as the company have to furnish additional kinds of information to the E-Hub system in order to improve the SC resilience and assess the impacts of risk incidents. The results show improved SC resilience for the case company in encountering risk incidents and much faster recovery speed once an incident occurs.

KEYWORDS

Supply chain resilience; risk recovery; de-risking plans; information sharing

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INTRODUCTION

Recent risk incidents, such as rising energy costs and material prices, financial crisis, volatile exchange rates, etc. have added challenges and susceptibility for business operations. Plausible disasters, such as 911 terrorist attacks and hurricane Katrina in 2005 have created unstable demand, while earthquakes in California, Taiwan, Japan, China and heavy flood in Thailand, etc., have created disruption of component supply to many industries around the world (Klibi and Martel, 2012). The risks for SCs have come to a stage that companies have to build a risk management system to evaluate, manage and respond carefully and thoroughly to mitigate risk occurrence probability and the resultant consequences. Besides, the market demand is highly competitive and on-time delivery of products is essential and the ability to recover quickly from a risk incident is imperative and requires special attention.

In facing more and more complex and vulnerable SC structures, ensuring continuous supply of parts/materials is a challenging job because some of the critical parts are sourced internationally with limited choices. Self-own facilities like production sites and warehouses are also subject to risk incidents like floods, accidents, labor/power shortage, man-made disasters, etc. As the products have been fabricated, transportation and logistics facilities for shipping the products to customers might also face incidents like sea/air ports strikes, terrorism threats, natural/man-made disasters, etc. To ensure customer orders can be delivered as they are, AKH executed several de-risking plans, which can be divided into four Rs - resourcefulness, redundancy, robustness and rapidity. Many of the de-risking plans rely on the E-Hub system the company implemented a few years ago because of information visibility provided by the system.

Resilience is the ability of a SC to withstand and recover from the risk incurred by a security, hazard or disaster incident. From a SC perspective, it is significant to evaluate how well can the SC respond to risks and how fast can damaged facilities or supplies be recovered. A resilient SC is proactive in anticipating and establishing steps to prevent and respond to incidents that result in risks for businesses. It can also quickly rebuild or reestablish alternative means of operations when experiencing risks (Sawik, 2013). In facing more frequent unpredictable risks than before, many companies adopt risk management systems and redesign their SC structures for stronger SC resilience to reduce their impacts on business operations. For example, Cisco initiated their SC risk management program in 2006 to ensure readiness and resilience based on incident management and business continuity planning after

learning from 911 attacks and experiencing earthquakes in Taiwan and Japan, where many of their production sites were located (Miklovic and Whitty, 2010). To make sure their business can continue when an incident occurs, they set up a crisis management system to monitor global events that could disrupt their SC.

Being an important part of the global SC, many companies in Taiwan also initiated risk management programs like that of Cisco. AKH is a large IC packaging and testing company, having sale revenue around US\$ 6.5 billion. They set up their Enterprise Risk Management (ERM) program two years after they had launched an E-Hub and logistics hub (L-Hub) program in 2008 (Lu, et al., 2013). Information visibility helps the company monitor the supply status from suppliers and inventory along the SC.

Bruneau et al. (2003) proposed a framework to evaluate the resilience of a physical or social system resulted from disasters, and it consists of the following 4Rs: (1) **Redundancy**: system properties that allow for alternative options, choices, and substitutions under stress;(2) **Resourcefulness**: the capacity to mobilize needed resources and services in emergencies; (3) **Robustness**: the inherent strength or resistance in a system to withstand external demands without degradation or loss of functionality;(4) **Rapidity**: how fast a system overcomes disruption and restores safety, services, and financial stability. Resourcefulness and redundancy are considered to be the “means” by which disaster resilience can be improved, while robustness is about the inherent capability to withstand a disaster and rapidity measures how fast the system can recover. The 4Rs provide a good structure to evaluate how AKH implements plans to lower down the risks.

FIELD STUDY AND INTERVIEWS

To study the plans AKH executed, we implemented on-site field study supplemented by secondary data about the company. After implementing the E-Hub and L-Hub, AKH obtained the inventory and capacity visibility of the suppliers, which made the company capable of managing and evaluating their supply risks from the information provided by suppliers. The authors made several field trips to the case company and conducted a few in-depth interviews with the managers and personnel involved in the ERM program so as to understand how the company utilized E-Hub, L-Hub to reduce procurement risks and the resultant supply risks to customers. Additionally, secondary data were employed to get a better understanding of the influences the significant incidents like the 2008 global economic crisis, 2011 Fukushima disaster, etc. have on their global supply discontinuity. By utilizing the Bruneau’s four factors of resilience, the 4Rs, we describe how AKH mitigated their supply risks.

THE PLANS FOR CONTROLLING AND MITIGATING RISKS

De-risking plans include the works prepared before the risk incident occurs and those performed at the moment the incident happens. The works beforehand can be classified into Bruneau's four factors of resilience, while those at the instant are performed at the Risk Management War Room.

Plans for resilience

AKH implemented Enterprise Risk Management (ERM) system and defined risks as any incident that could trigger supply stoppage and demand shortage. We classify them into the 4R for resilience as follows.

- A. *Plans for Robustness*: To make sure the company is robust enough to absorb and withstand disturbances and crises, AKH implemented the following: (1) link and retrieve the supply amount of all 1st tier of suppliers and some critical 2nd tier of suppliers as well as the demand from customers into the E-Hub; (2) perform what-if analysis in the ERM to evaluate days of supply if a potential risk incident occurs; (3) perform what-if analysis in the ERM to see how many product families are affected under certain risk incidents.
- B. *Plans for Rapidity*: Rapidity concerns the time required to respond to a crisis incident and is performed as follows: (1) calculate and simulate the lead time required for the supply of materials/parts when different kinds of risk incident occur; (2) calibrate supply requirements of critical parts/materials such as lead time, inventory stocking level, etc. with the actual delivery data from E-Hub to adjust the supply lead times to meet the request of AKH.
- C. *Plans for Redundancy*: Redundancy involves having excessive capacity prepared and additional inventory back-up at the sites of suppliers, which enables the core business functionality in the event of incident disturbances. The redundancy is to assure that the company will be less likely to experience a collapse in the wake of stresses or failures of some of its inventory or resource management. Thus, the company incorporates critical suppliers via E-Hub by implementing diverse forecast overlapping methods, inventory policies, and second resource of suppliers to fulfill the requirement of customers.
- D. *Plans for Resourcefulness*: Resourcefulness is the ability of materials and capacity to adapt to crises and to respond flexibly and, when possible, transform a negative impact into a positive one. The company is adaptive means that by sharing information via the E-Hub, the flexibility of suppliers is enabled to

influence system resilience. AKH builds a trust relationship with their external suppliers, customers and internal employees and organizes them together via the E-Hub. Thus they are more likely to spontaneously react and discover solutions to resolve the unanticipated challenges in the face of risk incidents.

Plans at the war-room

As an incident that triggers risks occurs, a war-room will be initiated to (1) evaluate the impact, (2) control the risk, (3) recover from the impact, and (4) reinforce the weakness spots in the whole SC, Figure 1. During the first 24 hours, the impact of the event is observed and a survey is sent out automatically via E-Hub to 1st tier of suppliers and some critical 2nd tier of suppliers. The next 24 hours are to control and recover from the risk incidents as follows:

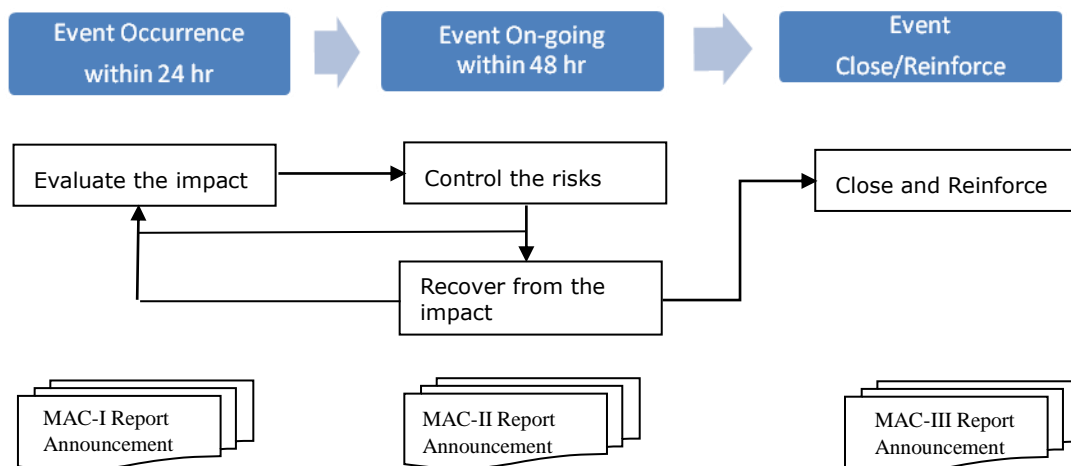


Figure 1 Golden 48 hours after a risk incident occurs

- (1) Evaluate the impact: Within the first 8 hours, responses from external suppliers and internal company sites/departments are obtained and an initial impact evaluation report, which is mainly the MAC-I report (material availability chart), is performed. With MAC-I report, AKH can have an initial impact report to make announcement to their customers as well as to the society if necessary.
- (2) Control the risks: During the second 24 hours, with further information from the external and the internal, AKH evaluates the impact level of their supply chain disruption and the risk level is then controlled within it.
- (3) Recover from the impact: After conducting cross functional and cross locational meetings, AKH can acquire a robustness and rapidity diagnoses and propose some possible recovery methods. A resilience index is computed within the second 24 hours and the MAC-II report is obtained with a more detailed

announcement to the customers and the society if necessary. The war-room keeps running and updating for prolonged and more serious events.

- (4) Reinforce the weakness: After the event is concluded, the weakness spots within the supply chains are identified for review and improvement for the robustness of the company. An audit team is formed to examine the improvement acts and the associated reports are organized into the KM system of the company.

CONCLUSIONS

After carrying out the de-risking plans, the case company found that the suppliers and customers as well as the company have to furnish additional kinds of information to the E-Hub system to improve the 4R of resilience such that AKH can evaluate more accurately the supply chain resilience for assessing the impact of risk incidents. The war-room operations are also improved mainly in facilitating the communication between AKH and suppliers. Besides, the improvement of the weakness spots as well as the KM obtained further direct the company into risk mitigation cycle. The results show improved SC resilience for the case company in encountering risk incidents and much faster recovery speed once an incident occurs.

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AN INVESTIGATION OF CORPORATE SOCIAL RESPONSIBILITY DEFINITIONS FROM ACADEMIC AND PRACTITIONER PERSPECTIVES: ARE THEY DIFFERENT?

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ABSTRACT

Aim/Purpose: The objective of this study is to evaluate corporate social responsibility (CSR) definitions defined by both academics and practitioners (organisations) published over the last six decades and compare these definitions against common categories and dimensions to identify the differences and suggest a comprehensive definition.

Design/Methodology/Approach: This study employs the systematic literature review approach to identify CSR definitions published between 1953 and 2013. These definitions are then organised chronologically into academic and practitioner (organisational) definitions over time to investigate the changes which may have occurred in terms of dimensions and categories of CSR definition.

Findings: A total of fifty six definitions of CSR published over a period of six decades between 1953 and 2013 are identified. Among these definitions twelve definitions are suggested by practitioners (organisations) and the remaining forty four are defined by academics. From the content analysis of all these definitions, we identified twelve dimensions of CSR definition which are then grouped into five broad categories such as aspect, outcome, beneficiary, approach and time frame. The most commonly referred categories are aspect, beneficiary and outcome, whereas, the most commonly referred dimensions are social and external stakeholder. Practitioner definitions published between 2005 and 2010 are found to be the most comprehensive definitions.

Originality/Value: This study advances on the discussion of CSR evolution by comparing definitions from practitioners (organisations) and academics with respect to dimensions and also by grouping these dimensions into broad categories.

Research Limitations: Since the focus of this study is on CSR, hence, all the other related CSR concepts and themes such as corporate citizenship, corporate responsiveness, and corporate governance are not considered as a part of this study.

Research Implications: This study can be considered as a starting point to develop coherent and congruent knowledge on CSR definitions which could assist in the identification and resolution of issues related to CSR definition.

Keywords: Corporate social responsibility, social responsibility, corporate responsibility, definition, categories, dimensions.

INTRODUCTION

In 2010, eighteen Foxconn employees attempted suicide with fourteen deaths. Chinese universities described Foxconn factories as a labour camp with widespread abuse of work rights and illegal overtime. This factory is a major manufacturer and supplier to global brands companies including Apple, Dell, HP, Motorola, Nintendo, Nokia and Sony (Deann, 2010). On September 11, 2012, more than 300 workers died in a fire incident in Ali garment factory in Karachi, Pakistan (Lund-Thomsen & Lindgreen, 2013). Blocked windows and doors preventing workers from escaping fire, is the major reason for such high death toll. In April 2013, more than 1100 workers died due to the collapse of Rana plaza in Bangladesh (Lund-Thomsen & Lindgreen, 2013). The factories in the Rana plaza manufactured garments for big brands including Benetton, Mango, Walmart, Fresh, and several others. These are not isolated incidents rather happening in a systematic manner. These incidents led to an increasing recognition that organisations must address corporate social responsibility (CSR) not only in their operations but also within their supply chains.

CSR had been a contested topic in academics over the last six decades (Okoye, 2009). Increasing recognition of CSR can be seen with the publication of special issues in academic journals ('Global responsibilities', *Corporate Governance Journal*, 2003; 'Sense Making and CSR', *Journal of Business Ethics*, 2006; 'Corporate social responsibility in sport', *Journal of Sport Management*, 2009). The launching of a number of dedicated journals on CSR in the recent past such as *Corporate Social Responsibility and Environmental Management* in 2002, *Social Responsibility Journal* in 2005 and *Journal of Global Responsibility* in 2010 also highlights the significance given to this topic.

In spite of such significance assigned to CSR, neither the academia nor the corporate world could agree to a consensus definition of CSR. In 1973, Votaw and Sethi pointed out that 'CSR means something, but not always the same thing to everybody' (cited in Okoye, 2009, p.613). Forty years later, it's still remains the case. It seems everyone has something to say about it within the paradigmatic confines of their own field of interest. As definitions of CSR are based on the contexts that are biased towards specific interest (Van Marrewijk, 2003), often they are distorted to such an extent that the concept becomes meaningless and unrecognizable (Orlitzky, 2005). Dahlsrud (2008) suggested that the confusion is about how CSR is defined in a specific context, not the definition itself. Continuous introduction of new CSR constructs hinder the consolidation of CSR knowledge (Rahman, 2011) and creates identity crisis (Harwood, Humby and Harwood, 2011). Due to the lack of widely accepted CSR definition there is a cynicism towards the concept. This raises a debate whether it is necessary to have a definition of CSR at all (Wan-Jan, 2006). Lack of common language creates inconsistency in the interpretation of companies dialogue (Hopkins, 2003). There is not only a great deal of murkiness in terminology and definitions of the concept, but also there is no clarity on what can be regarded as socially irresponsible behaviour (Shinde et.al, 2011). Against this background, the aim of this study is to advance the debate over the evolution of CSR definitions by comparing these definitions suggested from both academic and practitioner perspectives. Remainder of this paper is organised as follows. First, we review literature on CSR studies and CSR definitions. We then present the methodology used for the analysis and analyse CSR definitions. Next, we present the results and discussion on our findings. Lastly, we present our conclusions and limitations of this study.

RESEARCH ON CSR DEFINITION: OVERVIEW

In recent years a number of literature review articles on CSR definition have been published (De Bakker, Groenewegen & Hond, 2005; Taneja, Taneja & Gupta, 2011; Montiel, 2008; Ahi & Searcy, 2013). These studies concluded that the lack of a common definition and difficulties in finding a relevant definition is the most common problem. Researchers have attempted to review CSR definitions to address the challenges associated with the definition and to bring clarity (Rahman, 2011). Broadly these reviews can be classified into two categories. One deals with the historical perspective of the development of CSR definition. One of the most commonly cited review paper in this category is by Carroll (1999) who investigated the progress of CSR definition since 1950. Later this work was extended by Thomas and Nowak (2006) and Arevalo (2009). More recently Moura-Leite and Padgett (2011) conducted a review and suggested that the definition of CSR have been modified a great deal over the past six decades and certainly more definitions will be suggested to address the future changes in the business environment. Reviews of definitions to identify, categorise and synthesise them based on different attributes fall into the second category. Our objective is to develop a comprehensive list of CSR definitions suggested by both academics and practitioners since 1953 and compare and analyse these definitions against common categories and dimensions to investigate the progress.

CSR definition first appeared in 1953 as 'the obligation of business man to pursue those policies, to make those decisions, or to follow those lines of actions which are desirable in terms of the objectives and values of our society' (Carroll, 1979). Since then, CSR has been considered as an organisations obligation to society. Overtime, CSR definitions began to proliferate within different organisational and political contexts (Carroll &

Shabana, 2010). In socially constructed discourse, CSR definition has several dimensions which draw attention of corporations and society. One major writer to contribute to the field of CSR definitional construct with respect to dimensions is Carroll. In a seminal article, 'A Three-Dimensional Conceptual Model of Corporate Performance', Carroll (1979) discussed economic, legal, ethical and discretionary categories of CSR and developed a pyramid of CSR based on these categories. For the next two decades no researchers have major concern regarding this framework which have been widely used in theory building and empirically testing various CSR issues (Carroll, 1997). Later in 2003 Schwartz along with Carroll identified that discretionary cannot be a separate category in CSR, rather it should be embedded into three categories and had a three domain approach for CSR in terms of Venn diagram.

Several other studies focused on the dimensions of CSR definitions. For instance, Dahlsrud (2008) reviewed 37 definitions and identified six dimensions of CSR definition such as economic, social, environmental, voluntary and stakeholder dimensions. However, Dahlsrud's (2008) study underestimates the true number, because many academically derived definitional constructs were not included owing to the methodology employed (Carroll & Shabana, 2010, p.89). Rahman (2011) identified ten dimensions, which are broader in context. Similar study was conducted by Shinde et.al. (2011) and identified six dimensions of CSR definition based on a limited number of definitions prescribed since 2009. There is nothing inherently incorrect about analysing a limited number of definitions, however such analysis could be incomplete as there is a chance of omitting key definitions from the analysis. More recently Ahi and Searcy (2013) identified seven dimensions after reviewing several definitions of CSR. They argued that in businesses corporate sustainability and responsibility are same and took both definitions into consideration. Resilience is a dimension that is more specific to their research which can be attributed to sustainability aspect.

The key initial dimension 'responsibility' or obligation is another aspect of CSR definition (Meehan, Meehan and Richards, 2006), which is not regarded as a dimension by many researchers. This dimension is an important one as it is always contesting in literature that CSR is an obligation or voluntariness or responsibility (Mior, 2001). The core of CSR debate has shifted from a mere compliance towards value creation for the organisation (Jamali & Mirshak, 2007). Interestingly, no prior study has focused on the aspect of value creation or outcomes in CSR definition. Van Dijken (2011) argued that the primary goals of businesses are profits, public good and good will, and proposed the a CSR2 model based on these objectives. Irrespective of whether CSR is defined by academics or by practitioners, all the above mentioned dimensions can be used to analyse CSR definition.

RESEARCH METHODOLOGY

Systematic literature review adopts a scientific, imitable, and transparent process that provides the course of reviewers' decisions, procedures and conclusions (Cook et al., 1997). Literature review identifies the knowledge gaps and also the opportunities to address those gaps (Tranfield et al., 2003). In this study we employed the systematic literature review approach suggested by Tranfield (2003) to develop and expand the body of knowledge on CSR definition.

As previously mentioned, the purpose of this paper is to identify and analyse the definitions of CSR from academic and practitioner perspectives. To achieve this objective, literature review focused on keyword search on ABI/INFORMS Proquest, EBSCO Host, springer, Emerald text and Scopus databases is performed. More than one database is used to provide an extensive review on CSR. Selection of these databases is based on its wide coverage on CSR topics in business contexts. Corporate Responsibility (CR), Social Responsibility (SR) and CSR are used along with the Defin* by having AND operator. An asterisk (*) wildcard or truncation character 'id' is used at the end to expand the range of possible studies that cover all the terms starting with 'defin' which are definition, defining and define. Date range is not specified to cover all relevant literature published so far.

In our study, Taneja, Taneja & Gupta's (2011) strategy of identification of relevant literature is followed. Duplicate articles, newspaper articles and editorial reviews that are less than 4 pages along with book chapters are excluded from the study. Whereas peer reviewed conference papers are included as there are significant numbers of papers concerning CSR definitions published at various conferences. Then the enlisted papers are further scrutinized based on the review of abstracts. The major criterion used to review the abstracts is whether or not a paper attempted to define CSR in a particular context or used the CSR definition from previous studies. As of June 2013, a total of 217 articles were identified.

Definitions of CSR from literature are identified based on the aspect of uniqueness. This study uses the approach of Stock and Boyer (2009) to identify the unique definitions. If a definition is dealing with at least one new aspect, or using the same aspect in different context it is regarded as unique and is included in the analysis (Stock & Boyer, 2009). In the evolution of CSR literature, researchers in the past decade used the existing CSR definitions or in some cases developed a CSR definition based on more than one definition that best suits to their context (Carroll, 1999). In this circumstance, the earlier definition is regarded as unique and is considered for analysis.

ANALYSIS

A list of 56 unique definitions is identified for word-to-word content analysis. Distribution of definitions across different time periods is shown in Figure 1. These definitions are further classified based on academic and practitioner perspectives to identify the differences. There are 12 definitions from the practitioner perspective and rest 44 from the academic perspective. Among practitioner definitions most of them appeared after the year 2000. However definitions from academic perspective are spread across 6 decades and appeared in various forms of literature which can be seen in Figure 2.

This study uses five categories to cluster the CSR definitions based on the classification scheme suggested by Galbreath (2006). These are: (1) aspect, (2) beneficiary, (3) approach, (4) outcome, and (5) time frame. The categorisation is performed by asking the following questions:

1. What are the aspects does CSR concentrate?
2. Who are the beneficiaries of CSR activities?
3. What approach is appropriate for CSR implementation?
4. What are the outcomes or goals of CSR implementation?
5. What is the time perspective of the definition?

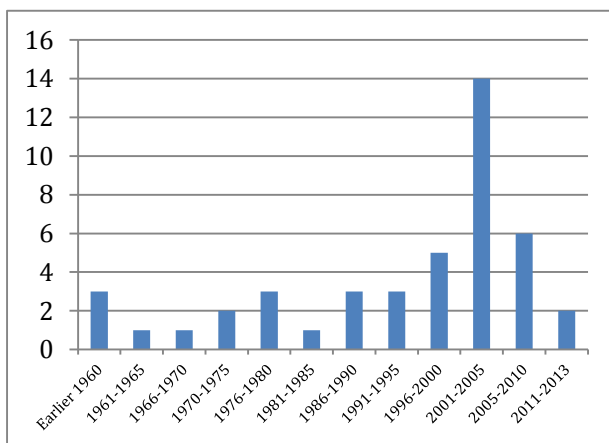


Figure 1 Distribution of definitions over time



Figure 2 Distribution of academic CSR definitions

Further these five categories are divided into twelve dimensions. Table 1 shows the coding scheme, the categories of dimensions and the sample phrases that refer to each dimension. The detailed analysis of the definitions and descriptions against the dimensions and categories are performed to analyse the trends in both academic and practitioner definition categories.

Category	Explanation	Dimension	Example phrases
Aspect	The way in which CSR is implemented	<ul style="list-style-type: none"> Social Environmental Economic 	<ul style="list-style-type: none"> Integrating social demands Environmental concerns in business operations Integrate social and environmental concerns Economic requirements
Beneficiary	A person or group that receives benefits, profits or advantages of CSR implementation	<ul style="list-style-type: none"> External Stakeholders Internal Stakeholders 	<ul style="list-style-type: none"> Impact on stakeholders Generate value to the stakeholders Contribute to a better society Improve wellbeing of employees
Approach	Organisations view or approach towards implementing CSR	<ul style="list-style-type: none"> Voluntary Responsibility Obligation 	<ul style="list-style-type: none"> On voluntary basis Responsible manner Beyond legal obligation Obligation of the firm
Outcome	The goals or the outcomes that is expected by the implementation of CSR	<ul style="list-style-type: none"> Sustainability Profits Goodwill 	<ul style="list-style-type: none"> Contribute to sustainable businesses Fulfilment of corporate goals Financial performance Environmental stewardship Social betterment
Time frame	The time frame of achieving the potential benefits of CSR	<ul style="list-style-type: none"> Time focus 	<ul style="list-style-type: none"> Longevity Future

Table 1 Categories and dimensions of CSR definitions

RESULTS & DISCUSSION

The CSR definitions over time show a great deal of variability in terms of dimensions and categories (see Figure 3). As the field of CSR evolved, more and more practitioners studied the appropriateness of the definitions which resulted in a broader and encompassing view of the field with more dimensions and categories (Figure 3). However, definitions from the academic perspective covered on average 3-4 dimensions per definition except for the period between 1981 and 1985. During this period only one definition appeared and considered in this analysis. So the number of dimensions during this period is the reflection of only one definition. In line with the results of the previous

studies, results of this study in terms of average number of dimensions covered in academic definitions remained same. Overall, during 2005-2010, a maximum of 7 dimensions are covered by definitions prescribed from the academic perspective. Definitions from UK government, World Bank and ISO 26000 are more comprehensive with 10, 9 and 7 dimensions respectively.

An analysis of the dimensions and categories of definitions indicates that the categories such as aspects, beneficiary and approach are explicitly addressed in more than half the definitions (Table 2).

Dimensions such as social and obligation contribute to aspects and approach categories respectively. However, internal and external stakeholders contribute similar proportion

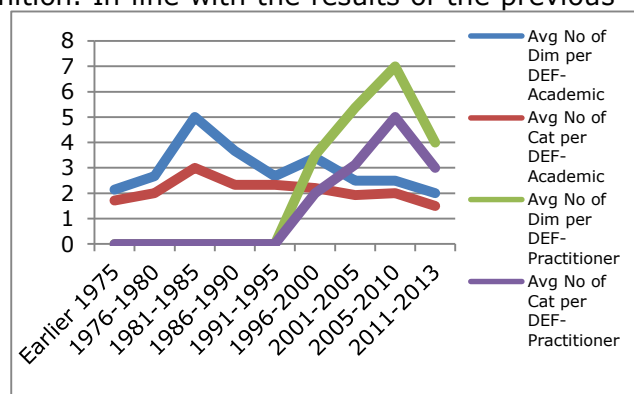


Figure 3 Distribution of number of categories and dimensions covered by CSR definition

(41.1% and 50% respectively) to the beneficiaries. Time frame is mentioned in only 8 definitions.

Category	No of definition	% of definitions with category	Dimension	% of definitions with dimension
Aspect	36	64.3%	Social	55.4%
			Economic	28.6%
			Environment	26.8%
Beneficiary	32	57.1%	Internal Stakeholder	41.1%
			External Stakeholder	50.0%
Approach	33	58.9%	Voluntary	14.3%
			Obligation	28.6%
			Responsibility	19.6%
Outcome	16	28.6%	Sustainability	12.5%
			Profit	14.3%
			Goodwill	14.3%
Time frame	8	14.3%	Time period	14.3%

Table 2 CSR definitions containing categories and dimensions

Further analysis of categories and dimensions suggested that compared to academic, practitioner definitions address more number of categories and dimensions (Figure 4 & Figure 5). Approximately 90% of practitioner definitions cover aspects category of CSR definition, a major contributor being the social dimension. The increasing representation of aspects category (social, environmental and economic) can be attributed to the increasing recognition that organisations must address the issue of sustainability (Van Marrewijk, 2003). As CSR is always considered as socially desirable activity (Rahman, 2011), it is most often referred dimension in both academic and practitioner definitions (54% and 84% respectively). It is clear that economic dimension is mostly found in practitioner definitions as their major concern of implementing CSR activities is investing monetary funds.

The term 'stakeholder' is another key term which has been discussed all along the CSR literature except few definitions published in the period earlier to 1980. Managing multiple stakeholder needs is regarded as the potential benefit of CSR (Galbreath, 2006). The beneficiary category is the second most important category discussed in practitioner as well as academic definitions. The internal stakeholders such as employees were emphasised more compared to the external stakeholders in the practitioners' definition,

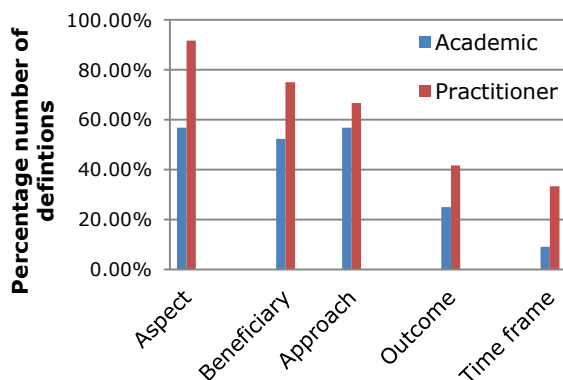


Figure 4 Percentage of the definitions addressing key CSR categories

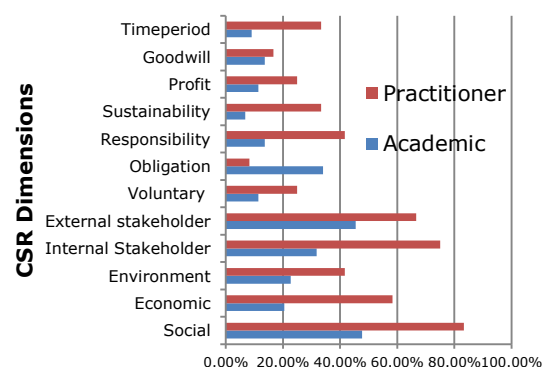


Figure 5 Percentage of the definitions addressing key CSR dimensions

whereas academics emphasised more on the external stakeholders than the internal stakeholders.

Compliance-driven CSR, caring CSR and profit-driven CSR are the three major classifications of CSR based on the 'approach' category (Van Marrewijk, 2003). In comparison to academics, practitioners' focus on approach is higher. In earliest literature, CSR is perceived as complying with law or obligation (Moura-Liete & Padgett, 2011). Obligation is the only dimension which is mostly referred in academic (34%) compared to the practitioner definitions (8.5%) (Figure 5), and this contributes to the weight given to approach in academics. Practitioners believe CSR is more than obligation, it is the responsibility or commitment. This is probably the reason why a large number of practitioners' definitions address this aspect of CSR.

Since its first introduction by Brundtland commission (WCED) in 1987, businesses gradually started operationalizing sustainability concept into their business model. Similarly it gained attention in CSR definitions since late 1990s (Van Marrewijk, 2003). There is a huge difference in the representation of sustainability dimension among academic and practitioner definitions (7% and 33% respectively), as organisations are under continues pressure to improve their sustainable business performance. Though time frame is an important element of CSR, however this appeared sparingly in the literature (Galbreath, 2006; Ahi and Searcy, 2013). A similar pattern shows in our study as well. Since the importance of sustainability increased, the relevant discussion of time frame in definitions also increased as sustainability generally refers to something which take a long term view.

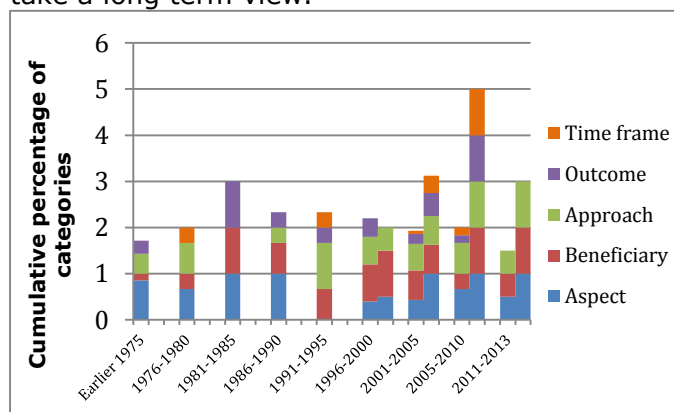


Figure 6 Distribution of proportion of definitions against categories

On the other hand, only 50% of academic definitions addressed aspect, approach and beneficiary during the period 2011-2013. Overall, most of the academic and practitioner definitions have addressed three categories irrespective of the time period. The categories such as aspect, benefits and beneficiary are recognised very often in both academic and practitioner definitions.

The definitions analysed in this study show that CSR is nothing new at the conceptual level both from the academic and practitioner perspective, as all the categories have been considered at some stage. But the changes can be seen through well-established patterns of comprehensive practitioner definitions developed over the years. The number of categories addresses by the academic and practitioner definitions are exhibited in Table 3. ISO, World Bank, GRI and some other practitioner definitions are more

No of categories	% academic definitions	% Practitioner definitions
0	6.82%	0.00%
1	15.91%	0.00%
2	52.27%	50.00%
3	20.45%	16.67%
4	4.55%	8.33%
5	0.00%	25.00%

Table 3 Categories contained in definitions analysed

Further comparative analysis of academic and practitioner definitions against the categories, shows that in any given time period the proportion of the number of definitions that addresses the categories varies widely (Figure 6). From the graph it is clearly evident that practitioner definitions appeared only after 1996. During 2005-2010, all the practitioner definitions addressed all the categories. Even during the period 2001-2005, practitioner definitions are comprehensive compared to the academic definitions.

During 2005-2010, all the practitioner definitions addressed all the categories. Even during the period 2001-2005, practitioner definitions are comprehensive compared to the academic definitions.

elaborate as they attempt to develop standards or guidelines which can be used by any organisation irrespective of the context. In contrast, academics are still defining CSR within their context of research. From Table 3 all practitioner definitions have more than 2 categories whereas no academic definition had all five categories.

CONCLUSIONS

Through the systematic literature review approach, 56 definitions from both academic and practitioner perspectives are identified. Using the content analysis twelve dimensions of CSR definitions are identified. These dimensions are grouped into aspect, beneficiary, benefits, approach and time frame categories for further analysis. Each definition is mapped against dimensions and categories, to compare the trends among academics and practitioners definition of CSR. Results suggest that over the time period practitioners (organisations) provided more comprehensive definitions which are broader in context. Economic, social and environmental issues are found to be the prominent dimensions along with the stakeholders.

Given the fact that the research on comparing academic and practitioner CSR definitions over the time is still new, this study provides a reference point for further study in this area. As the research in CSR continues to expand beyond the organisations borders to supply chain, it is important to address the inconsistencies in various definitions. This research helps to eliminate the inherent ambiguity and to develop a coherent and congruent knowledge. Based on the current understanding of CSR from this research, practitioners and academics can develop an appropriate definition. Corporate citizenship, corporate responsiveness, corporate governance and other related terms are not considered in this study which limits the scope. Exploring the potential implications of developing a standardised consensus CSR definition provides an avenue for the future research.

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EXTENDING SOCIAL RESPONSIBILITY TO GARMENT SUPPLIERS

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ABSTRACT

Aim/Purpose

The objective of this study is to identify and prioritise influential factors of extending (corporate) social responsibility (C/SR) from large retailers in developed countries to suppliers/ manufacturers in developing nations.

Design/Methodology/Approach

Based on the analytic hierarchy process (AHP) approach a two-part questionnaire was developed and employed for interview and data collection. A major Australian retailer importing readymade garments from Bangladesh is selected for interview. Expert choice® software was used to analyse data and determine relative weights of factors of extending social responsibility to garment suppliers/ manufacturers.

Findings

The results indicate that at the governance mechanism level supplier selection is by far the most critical element compared to the supplier development element. At the criteria level two most influential criteria are social and supplier assessment. The results show that the top five factors are child labour, environmental management systems, formal evaluation, lack of health and safety, and human rights abuse. The sensitivity analysis indicates that a slight decrease (from 0.750 to 0.735) in the relative weight of supplier selection element the ranking of the factors changes.

Originality/Value

This study advances the literature on implementation of social responsibility by including supplier selection along with supplier development.

Research Limitations

The major limitation of this study is the generalization of the findings. The results obtained by focusing on a particular context in the Australian retail sector importing from Bangladesh, may not be applicable to other nations.

Practical Implications

By identifying the criticality of factors of extending SR, this study facilitates retail chain managers in developed nations to extend SR practices to their suppliers/ manufacturers.

Keywords

Analytic hierarchy process (AHP), Social responsibility, readymade garment industry, Retailer, Social responsible supply chain

1.0 INTRODUCTION

In the past two decades the rapid globalization of markets, the increases in international trade, and technological advancements has created an opportunity to outsource part or entire manufacturing operations from countries with low production costs. However, this comes at a price of different nature. Sourcing from low-cost destination has resulted in the transfer of responsibility regarding social issues beyond an organisations boundary of ownership and control (Gimenez & Tachizawa 2012). For instance, retailers are being blamed for the lack of safety standards in manufacturing facilities in Rana Plaza and Ali garment factory in Bangladesh; Apple Corporation is criticized for harsh working

conditions at its supplier's Foxconn factory; Nike was vilified because of subcontractor's use of child labour (Park-Poaps & Rees, 2009). These incidents raised concerns among stakeholders including customers, competitors, regulators, industry peers, and media and forced corporations towards implementing social responsibility (SR) in their supply chains (Park-Poaps & Rees, 2009; Gallear, Ghobadianb, & Chena, 2012).

Although, retailers are generally very effective in implementing and practicing SR principles in their own facilities, they are not so when comes to their suppliers (Tate, Ellram & Kirchoff, 2010). As a result, they are often criticised for unethical practices such as operating sweatshops in developing countries. Australian retail supply chains are no exception to this, in the wake of the Rana Plaza incident; they are under pressure to monitor their suppliers' facilities for safety standards in developing nations (OXFAM, 2013). Characteristics of apparel industry that favoured unfair employment are (1) production is labour intensive and automation is limited, (2) Competitive pressure to lower production costs (3) Transparency issues in supply chain with respect to several sub-contractors (Park-Poaps & Rees, 2009). Perry and Towers (2013) pointed that high product variety, high volatility, low predictability, seasonality, and intense competition are the other factors that highly influence this industry. In order to address these challenges, retailers are gradually taking steps to extend social responsible practices to suppliers in developing nations. However, for attaining greater impact of CR implementation, how and which CR elements are necessary to address, still remained a big challenge for the global garment retailers. The objective of this study is to identify and prioritise influential factors of extending social responsibility (SR) from a large retailer in Australia to readymade garment suppliers/manufacturers in Bangladesh. The rationale for selecting this retailer is because of its global operations with portfolio of brands and volume of imports from Bangladesh. Remainder of this paper is organised as follows. In section 2 we review the literature on SR/CSR in supply chains to identify factors of SR implementation and proposed a conceptual model. We then briefly present research methodology in section 3. Section 4 presents results of the analysis; and section 5 provides the sensitivity analysis and discussion of the results. Lastly we present conclusions and limitations of this study in section 6.

2.0 LITERATURE REVIEW

Corporate/social responsibility (C/SR) evolved over the last 50 years (Carroll, 1999); still it is uncertain about what it is (Schwartz & Carroll 2003). Existence of several definitions, which are often biased toward specific interest groups, is the cause of uncertainty in the concept (Dahlsrud, 2008). In management literature C/SR refers to the approach of managing ethics (Lu, Lee & Cheng, 2012) and also managing relationships with stakeholders (Waddock, 2004). It enhances trust among stakeholders (McWilliams and Siegel, 2001). Firms with C/SR practices at functional level of purchasing and supply chain are in close partnerships in comparison to the ones that are not (Gallear, Ghobadianb, & Chena, 2012). C/SR in supply chain literature date backs to 1989 with concept of total responsibility approach. Though few studies have investigated the factors of social responsible supply chain, nevertheless, academics and supply chain practitioners are still slow in adopting social responsibility in supply chain contexts (Murphy & Poist, 2002). In the following paragraphs we briefly discuss the factors of implementing C/SR

2.1 Supplier Selection

Supplier selection is the considered as the first stage of establishing relationship among supply chain partners. Inclusion of SR aspects in supplier selection process will enhance the sustainable performance of supply chain (Gallear, Ghobadianb, & Chena, 2012). Right selection mechanisms will ensure that supplier capabilities will address the buying firms' current and future challenges (Paulraj, 2011). It also helps to maintain a strategically competitive position by enhancing the performance (Krause, Scannell & Calatone, 2000; Rajan 1999). Supplier selection requires the assessment of the suppliers based on criteria. In literature, green and environmental criteria have been widely used for supplier selection while social criteria are still missing (Govindan, Khodaverdi &

Jafarian, 2013). Selection of suppliers based on social criteria will manifest buying firms' commitment towards CSR issues (Baskaran, Nachiappan & Rahman, 2011). So in this study we will consider social, environmental and economic criteria for supplier selection.

2.1.1 Economic Criteria

Since 1960's supplier selection criteria have been widely researched topic. Dickson (1966) identified 23 different criteria of supplier selection. Quality, delivery, performance and service are listed as the most important traditional selection criteria (Govindan, Khodaverdi & Jafarian, 2013). Liao and Kao (2011) conducted an extensive literature review on selection criteria and grouped costs, quality and delivery performance under economic criteria. Our study examines quality, price and delivery performance as economic criteria.

2.1.2 Environmental Criteria

In recent, there is an increase in number of studies focusing on environmental criteria for supplier selection (Kannan et al., 2014). An environmental criterion varies from quantitative articulated in monetary terms to qualitative ones focusing on companies image (Humpherys et al., 2003). Some of the major criteria addressed in literature are narrowed down under three main criteria: pollution emissions, resource consumption and environmental management systems. We use these criteria in this study to find relative importance.

2.1.3 Social Criteria

Several incidents in manufacturing environment occurred due to issues related to human rights, long working hours, child labour, discrimination and lack of health and safety standards (Oxfam ,2013). In the context of developing nations, it is common to see the organisations practices such as bribery, excessive gift giving and unethical marketing to gain advantage over competitors (Baskaran, Nachiappan & Rahman, 2011). So the aspects of human rights, child labour, discrimination, policies on health and safety along with unfair competition are considered as social criteria in this study.

2.2 Supplier Development

A variety of supplier development mechanisms are in place to improve the performance and capabilities of suppliers (Krause, Scannell & Calatone, 2000). Supplier development activities vary widely and include evaluation/assessment, feedback of evaluation, education/ training, direct capital investments in the supplier, supplier dependency and buyer dependency (Krause & Ellram, 1997; Humphreys et al, 2004; Carr and Kaynak, 2007; Lu et.al, 2012; Modi & mabert, 2007). Several authors (e.g., Klassen & Vachon, 2003; Lee & Klassen, 2008; Large & Gimenez, 2011; Gimenez & Tachizawa, 2012) have used supplier assessment and collaboration as supplier development practices. Our study follows the same approach and considers supplier evaluation and supplier collaboration as mechanisms of supplier development.

2.2.1 Supplier Assessment

Supplier examination communicates the customer expectations of social and environmental practices from suppliers (Vachon & Klassen, 2006). It also helps to identify the suppliers development needs (Gimenez & Sierra, 2013). Supplier evaluation through formal process, management systems and feedback about results are the activities of the supplier assessment (Krause 1997). Assessment is considered as the first step to identify what actions are needed and then collaboration to improve sustainability (Gimenez & Tachizawa, 2012).

2.2.2 Collaboration

In the context supply chain, collaboration is regarded as a dominant mechanism to implement social responsibility in supply chain (Gimenez & Tachizawa, 2012). Based on Florida (1996) definition of environmental collaboration, collaboration in C/SR is considered as direct involvement of an organisation with its suppliers and customers to plan jointly for C/SR management. It provides a platform for suppliers and buyers to learn from each other (Bjorkuld, 2009). Collaborative activities include joint planning sessions and knowledge sharing regarding the product and process, site visits, training

and/or education and technical assistance are continually appeared in literature (Klassen & Vachon, 2003). In align with previous research; our study considers site visits, joint planning, technical assistance and training/education as factors of collaboration.

Based on the above discussion, a conceptual framework of extending social responsibility to suppliers is proposed. The framework is shown in Figure 1, which is described in two higher-level governance mechanisms, five criteria and and eighteen factors.

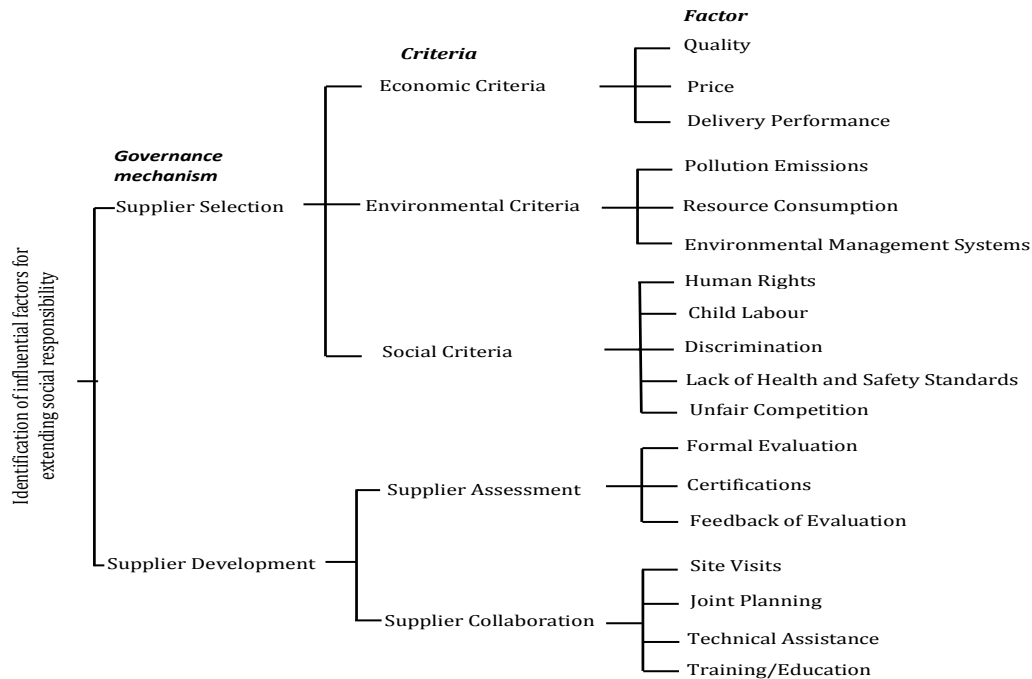


Figure1 Conceptual model for extending social responsibility

3.0 RESEARCH METHODOLOGY

3.1 Analytic Hierarchy Process – a brief overview

Analytic hierarchy process (AHP) is a decision-making approach which integrates simultaneously qualitative and quantitative information for prioritizing alternatives when multiple criteria must be considered. In the past, this method has been widely used to solve decision problems in areas such as supply chain risks assessment (Wang et al. 2012), six sigma implementation (Laosirihongthong et al., 2007), performance measurement (Chan, 2003). AHP translates a complex problem into simple hierarchical structure and provides best choice by ranking the alternatives. It also assesses how much more/less important a given priority is. The modelling process of AHP involves following the steps:

1. identification of criteria and factors of social responsible implementation,
2. structuring the problem as a hierarchy using criteria and factors and building the AHP model, and
3. collection and compilation of experts' opinions and application of the prioritisation procedure to determine normalised weights for each criterion and factor.

AHP offers not only a methodology to rank alternative courses of action but also provides a direct measure of consistency of judgment elicited by the decision makers. The consistency ratio (CR) can be calculated as follows (Saaty, 1986):

1. calculate the relative weights and largest eigenvalue (λ_{max}) for each matrix of order m ,
2. calculate the consistency index (CI) for each matrix of order m using: $CI = (\lambda_{max} - m)/(m - 1)$, and

3. compute CR using: $CR = CI/RI$. A $CR \leq 0.1$ is recommended as acceptable (Saaty and Kearns, 1985).

3.2 Case Study – Overview of the Retail Company

In order to determine senior executives understanding on influential factors that affect successful transfer of SR to suppliers, this study conducted an in-depth case study with one of the major retail chain in Australia. For confidentiality reason, this firm is identified as Smart Retailing Group.

Smart Retailing Group is a leading Australian garment retail chain with a portfolio of 10 brands and 1030 stores operating in 14 countries. Since its humble beginnings in 1991 as a family-run business, the Group has grown as a global company with over 17,000 employees across all brands. The business moto of the company is to ensure that it delivers the right product at the right place to the right customers at a great value. The key operational characteristics of the Smart Retailing Group are to be fast, flexible and dynamic, so that they can be a dominate player in any chosen market. Currently, the company is known for its fast-fashion for men, women, teenagers and children. It has diversified its product range to footwear brands along with stationary and gifts. With the intense competition and rivalry among global retailers, Group is aiming for the title of world's fastest- growing retailer with a strategy of expanding its operations into half a dozen countries by 2014. To enable the expansion and integration with the supply chain partners globally, Group has best in class IT systems in place. As of 2013, groups most of the production is outsourced to 125 factories in Asia. In the financial year 2012-2013, Bangladesh was the second largest sourcing country for the Group with an approximate 11% of total purchases. Smart Retailing Group always strives for the development of the suppliers, as they believe suppliers are an extension of their workforce. The Group has a policy of zero tolerance to bribery, corruption, forced and child labour. In align with their policies Group had a code of conduct in place that all of their suppliers need to follow. Smart Retailing Group believes that by having a long term relationships with suppliers, it can facilitates a better understanding between supply chain partners which can be translated into commercially sound business. In the wake of recent Rana Plaza incident, Smart Retailing Group is one of the first few Australian companies who signed the Bangladesh fire and safety accord.

3.3 Respondent

We adopt the single case design based on the case study design suggested by Yin (2003) and employed AHP methodology to provide insight into the criticality of factors of extending SR to suppliers/manufacturers. A senior executive who is responsible for ethical procurement and who has an extensive experience and expertise in this field was chosen for interview. A two-part questionnaire was employed for data collection. Part A contained questions (in AHP format) designed to capture respondent's opinions on the relative importance of the criteria and factors, whereas, Part B contained general questions about the company and respondent's background. As the respondent was not familiar with AHP data collection procedure, the following steps were considered:

1. The meanings of the integer scores of the 1-9 scale used was explained.
2. How the scores need to be considered while making the pairwise comparisons between any two criteria of factors was explained.

These two steps were critical to ensure the accuracy of data and consistency of judgements discussed earlier.

4.0 ANALYSIS AND RESULTS

In order to determine the priority weight of each factor, judgement matrices based on respondent's interviews were translated into the largest eigenvalue problems, and then calculated the normalised and unique priority vectors of weights by using the expert choice software®.

Numeric analysis was conducted to determine the weights of each higher-level governance mechanisms. These weights identify the degree of importance of each mechanism as a percentage of total importance. Similarly, weights of each criterion with

respect to higher-level mechanisms, and factors with respect to criterion are calculated. The results are summarised in Table 1 and Figure 2.

Governance Mechanism	Relative Weight	Criteria	Relative Weight	Factor	Relative Weight	Ranking		
Supplier selection	0.750	Economic	0.094	Quality	0.094	3		
				Price	0.627	1		
				Delivery performance	0.280	2		
				Environmental	0.280	Pollution emissions	0.268	2
						Resource consumption	0.117	3
		Envir-tal mgmt systems	0.614			1		
		Social	0.627	Human rights abuse	Human rights	0.112	3	
					Child labour	0.549	1	
					Discrimination	0.064	4	
					Lack of health and safety	0.229	2	
					Unfair competition	0.046	5	
		Supplier development	0.250	Supplier assessment	0.800	Formal evaluation	0.818	1
						Certifications	0.091	2
						Feedback of evaluation	0.091	2
						Supplier collaboration	0.200	Site visits
Joint planning	0.079			4				
Technical assistance	0.116			3				
Training/education	0.590			1				

Table 1 Relative weights of governance mechanisms, criteria and factors

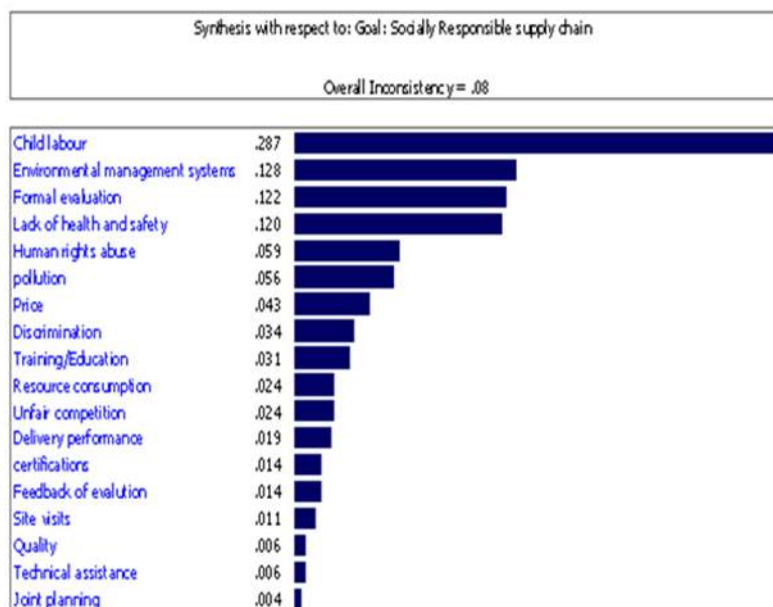


Figure 2 Overall priority weights of factors

From Table 1, it is evident that supplier selection with an overall weight of 0.750 is far more important mechanism than supplier development of 0.250. At the criterion level, social criteria (weight=0.627) plays a prominent role in supplier selection, whereas economic criteria (weight= 0.094) is the least important criteria in achieving social responsible supply chain. On the other hand, supplier assessment (weight=0.800) is the

most critical criterion in developing supplier. Price (weight= 0.627), environmental management systems (weight= 0.614) and child labour (weight= 0.549) are major contributors to economic, environmental and social criteria respectively. Similarly, formal evaluation (weight=0.818) and training/ education (weight= 0.590) are responsible for the importance of supplier assessment and collaboration respectively.

Overall, child labour (weight = 0.287), environmental management systems (weight = 0.128), formal evaluation (weight = 0.122), lack of health and safety standards (weight = 0.120) are the top four critical factors. Whereas, the factors such as technical assistance (weight=0.006), joint planning (weight=0.004), and quality (weight = 0.006) are found to be the least important factors while extending SR to suppliers (Figure 2). From the results it is evident that the company under study is giving prominence to the supplier selection based on social and environmental criteria than any other criteria.

5. SENSITIVITY ANALYSIS AND DISCUSSION

The sensitivity analysis is performed to investigate whether small variations in the model parameters would change the ranking of the enabling factors considered in this study. The final weight priorities of the factors depend on the weights associated with the higher-level criteria and mechanisms. Therefore, minimal change in the mechanisms could potentially change the ranking initially determined.

First, the weight of supplier selection was varied. Figure 3 demonstrates how the final weight of eighteen factors varies with respect to changes in supplier selection mechanism. When supplier selection is decreased from 0.75 to 0.735, formal evaluation becomes the second most important factor instead of environmental management systems. However, child labour remains as the top factor. The priority ranking remains same until the weight of supplier selection is further decreased to 0.536; formal evaluation becomes the top factor instead of child labour. A slight increase in original weight of supplier selection from 0.75 to 0.756, lack of health and safety becomes the third important factor and formal evaluation shifts to fourth.

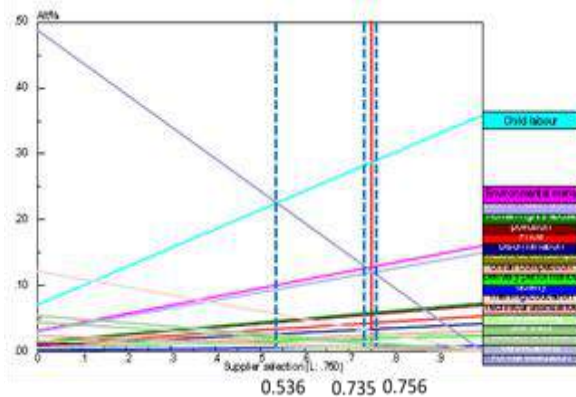


Figure 3 Sensitivity analysis when selection mechanism is varied

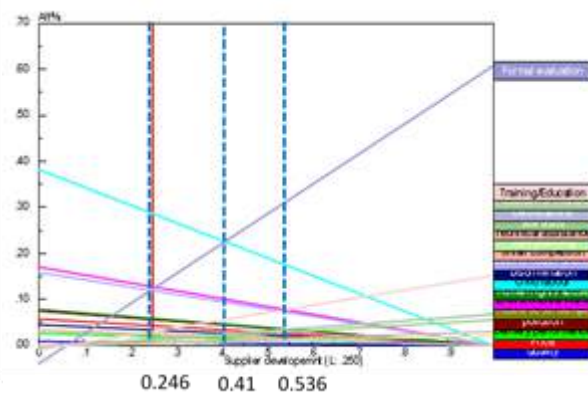


Figure 4: Sensitivity analysis when development mechanism is varied

Second, the weight of supplier development was varied from 0.25 to 0.246, formal evaluation shifts to fourth position from third, thus all the top three factors are from supplier selection mechanism. When the weight of supplier development is increased to 0.41, formal evaluation becomes the top most important factor and child labour becomes the second and all the other factors retain their ranks. On further increase in supplier development to 0.536, training/education of supplier collaboration becomes the third most important factor with formal evaluation and child labour as first and second respectively. This means that retailer with a relatively less critical supplier selection criteria, greater commitment will be given to the evaluation and training/education of the supplier.

6. CONCLUSIONS

In the wake of recent crisis at garment manufacturing facilities, stakeholders are demanding retailers to implement SR practices in their suppliers' facilities. This study investigates and prioritises the criteria and factors of extending SR to garment suppliers. Based on the extensive literature review a conceptual framework is proposed with two major governance mechanisms, five criteria and eighteen factors. We adopted the single case design and employed AHP methodology to provide insight into the criticality of factors of extending SR to suppliers/manufacturers. Results indicate that supplier selection is by far the most critical mechanism compared to supplier development. Factors such as child labour, environmental management systems, formal evaluation, lack of health and safety, and human rights abuse are found to be the top most critical factors. It can be suggested that senior executives should concentrate on these factors to extend social responsibility to suppliers.

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NAMIBIA WOULD LIKE TO BECOME A REGIONAL GATEWAY BY DEVELOPING A GLOBAL LOGISTICS HUB: WILL THIS AID DEVELOPMENT OR FRUSTRATE IT?

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ABSTRACT

This paper examines the concept of global logistics clusters (or hubs) and applies the key elements of clusters according to Muñoz and River (2012) to Namibia in order to establish if the country is able to successfully become a global logistics hub in southern Africa. The data for this analysis is extracted from multiple sources involving Namibian logistics sector stakeholders including: semi-structured interviews, workshops and published reports. The paper further explores the key issues for Namibia in its attempt to develop a global logistics hub and suggestions for future development.

INTRODUCTION

When a region espouses global supply chains, logistics activities can become a factor in its development strategy and thus influence public policy. Planners, especially those in developing countries with a limited manufacturing capability, tend to rely on trade to enhance their economies. Logistics activities generate employment and facilitate trade, which can help bring greater human well-being to their region. Global supply chains offer countries and city-states with appropriate port facilities (e.g. Singapore, Rotterdam, and Panama) an opportunity to bring prosperity to their communities. Their port based hubs have become the cornerstone of their economic growth. This has inspired some regions to base their development strategy on logistics clusters. Namibia is already involved in marine transport and so could play a strategic role in global supply chains by setting up such clusters. This paper aims to understand the potential for Namibia to use them as the basis for regional policy development and economic growth. The issues and arguments put forward in it need to be seen within the wider context of the economy of Namibia, in particular its current situation with respect to external trade.

Namibia is a founder member of the Southern African Development Community (SADC) which consists of 14 member states and is dominated by South Africa. It is also a member of the Southern African Customs Union (SACU) with South Africa, Botswana, Lesotho and Swaziland. Through this organisation, Namibia has supported tariff-free trade on goods between member countries. This is essential if it is to develop full advantage of its excellent geographical location and transport links with other members of SADC and SACU.

The economy of Namibia is inextricably linked to that of the Republic of South Africa (RSA). In 2012, for example, 16% of exports and a massive 70% of imports were with the RSA, (Namibian Statistics Agency, 2013). Further, the linkage includes the "pegging" of the currencies (N\$ & Rand) on a one for one basis. This means that, as the value of Rand against major currencies fluctuates, the Namibian Dollar (N\$) is also affected. For example as the value of the Rand v's GBP has fallen from about 10:1 to >16:1 between 2011 and 2013 (Rainbow Nation, 2013), the N\$ has also been drastically devalued, which has affected the price of imports. Between 2011 and 2012, there was a huge increase in exports of

diamonds and precious metal to Botswana although this may be partially due to Gaborone's burgeoning desire to become the "Centre of World Diamond Trading" (Young, 2013). Trade with Angola (10% of exports) has been more stable. Other than these three members of the SADC, Namibia's remaining exports are largely to developed economies. In contrast, her imports are chiefly from its local partners, although this may be misleading as a considerable percentage of the goods arriving from South Africa may have originated elsewhere. Developed economies such as EU member states and Switzerland provide a range of manufactured goods and services. Trade with China is relatively small compared to other economies in the region, (Namibian Statistics Agency, 2013).

Given the pattern described above, there are clear strategic reasons for developing a regional logistics hub and gateway through the port of Walvis-bay, the largest commercial port in Namibia (and on the south west coast of Africa). First, it will reduce the huge dependency that Namibia has on RSA. Simultaneously, it is likely to provide competitive pressure on RSA companies who currently over-price and dump expensive products not only on Namibia but also on other neighbouring SADC members (Clerck, 2008). Secondly, it will provide an opportunity for the logistics operators to offer re-export and other services to business in neighbouring countries. These may in turn generate relevant multiplier effects and invisible export earnings to assist in reducing the negative balance of trade. The recent announcement of plans by the Zambian government to construct a road from the Namibian border to the Copperbelt represents a huge boost for the economic potential of Walvis-bay port. The proposed route which will reduce the distance between Sesheke and the Copperbelt by 400km will reduce logistics costs and provide a new viable alternative to current export routes (Raballand and Whitworth, 2011). There is also a proposal to build a new line to transport coal from Botswana to Walvis-bay via the Namibia's Gobabis railhead, by-passing Windhoek, but this is only one of a number of options being considered by Botswana's revitalised coal industry (Ash, 2013).

LITERATURE AND BACKGROUND

Clusters and Network Integration.

A cluster can be defined as "geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g. universities, agencies and trade associations) in particular fields that compete but also cooperate", (Porter, 1998). The interdependency of clusters strengthens the products and/or services provided (Ketels, 2003).

Clusters augment competitive advantage by enhancing productivity, driving innovation and contributing to the emergence of new business (Porter, 1998). They develop where geographical location gives a comparative advantage whether contained within a single city or sprawled across international borders. Literature recognizes three types: the techno cluster, the historic know-how based cluster and the factor endowment cluster. Logistics ones tend to be the factor endowment type; they are "regions with a very high concentration of logistics activities relative to local population or economy" and "an amorphous agglomeration of companies and facilities with logistics-intensive operations, fuzzy borders and no central management" (Sheffi, 2012). Basically, they are zones where operators and all activities relating to the transport, logistics and distribution of goods, are gathered together.

Known as "Logistics Villages" in Germany, "Distribution Parks" in Japan or "Logistic Centres" in the Czech Republic and some European countries (Kampf et al., 2012), clusters play a strategic role in global supply chain management by synchronizing logistics flow activities. Clustering and developing network integration processes enable regions or countries to become strategic nodes in global supply chains (Bosona and Gebresenbet, 2011). This induces collaboration in logistics clusters built on, and motivated by, economic benefits, power, trust and information sharing (Groothedde et al., 2005).

Global Supply Chains and Logistics Clusters.

The emergence of logistics clusters has been partially driven by the need to manage supply chains during turbulent times. Successful management of these increasingly complex chains, crucial to multi-national businesses, calls for high levels of functional and organizational integration (Krajewski et al., 2003). Logistics employs powerful I.T. systems to manage global flows and reduce distance by saving time. Accelerating physical, informational and financial flows enables multinationals to satisfy their customers' need for time-based competition (Blackburn, 1991). Organizations that are unable to deliver their goods at the right time and at the right price are likely to suffer from global competition (Handfield and Nichols, 1999). So, today's global supply chains must be *hyperflexible* to face the increasing level of volatility (Christopher and Holweg, 2011). Their construction constitutes a major challenge for corporations. Their networks must be designed to shorten the time-to-market for their products and build risk avoidance (Handfield and Nichols, 2002).

To make global supply chains more flexible, agile and resilient, corporations have begun to concentrate their logistics activities into a few strategic and innovative nodes (logistics clusters). Logistics clusters have a very strategic role in global supply chain management as a space where synchronization of logistics flows' activities takes place. They are zones where operators and all activities relating to transport, logistics and good's distribution, national, regional, international and global supply chains tend to be gathered together (Lambourdiere et al, 2012).

In response, some governments give their strategic regional development programs a logistics and supply chain "bent", making heavy investments and efforts to attract clusters to their territories. Thus, valuable collections of resources are set up by regional authorities that bring local benefits as well as supporting the world supply chain and logistics community.

METHODOLOGY

As published information on the state of the logistics industry in Namibia is limited, this research used an exploratory approach. An investigation into the state of logistics in Namibia was carried out based on 25 semi-structured interviews with key stakeholders to produce a complex matrix, analysing similarities or differences by row or column as proposed by Cassell and Nadin (2008). The initial research was disseminated in the form of a Polytechnic of Namibia Report "Logistics in Namibia: Issues and Challenges", conference papers (Jenkins et al., 2012, Savage et al., 2013) and practitioner workshops. The comments from these, together with further interviews and feedback from stakeholders, has been analysed and used to assess the critical factors needed for Namibia to develop a successful logistics cluster strategy. Thus, the research design is principally qualitative and incorporates a single international case study, namely Namibia.

FINDINGS

The Role of Logistics Clusters in Global Supply Chains: What could it mean for Namibia?

Developing an advanced logistics cluster in Namibia could provide much needed services for corporations, thus encouraging investment for infrastructure improvement, enabling industrial skills capacity building and stimulating trade. By doing so, it could enhance the location's capabilities and potentially support Namibia's aspirations to make the gateway concept a reality. This would suggest that the case for a logistics hub is so positive as to be axiomatic, but, even if everything were to be developed successfully, there are concomitant risks.

The relationship between transport infrastructure investment and economic development has been the subject of many empirical investigations in both developing and developed economies. Superficially, the relationship ought to be positive, i.e. that new investment in ports, railways and roads generates economic growth over time. This comes about through

increased productivity of businesses in a region, enhanced innovation and the attraction of new firms to the region. Bergman and Feser (1999) built upon Porter's (1998) earlier work by showing how industrial clusters could link together the various strands of regional policy to generate economic development.

The evidence of such a relationship is by no means overwhelming. An alternative view is of an endogenous relationship, namely that transport infrastructure investment should take place only when the demand is there. In other words, once economic development within a region is taking place, new roads, railways and port facilities will give a further boost to an emerging vibrant regional economy. For developing economies, this will in turn promote the regular flow of labour to urban areas over time, unlike the alternative approach, that can produce a mad scramble, aggravating social problems and the impoverishment of rural communities.

The significance of this argument for Namibia's proposed logistics hub at Walvis-bay is not easy to assess. The positive relationship is more evidenced in developing economies than in those that are developed. This is largely accounted for by the complexity of economic relationships and linkages in the latter. At the same time, the opportunity cost should be acknowledged. For example, if public sector funding is used for Walvis-bay then this means that the additional resources involved will have to be taken from other areas of government funding. Given the current state of Namibia's economy, many risks and uncertainties are involved. The cost of taking no action though is one that may well be regretted later.

Requirements for Successful Logistics Clusters.

In order to evolve into successful entities, logistics clusters need to have a sound framework, built on solid foundations. Following research on Singapore, Dubai and Panama clusters, Muñoz and River (2010) have identified a number of critical factors needed for a successful logistics cluster strategy: 1) a strategic location, 2) government commitment and stability, 3) human resources, 4) infrastructure, 5) administrative processes, 6) regulation and 7) anchor companies and FDI (Foreign Direct Investment) attraction. Table 1 applies these requirements to Namibia.

Table 1. Key elements of clusters according to Muñoz and River (2012), applied to Namibia.

Criteria	Namibia	Classification against criteria
Strategic location	Strategic position on the coast of south-west Africa with connections to global shipping routes giving access to the SADC countries.	Excellent – But, some risk as there are other competitors.
Political stability	Since independence from South Africa in 1990 the political situation has been stable with an elected government. The recently published National Development Plan (NDP_4) sets logistics and infrastructure as important priorities.	Good – provided intentions become actions.
Human capital	There is a perceived (& real) lack of logistics training, education and qualified staff. In addition there is a lack of understanding of the concepts of international service standards and a reluctance to conform to them.	Poor – education can be improved but time is needed. Further, the attitude issue may be a "deal-breaking" stumbling block.

Infrastructure

The port of Walvis-bay has a good strategic location, but the present container capacity (350,000 TEUs) is a limitation. This has been recognised and there are plans to enlarge to up to 1million TEUs, but recent (2011/12) congestion suggests that the supporting road infrastructure may become a limiting factor. There is a rail network, but it is narrow gauge, and is considered to be expensive and unreliable. The small size of the population together with the vast geography of the country makes the investment in and maintenance of transport infrastructure very difficult.

Fair – there is potential, but major investment and time will be required.

Admin. processes

This is a contentious area for, whilst the Walvis-bay Corridor Group state that “turnaround times for offloading vary from 12 to 15 hours for container vessels; 24 to 48 hours for bulk vessels, depending on tonnage and shipment; and between 18 and 20 hours for break-bulk vessels”, logistics stakeholders say that “There are Customs issues and delays”. Additionally operators and users claim that “Border control paperwork is cumbersome and it happens often that goods are held at the border too long because of the submission of paperwork” and “charges are applied at the borders”.

Mixed (fair to poor) - the optimism of the corridor groups is commendable. But the general attitude, especially in the Parastatals will have to be addressed and changed.

Regulations for attracting FDI

There is an history of attracting inward investment from countries such as China, the USA and Germany, but results have not always lived up to expectations.

Average – the scope is there, but whether it can be capitalized on fully remains to be seen.

Anchor companies

Several logistics service providers such as Transworld Cargo and DHL are established locally.

Average – there is potential but it will only develop if companies feel that other criteria have been met.

CONCLUSION

Successful logistics hubs can form a gateway to a country or region. The services, they and their “clustered” companies provide, facilitate the movement of goods and add value through technical activities that benefit both producers and consumers in a cost effective way. By doing so, they can facilitate economic development; but, only if there is sufficient existing or potential trade. Under pressure from fierce global competition, executives, entrepreneurs and investors, seek places where the location is “right” and logistics innovation is taking place. There are opportunities for Namibia to provide a logistics hub for her region, but to succeed, she must understand the issues and be willing to address them.

Where the necessary criteria are satisfied, hubs/clusters are able to form a plank of a region's strategic development policy by providing high value-added logistics services to multi-nationals. International companies seek competitive places to install logistics facilities where they can be sure that functional and geographical integration of their global supply chains can be accomplished. As well as serving the supply chain, such facilities can improve national competitiveness. Efficient logistics clusters can enhance a territory's economic growth and development by becoming a geopolitical weapon that improves their strategic competitiveness by offering positional benefits for global supply chains.

This paper suggests that, whilst the vision is appealing, there are some pitfalls and as Craig (2012) states: "many locations have invested in infrastructure but have failed at being the logistics hub". It suggests that identifying and implementing "remedies" for shortcomings must be part of Namibia's logistics cluster development or the whole concept could implode, fail and have an overall negative impact on the country (& the region). Logistics clusters are places where innovation and learning are vital components, which together with the close proximity of suitable commercial, physical and academic institutions can form a virtuous spiral. If developed and run successfully, a Namibian logistics cluster project could prove to be the catalyst for increased trade, leading to the country's economic and social advancement. The use of logistics hubs or clusters to develop Namibia as a regional gateway has the potential to be an economic blessing and aid development. But, if not approached in a realistic and comprehensive manner, it could turn out to be a curse that will frustrate developmental aspirations. This paper has outlined some of the arguments; but only time can provide an incontrovertible answer to the question.

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MODERN PARADIGM OF SOCIAL RESPONSIBILITY IN SUPPLY CHAIN PRACTICES - THE CASE OF SAINSBURY

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ABSTRACT

The paper illustrates the complex character of properly implemented Corporate Social Responsibility (CSR). It demonstrates how the most important supply chain stakeholders participate actively in diversified fields of the core issues of social responsibility of business. Results proved that a modern complex concept of social responsibility of business could be effectively implemented among all main stakeholders of supply chain network. Such implementation involves all stakeholders and mainly – the customers of that supply chain. The leader of supply chain is the main source of creativity for the CSR concept, whereas supporting resources are generated by all stakeholders.

INTRODUCTION

Various supply chain stakeholders are showing an increasing interest in environmental and social issues related to business. Responsibility of businesses involved in supply chains can increasingly be found high on the CSR-agenda of European companies and governments, since it has become a crucial factor in creating competitive advantage. Among the concepts that have been used – apart from Corporate Social Responsibility – are sustainable development, corporate citizenship, sustainable entrepreneurship, the triple bottom line, and business ethics [Marrewijk, 2003]. Corporate social responsibility (CSR) is a concept of large relevance for business in general and within logistics specifically [Seuring, S., Sarkis, J., Muller, M. and Rao, P., 2008]. The need for CSR in logistics and supply chain operations should particularly be seen in light of the fact that a large part of their activities is conducted through systems of governance, which link firms together in various sourcing and contracting arrangements [Andersen M.A., Skjoett-Larsen T. 2009]. However, despite all these efforts and standards [Bjorklund M., 2010], a number of CSR issues connected to supply chain management issues still remain unsolved.

Sustainability has many impacts on food industry and vice versa (Maloni and Brown, 2006). Customers become increasingly interested in the origin of food products, they want to be sure what those products contain and want to know many facts about their producers [Bourlakis et al., 2013]. Existing literature discusses several groups of problems concerning supply chain social responsibility related to food supply chains [Spence and Bourlakis, 2009]:

- Relationships between buyers and suppliers: 1) Power, partnership and integration of the supply, 2) Negotiation, honesty, openness, trust in supply relationships, 3) Supplier selection and delisting: enabling supplier diversity (e.g. SMEs/ethnic minority businesses/women-owned businesses)
- Extended responsibility: 1) The appropriateness of extended responsibility, 2) Monitoring and auditing versus engagement with suppliers
- Industry-specific issues: Extreme dominance of supermarkets
- The food sector: 1) Seasonal supply – temporary labour, 2) Highly competitive – promotional offers and price competition, 3) Growth of retail brands and direct sourcing, 4) Consumer safety – Hygiene, 5) Animal welfare – husbandry, use of antibiotics and hormone treatments, feed, transportation, slaughter, 6) Arable farming – Genetic engineering, use of pesticides, organic/conventional, 7) Fair trade, 8) Perishable goods – short life, 9) Packaging, 10) Labelling.

Even though there is a stream of literature investigating different issues of sustainability or/and CSR in food industry and grocery supply chains, there has been little research applied to the precise analysis of the total integrated CSR concept adapted by different chains. Such an integrated application expresses the modern approach to the framework of the CSR concept. This paper illustrates, how an integrated conceptual CSR framework has been practically used in a grocery distribution network. The goal of the paper was to prove that complex sustainability concept is not only a theoretical approach but can be practically adapted in real day-to-day operations of companies and their respective supply chains.

In order to reach the goal of the paper the following research questions were addressed:

- **RQ1:** What are the main aspects of the Corporate Social Responsibility influencing the processes in a grocery supply chain?
- **RQ2:** What is the role of different supply chain stakeholders in implementation of the CSR strategies?
- **RQ3:** What are the main factors supporting implementation of social responsibility concepts in the whole supply chain or distribution network?

THE CONCEPT OF CORPORATE SOCIAL RESPONSIBILITY IN SUPPLY CHAINS

The idea of the need to ensure healthy ecosystems, social equity and good organizational governance was embedded into the concept of sustainable development, i.e. *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* [International Standard ISO 26000]. Sustainable development assumes integration of the goals of a high quality of life, health and prosperity with social justice. It also relates to supply chains operations where sustainable development is defined as an approach where the economic, the environmental and the societal sphere of a business needs to be harmonized in the form of the "triple bottom line approach" [Carter, C.R., Rogers, D.S.,2008]. Therefore in sustainable supply chains *"... environmental and social criteria need to be fulfilled by the members to remain within the supply chain, while it is expected that competitiveness would be maintained through meeting customer needs and related economic criteria"* [Seuring, S. and Muller, M.,2008]. The same authors conclude that *"...sustainable supply chain management is the management of material, information and capital flows as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e. economic, environmental and social, into account which are derived from customer and stakeholder requirements"*.

The general concept of sustainable supply chain management has been presented in Figure 1. It demonstrates four supporting facilitators of sustainable supply chain management such as [Carter C.R., Easton P.L., 2011]:

- strategy, which clearly and in complex way identify specific SSCM initiatives supporting the overall sustainability strategy of an organization;
- risk management together with contingency planning for both the upstream flows and the downstream flows within a supply chain;
- an organizational culture tightly connected to organizational citizenship, including high ethical standards and expectations associated with a respect for society (both within and outside of the organization) and the natural environment;
- transparency in terms of communicating with key stakeholders (individual or group that has an interest in any decision or activity of an organization) and traceability (visibility) into upstream and downstream supply chain operations.

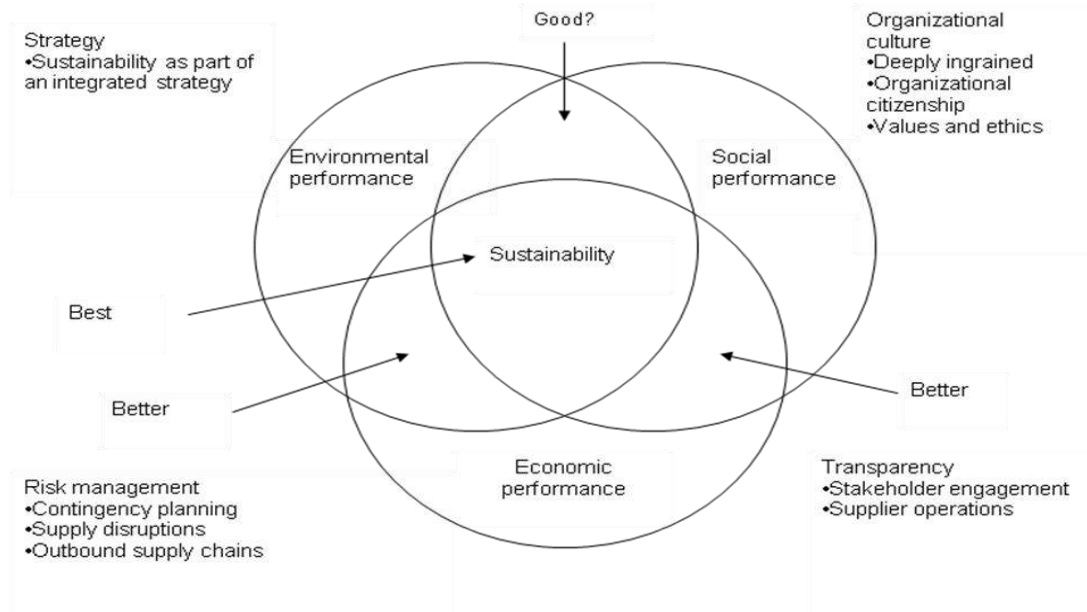


Figure 1: Sustainable supply chain management [Carter C.R., Easton P.L., 2011]

Sustainable supply chain management expresses the concept of social responsibility of member organizations for the impacts of their decisions and activities on society and the environment, through transparent and ethical behaviour that:

- contributes to sustainable development, including health and the welfare of society;
- takes into account the expectations of all supply chain stakeholders;
- is in compliance with applicable law and consistent with international norms of behaviour;
- is integrated throughout organizations operating in a supply chain and in its relationships.

Research on supply chain social responsibility is multidisciplinary in nature and is based on the chain-wide consideration of many issues "...beyond the narrow economic, technical and legal requirements of the supply chain to accomplish social (and environmental) benefits along with the traditional economic gains which every member in that supply chain seeks" [Spence, L., Bourlakis, M., 2009]. Where social responsibility issues have been made operational, the standard practice is the concept of Corporate Social Responsibility in logistics [Carter, C., Jennings, M., 2002] and in supply chain management [Kovacs, G., 2008].

In 2010 the International Standard was developed to assist organizations in contributing to sustainable development, i.e. the International Standard ISO 26000 "Guidance on social responsibility" prepared by ISO/TMB Working Group on Social Responsibility in order to provide organizations with guidance concerning social responsibility. This International Standard provides guidance on the underlying principles of social responsibility, indicating the core subjects and issues pertaining to social responsibility (see Table 1).

THE CASE OF SAINSBURY DISTRIBUTION NETWORK

Research methodology

The main framework of CSR has been based on the standard of ISO 26000. A qualitative case study research was used, based on:

<i>Core subjects</i>	<i>Issues</i>
<i>Organizational governance</i>	<ul style="list-style-type: none"> • Formal and informel processes, systems, structures, or other mechanisms that make it possible to apply the principles and practices of social responsibility
<i>Human rights</i>	<ul style="list-style-type: none"> • Due diligence • Human rights risk situations • Avoidance of complicity • Resolving grievances • Discrimination and vulnerable groups • Civil and political rights • Economic, social and cultural rights • Fundamental principles and rights at work
<i>Labour practices</i>	<ul style="list-style-type: none"> • Employment and employment relationships • Conditions of work and social protection • Social dialogue • Health and safety at work • Human development and training in the workplace
<i>The environment</i>	<ul style="list-style-type: none"> • Prevention of pollution • Sustainable resource use • Climate change mitigation and adaptation • Protection of the environment, biodiversity and restoration of natural habitats
<i>Fair operating practices</i>	<ul style="list-style-type: none"> • Anti-corruption • Responsible political involvement • Fair competition • Promoting social responsibility in the value chain • Respect for property rights
<i>Consumer issues</i>	<ul style="list-style-type: none"> • Fair marketing, factual and unbiased information and fair contractual practices • Protecting consumers' health and safety • Sustainable consumption • Consumer service, support, and complaint and dispute resolution • Consumer data protection and privacy • Access to essential services • Education and awareness
<i>Community involvement and development</i>	<ul style="list-style-type: none"> • Community involvement • Education and culture • Employment creation and skills development • Technology development and access • Wealth and income creation • Health • Social investment

Table 1: Core subjects and issues of social responsibility (International Standard ISO 26000)

- the field research a (study visit at the Sainsbury's distribution center in Northampton, UK, analysis of company's documentation
- desk top research based mainly on the rich and extensive Internet information available.

Choice of *Sainsbury* as the main object of analysis has been based on the recognition of long-term tradition of social responsibility of that company reaching the past periods when that concept has not been well developed yet. The most important competitors for Sainsbury are Tesco, Morrisons, Asda (owned by the American Wal-Mart retail network) and Waitrose. The competitors also developed sustainability programs but that one of Sainsbury's seems to be the most advanced and complex.

Practically, the first approach of Sainsbury towards pro-social operations started in 1986 when first Sainsbury's supermarket offered organic brands. Today their

SO Organic brand offers over 250 products. In 1989 first ever carrier bags made from recycled material were used in Sainsbury's supermarkets. Most of other grocery supply chains started their sustainable operations and the CSR involvement in late 1990-ties.

In order to verify the Sainsbury's approach to social responsibility, the main components of sustainability applied in that company were examined, i.e. strategy, company's culture, risk management and transparency of its relations with the main stakeholders.

Sainsbury's strategy for sustainability

The company was founded in 1869 by John James Sainsbury and his wife Mary Ann Sainsbury in London. At present it is one of the largest retail networks in the UK, owning 1200 points of sales: a chain of 592 supermarkets and 611 convenience stores and Sainsbury's Bank. The group also has interests in property. Sainsbury's distribution system consists of 21 distribution centres and 3 supporting centres for supermarkets. The company provides work for 157 000 employees in the United Kingdom.

Developing new business and investing beyond the core of their operations is an important part of Sainsbury's long-term strategy for the future. In the last five years, Sainsbury have added £4 billion to the value of their property portfolio, the market value of which is now £11.5 billion. They have a clearly defined strategy for growing space and increasing Sainsbury's store portfolio. This falls into three main areas: new supermarkets; adding space to existing stores through extensions; and new convenience stores. Remaining commercially competitive is crucial for Sainsbury's. They claim that when they invest, they do so with strict control over the capital spent to ensure appropriate returns.

Corporate responsibility becomes an important part of Sainsbury's strategy. To ensure a high level of accountability, the company was one of the first FTSE 100 businesses to establish a dedicated Corporate Responsibility Governance Structure. This has full support from the very top of the organization, whereby members of their Operating Board hold accountability for the main values of their sustainability and their steering groups became accountable for their own targets within CSR new strategy.

Organizational culture

Sainsbury have a strong culture, focused on ensuring that their values make them different. This underpins Sainsbury's business, and is interwoven into their strategy. They claim that their values are critical to achieving their vision to be the most trusted retailer, where people love to work and shop. They declare that their customers trust Sainsbury's to do the right thing and help them *Live well for less*. They expect Sainsbury to maintain high social, ethical and environmental standards across all aspects of business.

Sainsbury's "five values" became part of what makes them different from other supermarkets and shapes their organizational culture. as we see this as a strength, as well as a responsibility. The five values are: 1) Best for food and health, 2) Sourcing with integrity, 3) Respect for the environment, 4) Making a positive difference to company's community, 5) A great place to work.

In October 2011, Sainsbury published their *20x20 Sustainability Plan* to ensure they continue to lead in this aspect of business, and derive long-term, sustainable advantage from it.

Risk management

Corporate governance became the main factor of risk management and risk mitigation. Sainsbury's is committed to high standards of corporate governance in their business, and apply the principles and supporting principles of the UK Corporate Governance Code. This emphasizes the need for well-balanced, effective boards, strong overseeing of risk management, alignment of remuneration policies with shareholder interests, and sound shareholder relations.

There is a clear division of responsibilities between the Chairman and the Chief Executive. All the Non-Executive Directors are considered to be independent. They bring wide and varied commercial experience to Board deliberations. The Chairman is responsible for leadership of the Board, setting its agenda and monitoring its effectiveness. The Chief Executive is responsible for executing the strategy once agreed by the Board. The Board delegates certain responsibilities to its principal Committees: the Audit Committee; Remuneration Committee; Nomination Committee; and Corporate Responsibility Committee. The Remuneration, Nomination and Audit Committees have written terms of reference that define their authorities, duties and membership.

The Board has overall responsibility for the system of internal controls, including risk management. It comprises all controls including financial, operational and compliance controls and risk management.

Transparency (relationships with stakeholders)

Sainsbury's relationships with their stakeholders are based on 20 outlined commitments to be achieved by 2020. They provide a clear focus and formalize Sainsbury's activities concerning their stakeholders under each of strategic "five values"

Within the framework of "Best for food and health" policy Sainsbury indicates the following sustainable operations: 1) Continuation of reducing salt, saturated fat, fat and sugar in their own brand products and leading role on providing clear nutritional information, enabling the customers to make informed choices, 2) Double the sales of lighter alcohol wine and reduce the average alcohol content (ABV) of Sainsbury's own brand wine and beer. These are quite clear plans connected to the customers considered to be the most important Sainsbury's stakeholders.

As the part of "Sourcing with integrity" program Sainsbury's strategy is based on the following goals: 1) The company will all of their key raw materials and commodities sustainably to an independent standard, 2) Company's own brand products won't contribute to global deforestation, 3) All the fish being sold by Sainsbury's will be independently certified as sustainable and we'll strengthen company's position as the leading retailer for sustainable seafood, 4) Sainsbury's sales of fairly traded products will hit £1 billion, 5) The company will double the amount of British food they sell, 6) All Sainsbury's meat, poultry, eggs, game and dairy products will be sourced from suppliers who adhere to independent higher welfare standards, 7) Company's suppliers will also be leaders in meeting or exceeding Sainsbury's social and environmental standards. Such sourcing policy provides a clear picture of Sainsbury's relationships with present and future suppliers and offers a transparent view of basic requirements for potential collaborating providers.

Sainsbury developed also quite transparent plan for "Respect for the environment" issues and it includes the following issues: 1) the Company will put all waste to positive use, 2) Sainsbury will make sure that their own packaging has been reduced by a half compared to 2005, 3) The company will have reduced

their operational carbon emissions by 30 per cent absolute and 65 per cent relative, compared with 2005, 4) Through robust water stewardship, Sainsbury will ensure that their supply chain approach is sustainable in areas of water vulnerability, 5) the company will have worked with their own brand suppliers to reduce carbon emissions across all of Sainsbury's own brand products by 50 per cent relative. Those conditions formulate a transparent picture for future co-operations between Sainsbury and their suppliers of products and logistics services.

“Making a positive difference to company's community” became also a sustainable target for Sainsbury, including such strategic goals as: 1) Encouraging over 20 million children to enjoy physical activity in the decade, 2) Plan of donating over £400 million to charitable causes in the decade. As examples of delivering additional value for the local communities one can also mention active participation in the Junior Road Safety Officer (JRSO) program and spreading the ecological awareness among members (particularly school children) of local communities.

Finally, the “fifth value” of sustainability plan for Sainsbury is to offer “A great place to work” with the following main goals: 1) Sainsbury will create 50,000 new job opportunities in the UK and at least half of “colleagues” (Sainsbury's employees) will have received externally accredited training by 2020, 2) 20,000 of company's “colleagues” will have reached 20 years of service at Sainsbury's confirming long-term employment policies, 3) Sainsbury will increase the number of colleagues with shares in company's business by 25 per cent, increasing long-term involvement, 4) The company will have provided 30,000 people from disadvantaged groups with work opportunities.

What is worth noticing, is the part of companies culture to relate to its human resources as “colleagues” rather than “employees”. It is a clear indicator of the profile of working relationships in companies hierarchical structures.

CONCLUSIONS

The main findings of completed case study, if related to the research questions, allow to draw the following conclusions.

RQ1: What are the main aspects of the Corporate Social Responsibility influencing the processes in a grocery supply chain? ? Analyzed paradigm refers fully to the multi-purpose concept of sustainability including its economic, social and environmental aspects. Results proved that a modern complex concept of social responsibility of business could be effectively implemented among all main stakeholders of grocery supply chain network. All identified strategic sustainability goals are deeply embedded in the nature of International Standard ISO 26000.

RQ2: What is the role of different supply chain stakeholders in implementation of the CSR strategies? Conducted analysis proves that it is totally possible to apply theoretical concepts of sustainability in sound and robust business practices in supply chains. Such implementation involves not only suppliers and logistics service providers, but also customers of that supply chain. The leader of supply chain is the main source of creativity for the CSR concept, whereas supporting resources are generated by all stakeholders. Members of local communities become and important part of chain's sustainability plan.

RQ3: What are the main factors supporting implementation of social responsibility concepts in the whole supply chain or distribution network? It seems that the main factor contributing to the effective implementation of sustainability and social responsibility in a supply chain is the business strategy

adopted by the leading company in that chain. If that strategy is directly focused on the CSR issues, it is very likely that its implementation would soon involve all stakeholders, actively motivated by the supply chain leader. Co-operation with legal bodies and other social and non-profit organizations is also very important for the overall success of the total concept of the CSR implementation. Finally, company's culture and its governance system strongly support sustainable operations in the whole supply chain.

The results of research based on a case study cannot be considered as universal relations. However, these results provide more insight into modern approach to social responsibility of businesses. Research results might be of importance for decision makers and managers in supply chains, demonstrating useful business behaviour patterns.

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SUPPLY CHAIN DECELERATION: IS IT AN EFFECTIVE DECARBONISATION MEASURE?

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ABSTRACT

Purpose of this paper

The paper will challenge the conventional view that the movement of goods through supply chains must continue to accelerate. The compression of transit times and order lead times has been one of the most enduring logistics trends of the past few centuries, intensifying in recent decades with the wide adoption of just-in-time and quick response replenishment. Will further acceleration be compatible with the goals of government climate change policies to cut greenhouse gas emissions by 60-80% by 2050? The paper will try to answer this question and, in the process, provoke a reassessment of the some of the standard principles and practices of logistics management. It will take as its starting point the claim by the World Economic Forum / Accenture (2009) that 'despeding logistics' is the second most effective method of 'decarbonising supply chains'.

Design/methodology/approach:

The opportunities for cutting CO₂ emissions by supply chain deceleration will be explored within a freight decarbonisation framework. The five key parameters in this framework (supply chain structure, modal split, vehicle utilisation, energy efficient and carbon content of the energy) are directly, indirectly or consequentially affected by the speed. Data will be drawn from various sources to quantify the relationship between speed and these parameters. The recent experience of slow steaming will be used to illustrate how companies' logistics systems can accommodate significant increases in transit times with minimal disruption. A distinction will be made between movement time, transit time and logistical cycle time.

Findings

Speed-energy-emission relationships have been modelled for road and shipping, showing that there are direct environmental benefits in deceleration. The strength of the indirect effects of deceleration on product sourcing and JIT are difficult to assess. It is argued, however, that reliance on express freight services could be significantly reduced if standards of production and distribution planning were improved. Trade facilitation initiatives are cutting border delays and the time saved could potentially offset reductions in vehicle speed.

Value

To achieve the dramatic reductions in carbon emissions required to stay within internationally-agreed limits by 2050, long-established logistical trends will have to be reversed. This paper examines the ramifications of a reversal of the acceleration trend.

Research limitations/implications

The paper is based primarily on a review of literature, supplemented with some primary data, collected mainly from the maritime sector. Given the current evidence base, it is not possible to model empirically some of the key relationships discussed in the paper

Practical implications

The paper may stimulate some new thinking by academics, managers and public policy makers on the potential carbon benefits of 'despeeding' logistics.

Keywords

Supply Chains, Deceleration, Carbon Emissions

INTRODUCTION

Increasing speed has long been regarded as one of the defining features of human progress. Freight transit times have shrunk as transport infrastructure has been greatly improved, border controls removed and vehicles accelerated. Janelle (1968) coined the term 'time-space convergence' to describe the compression of transit times. He and others (e.g. Knowles, 2006) have analysed the geographical implications of this process. The logistical implications have been equally dramatic. They have enabled companies to source and market their products over much wider areas within competitive order lead times, to centralise their production capacity and inventory, to cut their in-transit inventories and to use delivery time more effectively as a competitive differentiator. Just-in-time has become the dominant logistics paradigm of our age, 'hard-wired' into production and distribution systems across the globe. In its advertising, UPS goes so far as to say that 'logistics is speed', reinforcing the widely-held view that moving goods fast is inherently beneficial. To suggest otherwise can be considered heresy. Yet that is what this paper does in an effort to stimulate discussion on the possible need for a reversal of the historic acceleration trend to reduce the carbon intensity of logistics.

To be credible such a radical proposal needs to be both justifiable and feasible. The justification comes from the mounting body of evidence that over the next few decades we will have to make deep cuts in greenhouse gas (GHG) emissions to stand any chance of keeping the increase in average global temperature within an ecologically acceptable limit. There is an urgent need to put the steep growth in annual GHG emissions into reverse, bringing the annual level of CO₂ emissions down from around 35 Gigatonnes to 20 Gt by 2050 (Berners-Lee and Clark, 2013). In 2010 transport accounted for around 6.5 Gt of CO_{2e} with freight movement representing around a quarter of this total. The IPCC (2014) predicts that *'without aggressive and sustained mitigation policies being implemented, transport emissions could increase at a faster rate than emissions from the other energy end-use sectors and reach around 12 GtCO_{2e} by 2050'*. It is anticipated that freight's share of these transport emissions will increase over this period, putting added pressure on companies to decarbonise their logistics operations. Already many of the large logistics providers have set ambitious targets for cutting the carbon intensity of their freight transport by the 2020s (McKinnon and Piecyk, 2012). Government carbon reduction targets, however, are defined in absolute terms rather than on a carbon intensity basis. Given the projected growth in freight movement over the next few decades, meeting targets for 60-80% absolute reductions in emissions by 2050, as prescribed for example by the EU, UK and Germany governments, will require fundamental changes in the design, management and operation of logistics systems. It is within this context, that the deceleration option must at least be considered.

The feasibility of *'despeeding supply chains'* has been assessed by the World Economic Forum / Accenture (2009) as being relatively high. Their study assigned it a score of 0.8 out of 1.0, second only to improving the energy efficiency of logistics buildings, as a supply chain decarbonisation measure. When combined with the third highest 'emission abatement potential', this 'despeeding' option was deemed overall to be the second most effective of thirteen methods of decarbonising supply chains that were analysed (after 'clean vehicle technology'). The report acknowledges that *'the high speed of response needed in many supply chain activities means that consumer demand is met effectively, but at a price of increased CO_{2e} emissions'* (p.17). Its authors then assess the extent to which *'easing leadtimes and delivery stipulations could lead to emissions abatements through despeeding'*. Their analysis is confined to three forms of 'despeeding', slowing down trucks, 'slow steaming' of ships and widening delivery time-windows. This paper

begins by taking a broader view of the subject, placing these and other deceleration options within conceptual frameworks that permit a more comprehensive evaluation of the contribution that they can make to the long term decarbonisation of logistics.

CONCEPTUAL FRAMEWORKS

Several frameworks have been devised to help transport researchers and policy-makers review decarbonisation options on a systematic basis. Within the Activity Structure Intensity Fuel (ASIF) framework one can assess opportunities for reducing the level of transport *activity* (i.e. avoid), altering the modal *structure* of the transport system (i.e. shift mode), reducing the energy *intensity* of the transport operation (i.e. improve efficiency) and cut the carbon content of the *fuel* (Schipper and Marie, 1999). It has been adopted by the IPCC (2014) as the basis for its analysis of the carbon mitigation potential in the transport sector. Unlike the ASIF framework which was developed for transport in general, the green logistics framework is specifically designed for freight transport (McKinnon, 2012) and maps the relationship between the output of a company or national economy and the amount of freight-related CO₂. This relationship is defined with respect to five key parameters: supply chain structure, freight modal split, vehicle utilization, energy efficiency and carbon content of the energy. Figure 1 shows the close alignment between the ASIF and Green Logistics frameworks.

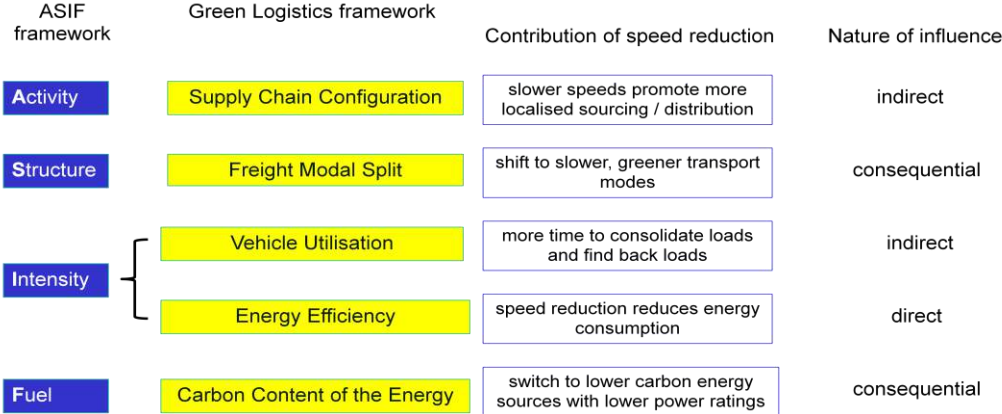


Figure 1: Speed reduction in the context of transport decarbonisation framework

Figure 1 also identifies the five main ways in which speed reductions can cut supply chain emissions and shows how they relate to key parameters in both the ASIF and Green Logistics frameworks. They have a influence on all of the ASIF and Green Logistics parameters. The nature of this influence would vary across the parameters and can be classified into three types:

1. *Direct*: where the speed reduction cuts energy use and emissions (e.g. by imposing tighter speed limits vehicles or vessels).
2. *Indirect*: where deceleration would cause supply chain restructuring or a change in operational practice which in turn would lead to a reduction in emissions (e.g. by promoting more localised sourcing or relaxing delivery schedules)
3. *Consequential*: where another decarbonisation measure would have the effect of slowing the freight movement and companies might have to adjust systems, processes and / or schedules to accommodate the change (e.g. by switching freight to lower carbon transport modes which are often slower or by using wind power for ships)

The remainder of the paper will examine the five main types of velocity reduction and consider their wider implications for logistics and supply chain management. It will show

that several of the forms of deceleration are closely inter-related, making it difficult to isolate their individual contribution. We will start with those exerting a direct influence on emissions.

DIRECT EFFECTS OF SPEED REDUCTION ON EMISSIONS

The relationship between speed and fuel consumption has been analysed for shipping (e.g. Maloni et al, 2013), trucking (AEA / Ricardo, 2011), aviation (Delgado and Prat, 2011) and rail (Tolliver et al, 2013). In the opinion of the World Economic Forum / Accenture (2009) slowing trucks and ships offers the greatest CO₂ abatement potential:

Road freight: A review of a range of truck fuel efficiency measures in the US by Ang-Olsen and Schoerer (2002) found that reducing the maximum speed from 104 km per hour to 96 kph yielded the greatest fuel saving (around 7.7%). One of the largest US trucking businesses, Schneider National Inc, lowered the maximum speed set by speed governors on its fleet of 10,600 trucks from 101 kph (63 mph) to 97 kph (60 mph), cutting annual fuel consumption and emissions by, respectively, 17 million litres and 40,000 tonnes. Truck speed limits are significantly lower in the EU. A 1992 EU directive required the installation of speed governors on all trucks over 7 tonnes and the imposition of national truck speed limits at 90 kph or less. Analysis of the speed-fuel curve for heavy trucks in Europe suggests that reducing the speed from 90 kph to 70 kph would cut fuel consumption by around 12% (AEA / Ricardo, 2010). It is important, however, to distinguish maximum speed from average speed and to allow for differences in driving styles and traffic conditions. On congested roads, trucks often operate significantly below their most fuel efficient speed and stop-start operations have been shown to carry a heavy fuel penalty. By smoothing the traffic flow, advanced traffic management (ATM) on busy roads can yield significant fuel savings for all categories of vehicle and this generally requires tighter speed restrictions at peak periods. Overall, reducing and stabilising truck speeds can be one of the most cost-effective means of decarbonising the road freight sector.

Container Shipping: The practice of 'slow steaming' has been widely adopted by deep-sea container lines since 2008, typically reducing the average vessel speed from 24 to 20 knots. It must be stressed that this has been done primarily for commercial reasons, though it has yielded a significant co-benefit in lower CO₂ emissions. The fuel and carbon savings are proportionally greater than the average speed reductions. It is estimated that slowing down the average container vessel by 10% and 20% saves, respectively, 15-19% and 36-39% in fuel and CO₂ (ICCT, 2009). Cariou (2011) calculated that over the period 2008-2010 slow-steaming cut its global CO₂ emissions by 11% against a baseline trend. What is also remarkable is the ease with which many shippers have been able to accommodate substantial increases in deep-sea transit times within their global supply chains. Interviews with senior shipping and export managers in a sample of fifteen large shippers has revealed how, in most cases, it has been possible to minimise any adverse impacts (McKinnon, 2012). Some evidence was found of companies modifying internal processes, switching from transshipment to direct services and prioritising the hinterland movement of more urgent consignments, but many of these changes were fairly minor. Relatively few of the international freight flows handled by deep-sea container services are so time-sensitive that an extra 2-4 days in transit between, say, China and Western Europe are critical. Maersk quotes typical end-to-end supply chain times of 70-80 days for orders from Chinese factories to shop shelves in Europe or north America, against which a few days extra at sea seems marginal (Jorgensen, 2012). Shippers have to bear additional in-transit inventory costs, though these are generally modest and can be off-set by improvements in reliability and by avoiding the higher bunker fuel surcharges that would probably have been imposed in the absence of slow steaming. Some researchers have suggested that slow steaming is a temporary phenomenon and likely to be abandoned when oil prices drop and trade volumes expand. The fact that Maersk, by far the world's largest container carrier, has designed its new

generation of triple E, West African Maximum and South American Maximum vessels to sail fuel efficiently at slower speeds suggests that slow steaming is likely to endure.

INDIRECT EFFECTS OF SPEED REDUCTION ON EMISSIONS

As explained earlier, this form of 'despeeding' acts through changes in business process, system design or supply chain configuration to conserve energy and thus cut emissions. It is exemplified by the promotion of more localised sourcing and a relaxation of the just-in-time principle. The former reduces the total demand for freight transport (in terms of tonne-kms), while the latter can give companies more flexibility to consolidate and match loads, thereby cutting the vehicle-kms required to move a given quantity of freight.

More Localised Sourcing

The reasoning underpinning this point is that since an acceleration of transport services promoted globalisation and the associated growth in supply chain GHG-emissions, a reversal of this speed trend would achieve the opposite effect. This assumes, first, that a return to more localised sourcing will yield a net reduction in GHG emissions and, second, that lengthening transit times will encourage a shortening of supply lines. Both assumptions can be challenged and are very difficult to test empirically on the basis of currently available data.

GHG impact of localised sourcing: As numerous studies have recognised (e.g. Smith et al, 2005, McKinnon, 2014), reducing the distance a product travels does not necessarily cut the total emissions associated with its production and distribution. Generally speaking, a much larger proportion of these 'life-cycle' GHG emissions emanate from production operations than from transport, making it more important to locate production where its carbon-intensity is low, even if this entails much longer freight hauls. Cristea et al (2013) have used a partial equilibrium analysis of trade, input-output and environmental data to estimate how much international trade actually yields a carbon reduction, after allowance is made for the relative carbon intensity of production in the exporting and importing countries and the related freight transport. They found that 31% of trade (by value) yielded a net reduction in carbon emissions. The remaining trade on average was responsible for 158g of additional CO₂ emissions per \$ of value. In theory, if decelerating international freight services discouraged this trade, it could help to cut emissions. One must exercise caution in interpreting this result, however. First, Cristea et al concede that this a 'very much back-of-the-envelope calculation' that does not consider the feasibility of replacing traded goods with domestic production. Second, the deceleration of transport would in itself partially decarbonise the cross-border movement of freight and thus, *ceteris paribus*, reduce the proportion of trade causing a net increase in CO₂ emissions. Third, the study relates only to cross-border trade and excludes a shortening of supply lines within countries and any related effects on carbon emissions.

Effect of lengthening transit times on the pattern of sourcing: Average transit time is one of many criteria influencing supplier selection. A deceleration of transport would disadvantage more distant suppliers in terms of the absolute number of hours or days it takes to receive an order. Assuming that the other selection criteria remained constant, one would expect longer transit times to reduce the relative competitiveness of more distant suppliers. In the trade economics literature various attempts have been made to quantify this loss of competitiveness by treating increases in transit time as an ad-valorem tariff. For example, by analysing the modal substitution of airfreight services for shipping services on inbound trade to the US, Hummels and Schaur (2012) estimated that 'each day in transit is equivalent to an ad-valorem tariff of 0.6 to 2.3 percent and that the most time-sensitive trade flows are those involving parts and components trade.' Much of this trade is subject to just-in-time (JIT) pressures. Hummels and Schaur partly attribute industrial 'fragmentation' at a global scale to a dramatic reduction in the real cost of air cargo

services over the last few decades, allowing companies to buy fast transport services much more cheaply than before. Their arguments relate mainly to trade in more time-sensitive products transported by air. As around 60% of air cargo moves in the bellyholds of passenger aircraft, its speed is largely governed by passenger schedules and thus difficult to reduce. Hummels and Schaur's analysis appears less applicable to the shipping sector, given the recent experience with slow steaming. Despite the 12-15% reduction in the average speed of container vessels post-2008, global container traffic in 2012 was 12% higher than its pre-2008 peak (UNCTAD, 2013). Company-level survey data also suggests that large shippers have been able to accommodate slow steaming without too much difficulty and not had to modify their sourcing patterns in response to longer deep-sea transit times.

Several recent studies have noted the emergence of a 'reshoring' trend and predicted a significant return of manufacturing activity to North America and Europe from Far Eastern low-labour cost countries by 2020. A slowing of transport services is seldom cited as a driver of this reshoring trend, though in a recent survey of UK manufacturers that had reshored some of their activities roughly a third of respondents cited 'reduce product delivery time' as a reason for their decision (Engineering Employers' Federation, 2013, p13).

Overall, the available evidence suggests that a reversal of the globalisation trend and return to more localised sourcing could help to cut GHG emissions and a deceleration of long haul transport services could contribute this process. Its contribution would be greatest in the case of the most time-sensitive freight, but most of this moves by air, the mode which, for technical and commercial reasons, offers limited potential for 'despeeding'. For less time-sensitive commodities moving by slower modes, transit times might have to lengthen substantially to induce much 'near-shoring'. It is likely too that in many trade corridors the effect of this deceleration will be largely or completely neutralised by the trade facilitation initiatives currently underway. These initiatives were given added impetus by the December 2013 WTO agreement in Bali which, if and when it is fully implemented, could boost global trade by \$1 trillion. Central to these facilitation initiatives is the reduction in waiting times at international borders. Even for long-haul trade, these waiting times often exceed the transport time. For example, mobile phones exported from Mexico to Brazil typically spend around 10 days being transported and 23 days delayed by Brazilian 'import processes, including customs' (World Economic Forum, 2013). UNCTAD estimates that worldwide the 'average customs transaction involves 20-30 different parties, 40 documents, 200 data elements (30 of which are repeated at least 30 times) and the re-keying of 60-70 per cent of all data at least once' (quoted World Trade Organisation website). For much world trade, streamlining and accelerating these administrative processes are likely to have a much greater impact on end-to-end supply chain times than any foreseeable initiatives to 'despeed' freight transport services. If such initiatives were considered necessary as part of a radical decarbonisation plan, the reduction in border delays would ease the net effect on the scheduling of global production and distribution operations.

Relaxation of JIT

Application of the JIT principle is often portrayed as being bad for the environment. The conventional argument is that in sourcing products on a JIT basis companies sacrifice transport efficiency for inventory savings, increasing the amount of freight traffic to the detriment of the environment. As JIT replenishment is heavily dependent on fast and reliable delivery, a deceleration of transport could force a relaxation of the principle and rebalancing of the transport / inventory trade-off in favour of the environment. This is a rather simplistic proposition that requires several qualifications. First, JIT is not simply an inventory-minimising stock control system: it is a whole business philosophy designed to cut waste, raise productivity and improve product quality. One therefore needs to make a more holistic assessment of the net effect of JIT on GHG emissions before threatening to undermine it. It is possible that any additional emissions from the under-

utilisation of transport capacity will be more than offset by emission reductions from lower energy consumption and waste in production and warehousing operations. Second, reliability is more important than speed in the execution of JIT. It may be possible to lengthen transit times, so long as schedules are carefully planned and components arrive when they are required. It is often when the planning is defective or internal processes fail that 'emergency', carbon-intensive transport services have to be used to maintain production operations in the absence of buffer stock. A significant proportion of airfreight traffic falls into this category, which could be reduced if internal planning and management of operations were more robust. Third, in this context, it is important to differentiate movement time, transit time and logistical cycle time:

Movement time: during which the freight is in motion, when energy use and emissions are a function of speed.

Transit time: this subsumes movement time but also includes time when consignments are stationary or being marshalled at freight terminals.

Logistical cycle time: this is the time elapsing between the recognition of the need for a component and its receipt for use in a production operation.

The focus of this paper is the movement time, but this often represents the minority of the transit time and a small proportion of the logistical cycle time, even within a JIT regime. Any time loss from the deceleration of the freight vehicle could be more than offset by a reduction in dwell times in terminals, waiting times in factories and warehouses and order processing times at both ends of the transaction. A multitude of studies on lean supply chains have quantified the large amounts of idle, non-value-adding time they contain and shown how it can be minimised. In most cases this can be done with little or no net increase in energy use or emissions, and often a reduction. So improved internal process management can allow companies to absorb increases in 'movement time' without increasing the logistical cycle time, which is, after all, the critical parameter in JIT scheduling.

CONSEQUENTIAL EFFECTS OF SPEED REDUCTIONS

Two such effects are envisaged, one related to freight modal shift and the other to the use of low carbon energy sources with lower power ratings.

Freight Modal Shift

Shifting freight to transport modes with a lower carbon intensity has been identified in numerous studies as a very effective means of decarbonisation (e.g. IPCC, 2014). It is also a key element in government decarbonisation plans for transport in many countries, including as the UK, Germany and China. Shifting freight within domestic markets from road to rail and waterborne services and from air to sea globally can achieve substantial reductions in carbon emissions. One consequence of such modal shifts is an increase in average transit time, reflecting the slower speeds of greener modes. The slower speeds are largely associated with lower energy- and hence emission-intensity though also related to the nature of the infrastructure and operating practices.

In the case of long haul, transcontinental services, the difference in transit time between airfreight services and surface modes is so great that modal shift opportunities are very limited and the air and sea markets effectively discrete. The main opportunity for altering the freight modal split is in domestic or continental markets, where narrowing differences in average speed would encourage a shift to lower carbon modes. This could either be achieved by imposing tighter restrictions on trucking or actually accelerating rail and waterborne services. Any modal transfer from road to rail and water as a result of deceleration would supplement the direct emission savings outlined above. Significant reductions in the transit time of rail freight services could be achieved without actually accelerating the trains, but instead by reducing terminal / marshalling time and time spent in sidings allowing faster passenger trains to pass. There is less potential for

accelerating barge services and efforts to develop fast short-sea freight services have had limited success.

On the demand-side, shippers could possibly do more to accommodate slower rail and waterborne services within their logistics systems by rescheduling activities and altering the order fulfilment process. In some sectors, such as FMCG, many high-volume product lines are replenished on a fairly regular basis, creating a stable flow that would be amenable to movement by rail or, even, water. Products might then spend more time as in-transit inventory in a train or on barge and less time in warehouses at either end of the journey, but the total logistical cycle time would not be lengthened. A service of this type, called 'Distrivaart', was trialled in the Netherlands in the early 2000s with Heineken providing a base flow of beer moving around a 'circuit' of canals and supplying a series of nearby retail distribution centers (Guis and Verweij, 2004). Although this service was discontinued, the basic concept remains valid and may be able to work commercially under different circumstances. This is a form 'synchromodality' linking the choice of freight transport mode to the synchronization of production and distributions cycles at different points in the supply chain (Lucassen and Dogger, 2012).

Switch to Lower Carbon Energy Sources

A move from fossil to alternative fuels also features prominently in logistics decarbonisation agendas. Some of these alternative power sources have a lower power rating and may not be able to propel freight vehicles at the same speeds as fossil fuels. Companies might therefore have to accept slower delivery as an operational penalty of switching to these energy sources. Biodiesel, for example, has a calorific value approximately 9% lower than conventional diesel, though this does not necessarily translate into inferior vehicle performance. As Fazal et al (2011) note, *'Engine power is reduced slightly or not at all because the consumption of biodiesel increases enough in order to compensate its lower heating value...overall biodiesel permits acceptable engine performance and it could be further improved if viscosity could be reduced'* (p.1321). Biodiesel is also blended with conventional diesel, typically in mixes between 5 and 20%, and so this further reduces any net impact on vehicle speed.

A potentially more important connection between alternative power source and speed is in the maritime sector where the use of sails has been piloted as a means of cutting fuel consumption and emissions. When used as a supplementary propulsion system, so-called 'sky-sails', which resemble large kites, can reduce fuel consumption by 30-40% (Skysail GbmH, 2013). This technology only yields significant energy and emission benefits up to speeds of 16-17 knots, however, significantly below even the typical 'slow steaming' velocity of large container ships (Willyard, 2008). It is, nevertheless, within the range of the 'super-slow steaming' speeds at which some container ships now operate (Maloni et al, 2013) and would be suitable for other categories of cargo vessel. It has also been suggested that the use of sails may allow some vessels to accelerate without any additional fossil energy use or emissions (Corbett quoted in Willyard, 2008).

CONCLUSIONS

This paper has made an initial attempt to assess the potential for cutting logistics-related GHG emissions by reducing the speed at which freight is moved through supply chains. It has classified different types of velocity reduction within existing transport decarbonisation frameworks and examined their direct, indirect and consequential impacts on emissions. Slowing down ships and, to a lesser extent, trucks has been shown to be an effective direct means of cutting emissions. The resulting increase in transit time can be partly or wholly offset by an acceleration of administrative processes within the supply chain. This would minimise any reduction in service quality or increase in inventory levels at little or no emissions penalty. The wider implications of 'de-speeding' for sourcing patterns and replenishment systems are more difficult to determine on the basis of currently available data and will require further research.

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Section 3: Services and the Supply Chain

VALUE CREATION IN PRODUCT RETURNS MANAGEMENT – A SYNTHESIS OF THE LITERATURE

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ABSTRACT

Value creation and maximising the appropriation of value vis-à-vis other entities in the supply chain are key aims of any organisation. Studies on the contribution of product returns management to firm value are limited and fragmented. Most have taken the narrow view that value is derived from product disposal activities. This paper synthesises the literature on value and applies the value construct to the product returns process in the business-to-business (B2B) context. The paper reviews the literature on value and distils the applicability of this construct to the management of product returns. The Strategic Profit Model (SPM), which connects an organisation's revenues, costs, and resources to its return on assets based on activities in the forward supply chain, guided the literature synthesis. The value elements were mapped against key elements of the SPM to develop an integrated framework for value creation in the B2B product return chain.

Key words: Value Creation, Product Returns, Supply Chain, Strategic Profit Model, B2B

INTRODUCTION

Value creation and maximising the appropriation of value vis-à-vis other entities in the supply chain are key aims of any organisation (Cox, 1999). While product returns management is acknowledged as being a key supply chain process (Lambert & Cooper, 2000), the concept of value and its application to the product returns management process is significantly under-researched (Mollenkopf, Frankel, & Russo, 2011). Product returns can be as high as 50% of sales and the handling of these returned products is estimated to cost the consumer electronics sector in the US US\$13.8 billion (Accenture, 2007). Organisations often view product returns management as a cost issue, paying little attention to the impact of returns on the firm and the opportunities that effective returns management can deliver (Accenture, 2007; Bernon, Rossi, & Cullen, 2011; Stock, Speh, & Shear, 2006).

This paper draws on value creation literature in the business-to-business (B2B) context and adopts the Strategic Profit Model (SPM) (Stapleton, Hanna, Yagla, Johnson, & Markussen, 2002) to link value drivers to return on assets, an acknowledged measure of firm value, in the product returns process. It contributes a novel perspective to assessing the value of product returns management, providing a practical tool for executives to devise an effective returns management program.

APPROACH

This paper is a synthesis of the relevant literature on value in business-to-business supply chains and distils the applicability of this construct in understanding the management of product returns. An iterative search of the literature was used. In the first stage, three major journal data bases - Emerald, Science Direct and Business Source Premier - were searched. Search terms used were a combination of "value", "customer value", "supplier value", "supply chain", "reverse logistics", "product returns". As these data bases are not exhaustive, a second search was conducted using the reference lists of most recently published papers to fill gaps in journals not covered by the selected data bases. A total of 216 papers were eventually reviewed from 76 peer reviewed journals and four peer reviewed conference proceedings. Table 1 lists the top seven journals, which contain 100 of the 216 papers reviewed.

Journal	No. of Papers
Industrial Marketing Management	36
Journal of Marketing	16
Journal of the Academy of Marketing Science	11
Management Decision	11
International Journal of Physical Distribution & Logistics Management	9
Journal of Business & Industrial Marketing	9
European Journal of Marketing	8

Table 1 Top seven journals containing 100 of the papers reviewed

WHAT IS VALUE?

The concept of value has a rich research heritage in the industrial marketing literature (Anderson & Narus, 1998; Beverland, 2012; Grönroos & Voima, 2013; Lindgreen, Hingley, Grant, & Morgan, 2012; Payne & Holt, 2001) and in supply chain studies (Childerhouse & Towill, 2000; Dietl, Royer, & Stratmann, 2009; Fawcett & Fawcett, 1995; Hammervoll, 2009; Jayaram, Kannan, & Tan, 2004; Lambert & Burduroglu, 2000; Lusch, 2011).

Although customer satisfaction has long been accepted as central to marketing theory and practice, Woodruff (1997) suggested that the delivery of customer value is a much more relevant source of competitive advantage. While value creation and value appropriation vis-à-vis other entities in the supply chain are key aims of any organisation (Cox, 1999), few supplier firms in business markets can define value, know how to measure it, or can explain how their products or services contribute to the customer's perception of value received (Anderson & Narus, 1998; Bowman & Ambrosini, 2010; Lepak, Smith, & Taylor, 2007). In a review of the state of value research in business markets, Lindgreen and Wynstra (2005) also concluded that many firms can neither define nor measure value adequately, highlighting that the field is still under-researched. Early attempts to define value are linked with the concept of the augmented product, a package of benefits beyond the core generic product (Levitt, 1980). In the marketing context, value has also been associated with price, benefits derived from product attributes, perceived product quality versus price paid, and, more broadly, what customers "get" for what they "give" (Zeithaml, 1988).

Value as a trade-off between, or net of, "get" (or benefits) versus "give" (or costs or sacrifices) is widely accepted in current literature (Babin & James, 2010; Blois, 2003; Gabbott, 2004; Khalifa, 2004; Lindgreen & Wynstra, 2005; Ulaga, 2003). A failure to understand the nature of value leads to a focus on price rather than total costs and benefits (Anderson & Narus, 1998). Importantly, value, or the benefits and costs from which value is assessed, is not necessarily tied to monetary units. Within the context of inter-organisational transactions, value can be derived from multiple sources: goods, services and the revenue they generate, and intangible elements, such as inventory information or demand forecasts (Allee, 2000). The benefits and costs might be evaluated along technical, economic, service or social dimensions (Anderson & Narus, 1998) or economic, strategic and behavioural dimensions (Wilson & Jantrania, 1994). Sacrifice made by the customer is the total cost of ownership, which includes in-use costs as well as acquisition costs (Ravald & Grönroos, 1996). Service quality has been identified as a value driver, separate and distinct from costs and benefits (Parasuraman & Grewal, 2000).

Lindgreen et al. (2012) and Lindgreen and Wynstra (2005) reviewed value studies and concluded that there are distinctive streams pre- and post-2005. Pre-2005, an assessment of the value of goods and services distils into a comparison of the benefits and the total costs associated with acquisition and use of the product or service. An understanding of value as a trade-off between costs and benefits takes a transactional view of value creation (Ulaga, 2003). Value can be acquired from relationships, and relational exchanges accrue more value than transactional exchanges (Lindgreen et al., 2012). This relational dimension of value is being regarded as of increasing importance

in B2B marketing (Haas, Snehota, & Corsaro, 2012). Gil-Saura, Servera-Francés, and Fuentes-Blasco (2010) identify trust, commitment, collaboration, flexibility, personal customer-supplier relationships as relational benefits leading to value. Supply chain collaboration (Horvath, 2001) and supply chain integration (Tuominen, 2004) are also suggested as value drivers.

A relational view suggests that value creation is not the sole domain of the supplier. Resources of both supplier and customer need to be deployed to create value. Value is created by exchange between seller and buyer, and each entity needs to appropriate value for itself from this jointly created value (Grönroos, 2011). Ngo and O'Cass (2010) support this dyadic view suggesting value consists of value-in-offering (the supplier's side) and value-in-use (the customer's side). Only through this dyadic view can a full comprehension of value be reached. Evans and Berman (2001) see the value chain as a unit of analysis with a focus on the role of processes within the chain that lead to value. Payne and Holt (2001) also recognise the multilateral perspective of value creation. They suggest relationship marketing is the framework that is best able to integrate the customer value concept through integration of customers, employees and other stakeholders. It moves customer value beyond a transactional outcome to one that is the result of a dynamic time dependent one, i.e., cumulative transactions over time create value. Table 2 summarises the key perspectives on value in the forward supply chain.

Value Perspective	Main Argument	Main Elements	Indicative References
Augmented product	Value derives from product attributes beyond the core offering.	Core and augmented product; total delivered product; revised supplementary services model.	(Levitt, 1980) (Evans & Berman, 2001) (Frow, Ngo, & Payne, 2014)
Quality	Perceived quality of the offering especially relative to price is the main indicator of value.	Product quality per price; service quality as value driver.	(Zeithaml, 1988) (Parasuraman & Grewal, 2000) (Ulaga & Chacour, 2001) (Cho & Pucik, 2005)
Benefits / costs	Value is assessed by comparing the benefits derived compared to the sacrifices made to acquire the offering.	Give and Get; total cost of ownership; non-monetary costs and benefits.	(Blois, 2003) (Ravald & Grönroos, 1996) (Allee, 2000) (Babin & James, 2010)
Relationships	Value is embedded in the relationship between buyer and seller.	Relational elements of benefits; value in relationships; relationship marketing.	(Lindgreen et al., 2012) (Gil-Saura et al., 2010) (Payne & Holt, 2001)

Table 2 Summary of key value perspectives.

THE STRATEGIC PROFIT MODEL AS FRAMEWORK

Return on assets (ROA) or economic profit (Economic Value Added or EVA) are useful metrics for quantifying value (Lambert & Burduroglu, 2000; Lee & Lund, 2003; Walters & Lancaster, 1999). The strategic profit model (SPM) combines costs, revenues, assets and liabilities to determine the ROA (Stapleton et al., 2002) and has been used to evaluate the value implications of supply chain strategies (Lambert & Burduroglu, 2000; Lambert & Pohlen, 2001; Pohlen & Coleman, 2005; Pohlen & Goldsby, 2003). The usefulness of the SPM is that the impact of non-financial activities, such as lead-time changes, service levels, and quality, can be monetized and incorporated into the model to derive a value assessment (Lambert & Burduroglu, 2000).

To deliver customer value, firms need to develop a range of capabilities that includes a shared understanding of value between buyer and seller (Woodruff, 1997). Some of these capabilities in a supply chain are identified by Rainbird (2004), who suggested that the balancing of customer demand with the capacity of the firm's supply processes needs to be achieved, using an analogy with chemical reactions, through a catalyst. The

catalyst for achieving such a balance is identified as a firm's capabilities, such as skills, assets, technology, and relationships (Rainbird, 2004).

The deployment of capabilities and firm resources is also seen as central in the creation of customer value in formulating a unified theory of logistics (Mentzer, Min, & Bobbitt, 2004). The links between resources, capabilities and value are summarised in Figure 1. Capabilities have cost and asset implications that can be monetised and incorporated into the SPM. This is illustrated in

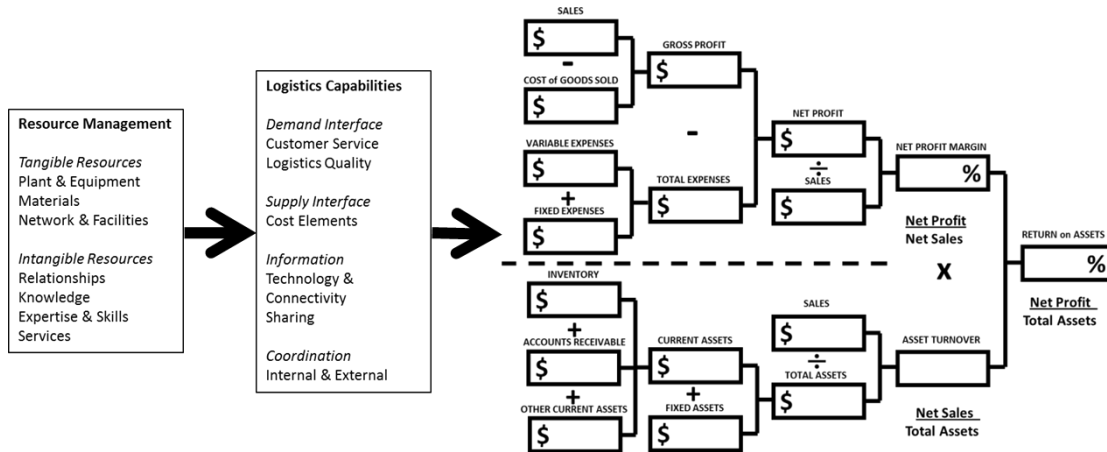


Figure 2.

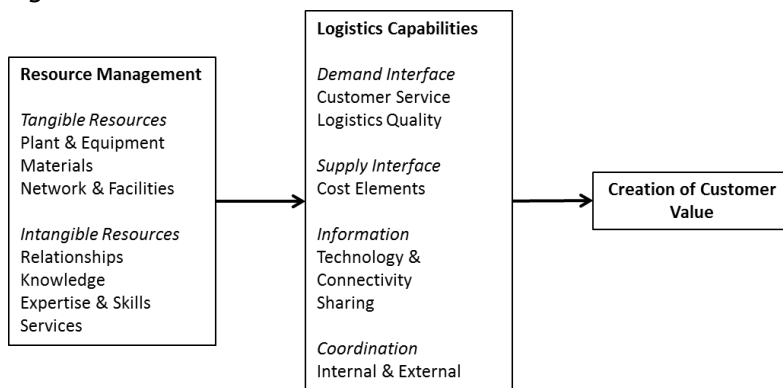


Figure 1: From resources to customer value. Adapted from Mentzer et al. (2004).

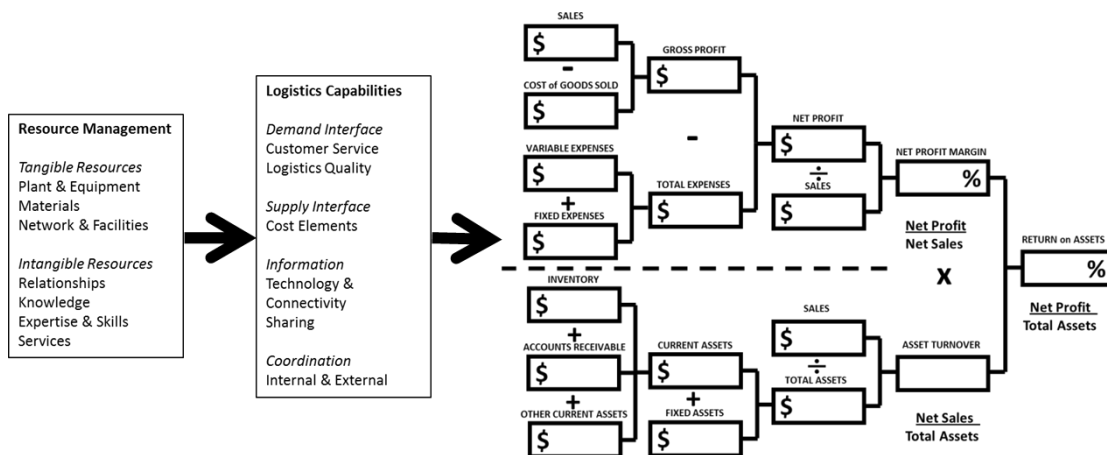


Figure 2: Value creation framework. Adapted from Mentzer et al. (2004) and Lambert and Burduroglu (2000).

VALUE DRIVERS IN PRODUCT RETURNS

A core process in supply chain management (Croxtton, Garcia-Dastugue, Lambert, & Rogers, 2001; Lambert & Cooper, 2000; Rogers, Lambert, Croxtton, & Garcia-Dastugue, 2002; Supply Chain Council, 2008), returns management subsumes the activities of reverse logistics and extends to gatekeeping and avoidance actions, both of which are aimed at cost minimisation. Gatekeeping involves the screening of products as they enter the reverse stream to ensure that only appropriate products are returned. Avoidance involves finding approaches that reduce items likely to be returned through such actions as user education, product design and improved product quality (Rogers et al., 2002).

Although reverse logistics has been defined as the management of the reverse flow of product for the “purposes of recapturing or creating value or proper product disposal” (Rogers & Tibben-Lembke, 2001; p. 130), the locus of that value has centred on the product and product flows. The study of value creation has focused narrowly on product disposal activities with value being interpreted as the economic gains made from recycling, reuse and salvage (Bernon & Cullen, 2007; Hugel Brodin & Anderson, 2008; Johnson, 1998; Pokharel & Mutha, 2009; Rogers & Tibben-Lembke, 2001). Relatively few studies have transcended this cost dimension (Mollenkopf et al., 2011).

An extended perspective has explored the impact of reverse logistics on profitability, customer satisfaction and the environment (Jayaraman & Luo, 2007), the need for speed in processing returns to minimise potential loss of value (Blackburn, Guide, Souza, & Van Wassenhove, 2004), enhanced customer perceptions of quality, and the goodwill that can accrue to organisations practising good corporate citizenship through managed product returns (Mollenkopf & Closs, 2005), the potential for value creation from tangible and intangible elements (Dapiran & Mollenkopf, 2010), and the role that internal firm integration plays in value creation (Mollenkopf et al., 2011).

Table 3 summarises the value drivers that have been reported in extant literature, together with the value outcomes extrapolated by the authors. The impact on the SPM elements is also shown.

Value Drivers	References	Value Outcomes	Extrapolated SPM Impact
Product disposition – reuse, repair, refurbish, remanufacture, recycle.	(Blackburn et al., 2004) (Jayaraman & Luo, 2007) (Johnson, 1998) (Kumar, Shirodkar, Camelio, & Sutherland, 2013) (Thierry, Salomon, Van Nunen, & Van Wassenhove, 1995) (Guide Jr & Van Wassenhove, 2001) (Heese, Cattani, Ferrer, Gilland, & Roth, 2005) (Hodge, Ochsendorf, & Fernández, 2010) (Mollenkopf & Closs, 2005) (Srivastava, 2008) (Stock et al., 2006) (Ayres, Ferrer, & Van Leynseele, 1997) (Gobbi, 2011) (Hugel Brodin & Anderson, 2008) (Lebreton & Tuma, 2006) (Mitra, 2007) (Rogers & Tibben-Lembke, 1998) (Rogers & Tibben-Lembke, 2001) (Rogers et al., 2002) (Thierry et al., 1995)	<ul style="list-style-type: none"> • Lower cost of material inputs. • Reduced inventory write-downs. • Reduced disposal costs. • Free up firm resources for alternative projects. 	<ul style="list-style-type: none"> • Sales • Cost of Goods • Costs • Inventory
Use of secondary markets	(Blackburn et al., 2004) (Thierry et al., 1995) (Heese et al., 2005) (Mollenkopf & Closs, 2005) (Tibben-Lembke, 2004) (Lee & Lund, 2003) (Mitra, 2007) (Prahinski & Kocabasoglu, 2006) (Rogers & Tibben-Lembke, 1998) (Rogers & Tibben-Lembke, 2001) (Rogers et al., 2002)	<ul style="list-style-type: none"> • Increase sales revenue. • Better margins. • Higher inventory turnover. • Reduced obsolete stock and inventory write-downs. 	<ul style="list-style-type: none"> • Sales • Costs • Inventory
Product returns chain design – 3PL, centralised returns centre.	(Blackburn et al., 2004) (Mollenkopf & Dapiran, 2007) (Stock et al., 2006) (Jayaraman & Luo, 2007) (Stuart, Bonawi-tan, & Loehr, 2005) (Lomba & Nakashima, 2012) (Prahinski & Kocabasoglu, 2006) (Rogers & Tibben-Lembke, 1998) (Rogers & Tibben-Lembke, 2001) (Rogers et al., 2002)	<ul style="list-style-type: none"> • Lower operating costs. • Improve relationships through 3PL know-how. • Improved information. • Help customers make better returns decisions. • Fewer facilities. • Reduced transport costs. 	<ul style="list-style-type: none"> • Costs • Inventory • Fixed Assets

	(Dapiran & Kam, 2011) (Dapiran & Mollenkopf, 2010) (Richey, Genchev, & Daugherty, 2005)	<ul style="list-style-type: none"> • Reduced administrative costs. 	
Returns avoidance and gatekeeping	(Sciarrotta, 2003) (Lee & Lund, 2003) (Rogers & Tibben-Lembke, 1998) (Rogers & Tibben-Lembke, 2001) (Rogers et al., 2002) (Dapiran & Kam, 2011) (Dapiran & Mollenkopf, 2010)	<ul style="list-style-type: none"> • Lower inventory. • Improved relationships. 	<ul style="list-style-type: none"> • Sales • Costs • Inventory
Functional integration, alignment, returns chain collaboration	(Mollenkopf et al., 2011) (Mollenkopf, Rabinovich, Laseter, & Boyer, 2007b) (Mollenkopf, Russo, & Frankel, 2007a) (Yalabik, Petruzzi, & Chhajer, 2005) (Abraham, 2011) (Bernon & Cullen, 2007) (Bernon et al., 2011) (Jayaraman, Ross, & Agarwal, 2008)	<ul style="list-style-type: none"> • Improved customer service in after-sales support. • Returns avoidance. • Improved returns authorisation processing. • Increased market knowledge. • Margin improvement. • Enhanced relations. • Identify quality issues. • Relational benefits. 	<ul style="list-style-type: none"> • Sales • Costs • Inventory
Time – speedy returns, speedy disposition decisions, responsive returns chain.	(Blackburn et al., 2004) (Guide Jr, Muyldermans, & Van Wassenhove, 2005) (Gobbi, 2011) (Lee & Lund, 2003) (Rogers & Tibben-Lembke, 1998) (Rogers & Tibben-Lembke, 2001) (Rogers et al., 2002) (Stock et al., 2006) (Stuart et al., 2005)	<ul style="list-style-type: none"> • Shorter lead times. • Lower operating costs. • Lower inventories. • Prompt customer credits. • Improved relationships. 	<ul style="list-style-type: none"> • Costs • Inventory • Accounts Receivable
Efficient returns chain	(Blackburn et al., 2004) (Thierry et al., 1995) (Mollenkopf & Dapiran, 2007) (Stock et al., 2006) (Gobbi, 2011) (Rogers & Tibben-Lembke, 1998) (Rogers & Tibben-Lembke, 2001) (Rogers et al., 2002) (Dapiran & Mollenkopf, 2010) (Prahinski & Kocabasoglu, 2006)	<ul style="list-style-type: none"> • Lower administrative and operations costs. 	<ul style="list-style-type: none"> • Costs
Process information – about timing, quantity, quality of returned products, return reasons.	(Ketzenberg, van der Laan, & Teunter, 2006) (Ketzenberg, 2009) (Mollenkopf & Dapiran, 2007) (Bernon & Cullen, 2007) (Bernon et al., 2011) (Jayaraman et al., 2008) (Lee & Lund, 2003) (Dapiran & Kam, 2011) (Dapiran & Kam, 2011) (Dapiran & Mollenkopf, 2010)	<ul style="list-style-type: none"> • Reduced uncertainty. • Lower inventories. • Reduced costs. • Increased asset recovery. • Efficient use of storage facilities. • Less damage to returned product. 	<ul style="list-style-type: none"> • Sales • Costs • Inventory • Fixed Assets
Analytical information – product performance, merchandising effectiveness, buying behaviour.	(Jayaraman & Luo, 2007) (Mollenkopf & Dapiran, 2007) (Stock et al., 2006) (Dapiran & Mollenkopf, 2010)	<ul style="list-style-type: none"> • Higher customer satisfaction and loyalty. • Improved product design. • Product quality information. 	<ul style="list-style-type: none"> • Sales • Costs
Good corporate citizen effect	(Johnson, 1998) (Jayaraman & Luo, 2007) (Mollenkopf & Closs, 2005)	<ul style="list-style-type: none"> • Increased customer loyalty. • Compliance costs. 	<ul style="list-style-type: none"> • Sales
Returns policy	(Jayaraman & Luo, 2007) (Mollenkopf et al., 2007b)	<ul style="list-style-type: none"> • Increased customer loyalty. • Higher customer satisfaction. 	<ul style="list-style-type: none"> • Sales
Service	(Mollenkopf & Dapiran, 2007) (Mollenkopf et al., 2007b) (Prahinski & Kocabasoglu, 2006)	<ul style="list-style-type: none"> • Higher customer satisfaction. 	<ul style="list-style-type: none"> • Sales • Costs

Table 3 Summary of value drivers and value outcomes.

VALUE FRAMEWORK FOR PRODUCT RETURNS

The use of the SPM in product returns has been reported in a few studies (Blackburn et al., 2004; Mollenkopf & Closs, 2005). These two studies evaluate the trade-off between

value of recovered assets and the operating costs involved in processing the returned product. The main gap in these studies is that they demonstrate the value impact for only a single party in the seller-buyer dyad.

In value creation both the supplier and customer need to be considered (Rainbird, 2004; Walters & Lancaster, 2000). Back-to-back SPMs allow both parties of the supplier-customer dyad to measure the value impact of their exchanges (Lambert & Pohlen, 2001; Pohlen & Goldsby, 2003). The product returns value drivers as summarized in Table 3 give rise to value outcomes for both the supplier and the customer. Figure 3 illustrates this point.

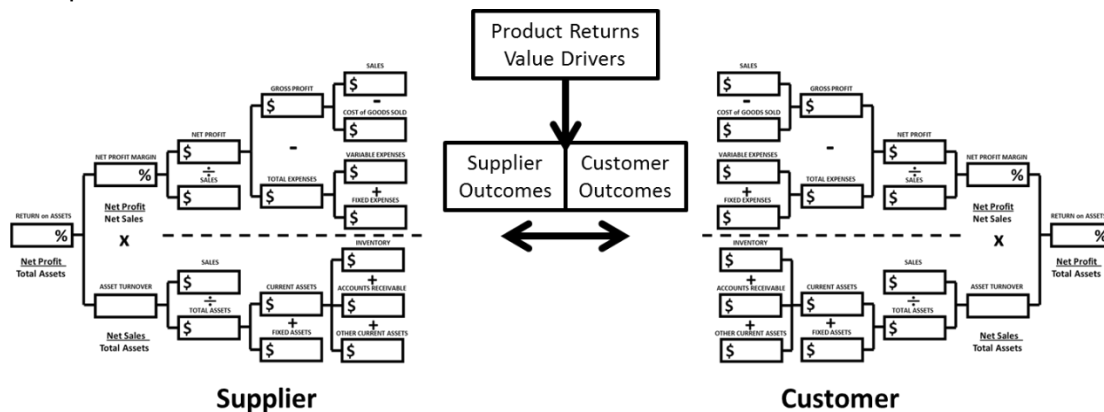


Figure 3 Dyadic product returns value framework.

An illustrative example using one of the value drivers will clarify the framework. Information about the returns management process is considered a major driver of value (see references in Table 3). The technology used and the operation of the information system will have cost implications for both the supplier and the customer. Process information provides visibility of the returns chain and gives the supplier advanced notice of what products are being returned, the volume of product, reasons for the returns, condition of the product, and timing of consignment arrival. The information gives the supplier the ability to plan for the returning product. Better product disposition decisions can be made if the quantity and condition of the returning product are known ahead of time. This is especially important if the returned products are being used again in the manufacturing process in a closed-loop environment (Ketzenberg, 2009). Over the long term the supplier can optimise storage space and so bring about a reduction in facilities size (Bernon & Cullen, 2007). Effective information systems allow the supplier to gain an insight into product design deficiencies or limitations of existing product use instructions (Mollenkopf & Dapiran, 2007). Responding to this insight leads to returns avoidance with related cost reductions and improved consumer satisfaction (Dapiran & Kam, 2011). The customer also benefits through a more efficient returns chain that information systems enable, which in turn leads to faster credit processing. The knowledge gained through process information systems and technology drives sales, costs, inventory, and fixed assets elements in the SPM. This is summarised in Figure 4.

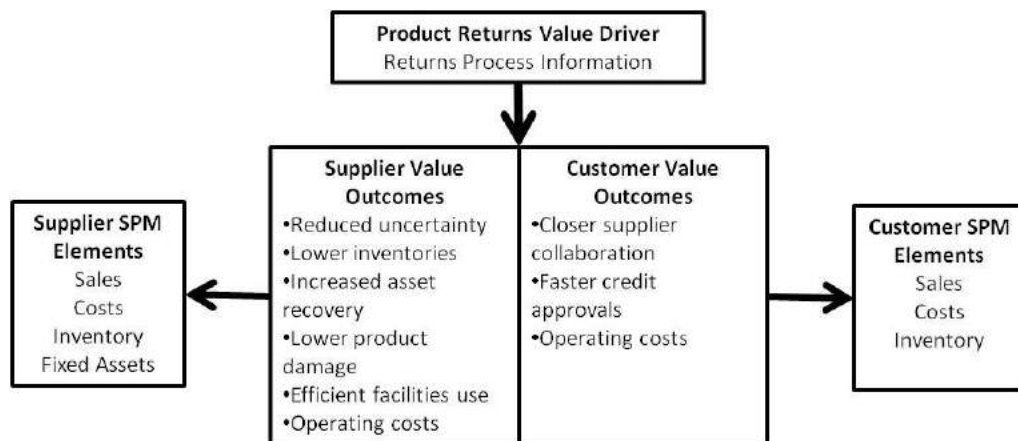


Figure 4 Dyadic returns value framework example for Process Information.

IMPLICATIONS AND CONTRIBUTION

This paper synthesises the literature on the value creation potential of the product returns process and draws on the SPM to link drivers to firm value. The conceptual argument presented offers a theoretical platform from which to further explore how value may be created and appropriated in product returns management. Applying the SPM structure to the context of product return management provides practical insights on how suppliers and retailers might create value for themselves through product returns management, turning around a conventionally held view that managing product returns only adds costs with little or no benefits to the supply chain (Meyer, 1999)

CONCLUSIONS

The management of product returns is a key supply chain process. It has been shown that a number of drivers can create value in this process for both parties in the returns chain. An assessment of the value created can be made by the use of back-to-back SPMs. Previous research in product returns value has focused primarily on product disposition as the main value driver. The framework proposed in this paper links an extended range of drivers to firm value as expressed by ROA. Although it lacks empirical substantiation, this paper extends the theoretical understanding of value in the returns process. The SPM also provides a useful tool for executives to quantify the value created by taking a broader understanding of product returns management. Further research via case studies of product returns chains as well as surveys of suppliers and retailers in a range of industries would provide the empirical validation needed.

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HARVESTING BIG DATA TO SUPPORT SUPPLY CHAIN INNOVATION

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ABSTRACT

Although the term of big data is not new, the use of big data in supporting supply chain operations is a relatively new area. There are many analytic tools and techniques in use (Tan and Platts, 2004; Mohri et al, 2012), but the majority of them are limited to information visualisation or identifying customer needs. The purpose of this paper is to develop and examine an analytic framework to assist firms to harvest big data to enhance their supply chain innovation capability. The proposed approach allows firms to tap into the potential of innovation afforded by big data to gain competitive advantages.

1.0 INTRODUCTION

How could operations managers harvest big data to enhance supply chain innovation as well as to deliver better fact-based strategic decisions?

Many countries are now pushing for Digital Economy, and Big Data is increasingly fashionable in recent jargon. Wong (2012) states that the key factor to gain competitive advantage in today's rapidly changing business environment is the ability to extract big data to gain helpful business insights. Being able to use big data allows firms to achieve outstanding performances against their competitors. For example, retailers can potentially increase their operating margins by 60 percent by tapping into hidden values in big data (Werdigier, 2009). Many researchers point out that firms can better understand customers' preferences and needs by leveraging data available in loyalty cards and social media (Bozarth *et al.*, 1998; Tsai *et al.*, 2013).

On manufacturing and supply chain operations, Manyika *et al.*, (2011) points out that big data analytics can be helpful to support innovation by creating data transparency, improving human decision-making and promoting innovative business models. For example, big data can potentially reduce product development and assembly costs by 50%. Currently, there is a variety of analytics techniques could help firms to mine the unstructured data i.e. understand customers' preferences and needs. However, the applications of existing techniques are limited. Wong (2012) points out that the existing techniques for big data analytic are, in general, likely to be mechanistic. Additionally, many researchers point out that big data analytic technique to aid the development of new products are relatively underemphasized (Ozer, 2011; Cheng *et al.*, 2013; Manyika *et al.*, 2013).

Clearly, there is a lack of analytical tools and techniques to assist firms to generate useful insights from data to drive strategy or improve performance (Yiu, 2012; Manyika *et al.*, 2013). Thus, how could operations managers harvest big data to enhance supply chain innovation as well as to deliver better fact-based strategic decisions? Analytics is the practice of using data to generate useful insights that can help firms make better fact-based decisions with the ultimate aim of driving strategy and improving performance (Wong, 2012). This research seeks to develop and test an analytic framework for a firm to expand their competence set. A firm's competence set (i.e. an accumulation of ideas, knowledge, information, and skills) is vital to its innovation capabilities (Li, 1999; Chen, 2001; Mishra and Shah, 2009). This research addresses the situation in which a firm is willing to harvest (i.e. from big data) and incorporate competence set of others so that its innovation capabilities can be expanded.

2.0 BIG DATA IN SUPPLY CHAIN MANAGEMENT

Big data can create opportunities in supply chain operations to improve firm's overall performance. According to Cecere (2013), enhancing the implementation of big data and developing new analytics to support supply chain innovation is a significant step towards change. Based on the survey results, big data is more of an opportunity than a problem in supply chain. 76% of respondents consider it an opportunity and 28% already have a big data initiative in place. Moreover, Eyefortransport (2013) illustrates that more than a third of respondents believe the use of big data analytics in supply chain can have a significant impact on company performance. Therefore, the potential value of big data in supply chain management is huge, and it has a long way yet to go.

What is more, big data has a bright future in supply chain operations, it can make the operations well organised as well as improve its efficiency. Supply chain is the entire set of activities, involving the organization and flow of materials and other resources to produce and deliver the product to the final customer. In order to make sure the entire activities perform well, the current operations systems have many functions (e.g. order management, demand planning, ERP). Each segment of the supply chain can be more efficient and achieve cost reduction by using big data analytics. Also, big data can make forecasting more accurate through analysing more variety and volume of data (Ohlhorst, 2012). Moreover, big data can also be used to improve supply chain visibility. In this way, the supplier, manufacturer and retailer can access the same database information immediately and it will be easier to achieve Just in Time. Furthermore, big data can be successfully applied in transportation such as optimizing traceability and transportation routes. As auto-ID technology like RFID and barcodes has been widely used in supply chains, more volume and variety of data has been generated in the supply chain. Taking Wal-Mart as an example, there are around 267 million transactions per day in Wal-Mart's 6000 stores worldwide. For seeking for higher competitiveness in retail, Wal-Mart recently collaborated with Hewlett Packard to establish a data warehouse which has a capability to store 4 petabytes of data, i.e., 4000 trillion bytes, tracing every purchase record from their point-of-sale terminals. Taking advantage of sophisticated machine learning techniques to exploit the knowledge hidden in this huge volume of data, they successfully improve efficiency of their pricing strategies and advertising campaigns. The management of their inventory and supply chains significantly benefits from the large-scale data warehouse. All the evidence shows that applying big data can improve operations performance and has a great potential development prospect.

However, seizing the big data opportunity requires new technologies and redesign processes in support. Because the data volumes are growing and the variety and velocity of data are increasing, there is much difficulty with companies not using the data well. As for the data of supply chain analysis, three quarters of data are internal, and there is also a complex system existing in supply chains (Mishra and Shah, 2009). The volume of original data of supply chains is huge, and they also need to handle more and newer forms of data now. So, the biggest challenge to implement big data in supply chain is integrating big data analytics with current operations.

3.0 CHALLENGES IN BIG DATA ANALYTICS

The data needs to be organised to transform the countless bits and bytes into actionable information-the sheer abundance of data won't be helpful unless we have ways to make sense out of it (Davenport and Patil, 2012; Louridas and Ebert, 2013). Until now, scientists have developed a wide variety of modern techniques and technologies to capture, curate, analyse and visualize big data.

Generally, big data tools can be divided into three classes, namely, batch processing tools, stream processing tools, and interactive analysis tools. Most batch processing tools are based on the Apache Hadoop infrastructure, such as Mahout and Dryad (Kadlec *et al.*, 2009). The latter is for real-time analytic for stream data applications (Zikopoulos and Eaton, 2011). S4 and Storm are good examples for large scale streaming data analytic tools. The interactive analysis processes the data in an interactive environment, allowing

users to undertake their own analysis of information (Chen *et al.*, 2012). The user is directly connected to the computer and hence can interact with it in real time. The data can be reviewed, compared and analysed in tabular or graphic format or both at the same time. Google's Dremel and Apache Drill are Big Data tools based on interactive analysis.

All of these techniques cut across a number of disciplines, including computer science, economics, mathematics, statistics and other expertise. Multidisciplinary methods are needed to discover the valuable information from big data. Even so, they are far away from meeting variety of needs (Barton and Court, 2012; Wu *et al.*, 2014). However, due to the characteristics of big data, it is extremely hard for current techniques to analyse it in real time and produce useful information (Bisson *et al.*, 2010; Mishra *et al.*, 2013; Chen and Zhang 2014). Although such techniques might help managers to produce a lot of information, they are unfocused, and hence inefficient. A lot of effort and time is needed to sort out the information generated and to identify those that are relevant and viable.

Moreover, there are inherent limitations in current big data analytic techniques and technologies (Chen and Zhang, 2014). It only provides 'silo' information to managers. This could be extremely hard for such analytics tools to harvest big data in real applications. Instead of just generating vast amount of information using existing tools and techniques, what managers need are something new to structure, and link various stream of data to create a coherent picture of a particular problem – so that a better insights into the issue being analysed could be gained (Georgiou, 2009; Jelinek and Bergey, 2013). Thus, what managers required is an analytic framework that uses big data as inputs to make more informed strategic decisions.

4.0 FRAMEWORK PROPOSED BASED ON COMPETENCE SET ANALYSIS

Therefore, this research aim to propose a big data framework based on competence set analysis to support firms in big data harvest as well as enhance their supply chain innovation capabilities.

4.1 Competence set analysis

The concept of competence set was first introduced by Yu and Zhang (1989) and Yu (1990). For each significant decision problem, there is a competence set consisting of ideas, knowledge, information, and skills for its satisfactory solution. If decision makers think that they have acquired and mastered the competence set as perceived, they can quickly make the decision confidently. Otherwise, the decision maker may want to expand their competence set (Li and Yu, 1994). The important function of big data is to identify the required competence set and the decision maker's current competence set, and then help decision maker to effectively expand the required competence set from the acquired competence set, thus allowing the decision maker to confidently make a good decision.

Over the years, researchers have proposed several models for managing competence set. Yu and Zhang (1992) addressed the problem of optimally expanding competence set using the concept of the minimum spanning tree. Li and Yu (1994) presented a model of expanding the competence set based on deduction graphs. Shi and Yu (1996) proposed the method of expanding the competence set with asymmetric acquiring costs in a cyclic causal network. Li (1999) proposed a deduction graph model of incorporating competence set of multiple decision makers. Chen (2002) provided a new forest learning approach to expand competence set and that was capable to address consumer decision problems. As an advantage over Yu and Zhang (1992), Li and Yu (1994), Shi and Yu (1996), Chen (2002) models, Li's (1999) model can treat both the cyclic causal network problem and the group decision making problem. Thus, Li's deduction graph model is more promising in solving competence set expansion problem and improving managerial decision making process.

Deduction graph model is an analytic technique that allows firms to incorporate their own competence set with other firms to achieve competence set expansion purpose. Here, an example is provided to illustrate the Li's competence set expansion approaches. Let Tr be the true competence set for a particular problem E (i.e. a company needs to have several specific skills, machines or technologies to produce a product); let Sk be the decision makers' already acquired skills or competence set and let habitual domains be the set of skills related to solving the problem E including Tr and Sk . There are intermediate skills (I) which are not needed in Tr , but could help the decision maker to speed up the learning. The question here is how can we harvest big data to help the decision maker to identify their own Tr , Sk , I , learning costs between skills and relevant information in order to effectively reach Tr based on Sk . Further description of competence set in details, is available at Yu (1990,1991) and Yu and Zhang (1990, 1992).

4.2 Development of big data analytic framework

Based on deduction graph model we propose a big data analytic framework to support managers in big data harvest and competence set expansion. Referring to Figure 1, the proposed process of the analytic framework consists of 4 stages:

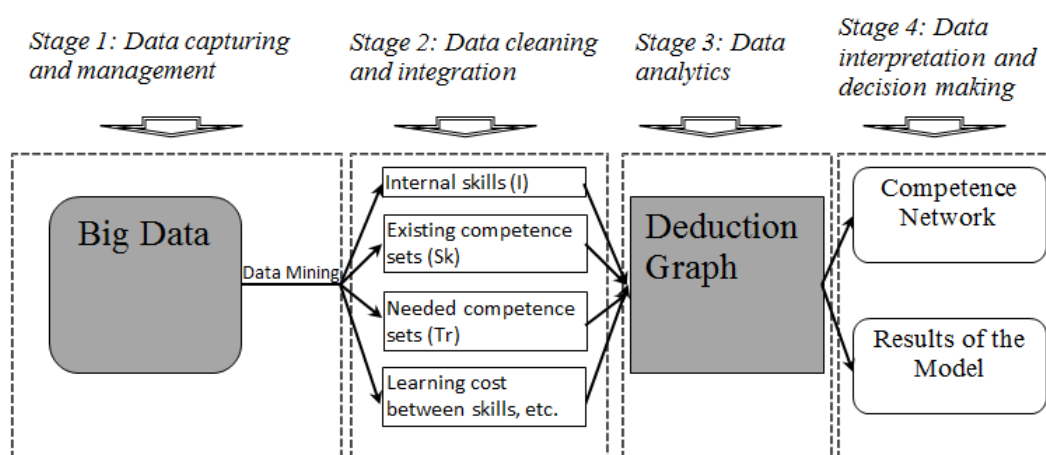


Figure 1: The analytic framework

The main focus of this research is in Stages 2, 3 and 4. It illustrates a step-by-step information sorting process, and the application of deduction graph to integrate data generated in Stage 1 to create a competence path. It could be used by managers in big data harvest and competence set expansion, as well as enhancing supply chain innovation capabilities. For each of the four defined stages, it involves specific process of activities.

Stage 1, Data capturing and management

Many valuable data are created and captured at high cost, but most of them are ignored finally. In this stage, it is essential for organisations to understand what information they need in order to create as much value as possible. Thus, it is significant to meet their bulk storage requirements in big data capturing and management stage for experimental data bases, array storage for large-scale scientific computations, and large output files. Requirements could be different due to different organisations' needs and problems.

Stage 2, Data cleaning and integration

As the sizes of data set are often very huge in big data analysis, sometimes several gigabytes or more, and their origin from heterogeneous sources, current real-world databases are severely susceptible to inconsistent, incomplete and noisy data (Zhou *et al*, 2014). Therefore, in stage 2, a number of data pre-processing techniques, including data cleaning, data integration, data transformation and data reduction, can be applied to

remove noise and correct inconsistencies. After that, data mining techniques can be used to help managers generate lots of useful information, involving internal skills, existing competence set, needed competence set and the relevant skills within the habitual domain (Yu, 1991) as well as the learning cost data towards a specific issue.

Stage 3, Data analytics

We use deduction graph model in stage three, which illustrates the competence set expansion process vividly (Li, 1999). As all the competence set related information within the habitual domain (Yu, 1991) and the learning cost data can be gathered from stage 2 via data mining techniques. In this stage, by serving these as inputs and enter them into the deduction graph, a unique mathematic model can be built. Then, managers can apply the deduction graph to visualise the expansion process and obtain the optimal solution by using optimisation programming (such as LINGO).

Stage 4, Data interpretation and decision making

In the final stage, a knowledge network (of competence set) will be developed allowing managers to see various options to achieve their goals. Then, the optimization programming could be used to help managers to find the optimal solution. The knowledge network also provides alternative paths to achieve a set goal. Thus, if the owner has more options for expanding its manufacturing process, it will be easier to make optimal decisions.

5.0 INTERVIEW RESULTS

Based on the proposed framework, further discussions with academic researchers who are active in and have experience in this area were needed to broaden the view on objective deployment issues and the state of art of the proposed big data analytic framework. And also, it is necessary to understand and take account of current industrial practice. The main objective of this section is to confirm and examine the proposed framework. This is done through several academic interviews with academic researchers and industrial experts.

The following table (Table 2) shows the feedback obtain from the interview of different firms and experts (4 firms and 3 academic researchers) about the proposed big data analytic framework. The applicability of the proposed approach was evaluated based on the criteria of feasibility, usability, and utility (Platts, 1994). Feasibility refers simply to whether it is possible to follow the established process; Usability relates to how easy the process is to use and utility refers to the usefulness of the process in reaching the decision and generating action plans.

<i>Dimension</i>	<i>Firm A</i>	<i>Firm B</i>	<i>Firm C</i>	<i>Firm D</i>	<i>Researcher A</i>	<i>Researcher B</i>	<i>Researcher C</i>
<i>Feasibility</i> (Participation, Availability of information, Timing)	√	√	√	√	√		√
<i>Usability</i> (Clarity, Ease of use, Appropriateness)		√	√	√	√	√	√
<i>Utility</i> (Relevance, Usefulness, Facilitation, Confidence)	√	√	√		√	√	√

Table 2: Summary of the interview results (√: Agree with the element)

In general, all participants felt that the process provided a structured approach for decision making and the competence network can help to illustrate the competence set expansion process vividly. The manager of firm B & C and researchers of A & C all felt that the method has high feasibility, utility and usability. In particular, manager of firm B said that *"This framework is able to help us to ask questions that we may never have been asked and to examine the information generated from big data analysis"*; managers of firm C pointed out that *"each of us sees the factory operations through a unique set of lenses that is determined by our personal experiences, and our capabilities. Thus, none of us as part of a functional group, have a good understanding of the competence set entirely"*; the researcher C describes the framework as *"a road map that provides many alternative ways to arrive at the destination"*.

However, some managers commented that the mathematical properties are not simple and takes lot of time to understand it. Additionally, researcher B suggested that more practical in-company cases and a longer time scale would be needed if they would like to look into the model in more depth and examine the developed competence network in detail.

6.0 CONCLUSIONS

In today's competitive changing environment, managers keen to capture potential values from big data to improve their operations performance. Therefore, there is a need for a big data analytic framework to aid managers in improving their operations performance by better managing their competence set. Many researchers and practitioners have pointed that most data available in companies are only worth something when it is put together with other data in a specific context. This paper addresses a significant gap in existing big data analytics by proposing a hybrid competence set and deduction graph approach. This paper contributes to the big data analytics and operations literature in three ways.

- First of all, the proposed framework gives integrated support in tapping big data values. It captures and inter-relates different competence set related information from big data analysis, and providing a comprehensive view of the firm capabilities for strategic analysis. Also, it provides a proven way of eliciting and quantifying the relationships necessary to utilise the information harvested from big data. Hence, managers are able to derive the optimal strategy for collaborating with others in term of expanding their operations competence set. Thus, it not only can improve the supply operations performance but also enhance firms' innovation capabilities.
- Secondly, this framework can help managers to create a visual knowledge path from information harvested from big data. The proposed approach allows managers to put together various 'silo' of information to create a coherent picture of their operations capabilities. As a result, the competence set network describes the strategic options, different routines available to all decision makers based on deduction graph model.
- Finally, this is the first attempt that incorporated the big data analytics with the deduction graph technique. The evidence provided in this paper reveals the promise of this hybrid approach, which we believe is worth further developmental efforts from big data and supply chain operations management scholars.

While the proposed approach is potentially useful there are a number of research issues that remain to be addressed. Ongoing refinement and testing is a fundamental component of valid research.

- First, the learning costs of each competence set is essential to the framework, as every little change could result in different outputs. But, there are no systematic approaches to define them precisely.

- Second, the big data collection and management approach does not guarantee the correction and inclusion of every measure in all of the dimensions. Therefore, in the absence of a gold-standard basis for comparison, the decision maker cannot be presented with a guarantee that the strategy identified by the framework is superior to all of the available alternatives.
- Third, the results collected from interviews could be limited and biased. In-company cases are required to further examine the proposed framework.

In light of the above limitations, future practical cases should be carried out to test the framework in real companies. And also, develop a systematic approach (i.e. via model or formula construction) to measure learning costs of competence set precisely. Additionally, software could be developed to simplify the deduction graph computation.

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AN INVESTIGATION OF THE COMPLEX RELATIONSHIPS BETWEEN ANTECEDENTS, INTERNAL INTEGRATION AND FUNCTIONAL PERFORMANCE IN VIETNAM

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ABSTRACT

Supply chain integration has been considered to be a source of competitive advantage for firms as it improves relationships and the flow of information and resources both between internal functions in an organisation and between supply chain partners. This study examines the relationship between internal integration and functional performance. It also examines the effects of three key antecedents on internal integration: communication, leader support and conflict. A questionnaire survey is used to collect data from a sample of 152 production managers. The data are analysed using regression. The results indicate that communication, conflict and leader support are antecedents of internal integration and also impact functional performance. Internal integration is also found to mediate the relationships between leader support and conflict with functional performance, but not for the correlation between communication and production performance. This is also the contribution of the paper which firstly examines and suggests these mediating effects among leader support, conflict, internal integration and production performance.

Keywords Supply chain management, integration, antecedents, performance.

INTRODUCTION

Supply chain management has received increasing practical and theoretical interest since the 1990s. Research has shown that improved management of the key business processes within and across the organisations within a supply chain does improve performance. For example, it helps to reduce operating costs, improve productivity and improve customer relationships (Gimenez and Ventura, 2005). Integration within the organisation (internal supply chain integration) and across organisations within a supplier network (external supply chain integration) provide a source of competitive advantage by encouraging better flows of materials and information from suppliers to end users (Gimenez and Ventura, 2005). Several studies have therefore explored the antecedents of supply chain integration to find a way to improve both internal and external integration (Le Meunier-FitzHugh and Piercy, 2007). Previous studies also have examined the direct relationship between integration and functional performance (Sanders and Premus, 2005). This study therefore extends previous research by investigating whether integration is a mediator of the relationship between its antecedents and performance.

This study uses a questionnaire survey to collect data from a national sample of 152 production managers in Vietnam to examine the mediating effect of internal integration on the relationship of communication, leader support and conflict with production performance. This paper first presents the literature review and theoretical context and uses this to derive the research hypotheses and model. Then the data collection and analysis methods are described and the findings is presented and analysed. The implications of the study are discussed and the paper concludes with some suggestions for future research.

LITERATURE REVIEW

This section describes the three antecedents of internal integration used in this study, explores the linkages among integration, its antecedents and functional performance, based on previous research. The review of the literature is used to derive hypotheses and a research model for this study.

The relationship between communication, leader support and conflict with internal integration

The antecedents of integration we are focusing on for this study are communication, leader support, and conflict. Communication is considered to be one of the major antecedents for integration and is mentioned as important in many studies (Rouzies et al., 2005). Communication is widely acknowledged as being an important antecedent for internal integration between departments such as R&D and marketing (Gupta et al., 1985) and sales and marketing (Le Meunier-FitzHugh and Piercy, 2007), as well as more generally (e.g. Maltz, 1997). Improved communication helps those involved to co-ordinate their activities (Chan and Chan, 2009; Mohr et al., 1996), to make better decisions and to better align processes across the supply chain (Lettice et al., 2010), improving integration and eventually leading to improved firm performance.

Hypothesis 1: Internal communication (COM) influences internal integration (INTE).

Previous studies have also identified the effect of leader support on co-operation among functions in an organization (Gupta et al., 1985). Leader support impacts significantly on the effectiveness of most operations both inside and outside an organization. Different backgrounds and objectives can often lead to increased conflict and reduced linkage among functions in organizations. However, strong support from leaders will shorten these gaps and help to increase integration (Le Meunier-FitzHugh & Piercy, 2007).

Hypothesis 2: Leader support (LEADSUP) influences internal integration (INTE).

Conflict can be described as either functional or dysfunctional. Functional conflict occurs when there are judgmental differences about how best to achieve common objectives or tasks, but is characterised by a "constructive challenging of ideas" and a respect for each others' viewpoints. Dysfunctional conflict has negative outcomes and occurs when there are disputes and there is hostility or distrust towards each other. Interdepartmental (dysfunctional) conflict is defined as working at cross-purposes, having incompatible goals, being obstructive, and not appreciating each other's roles and has a negative impact on collaboration (Le Meunier-FitzHugh and Piercy, 2007). This conflict influences the degree of activity coordination between functions and reduces the integration of functions. The conflict can manifest itself as power or dominance by one function over another, and role ambiguity can cause functions to polarize (Mollenkopf et al., 2000). Thus it is expected to negatively influence the level of integration between functions and between organisations.

Hypothesis 3: Internal dysfunctional conflict (CONF) influences internal integration (INTE).

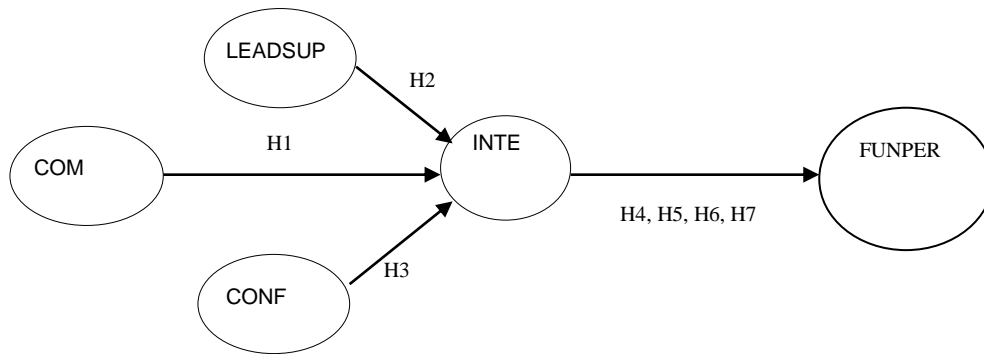
The relationship between Internal Integration and Functional Performance

The relationship between internal integration and functional performance has been researched in some areas. For example, in terms of production management, internal integration is revealed to have an effect on product development performance and production management performance (Kahn, 1996). In terms of the logistics area, marketing/logistics collaboration is found to have an impact on logistics performance. Firms that develop greater collaborative integration indicate higher relative logistics performance compared to less integrated firms. The performance of the highly integrated firms on service elements that go above and beyond the basics such as meeting key customers' needs, accommodating special customer service requests, and accommodating new product introductions is significantly better than for the low integration firms (Sezen, 2005).

Hypothesis 4: Internal integration (INTE) has a positive relationship with functional performance (FUNPER).

All of these relationships and hypotheses can be combined into a conceptual research framework, as shown in Figure 1.

Figure 1: Research Framework



Based on four previous hypotheses H1, H2, H3 and H4; this study suggests three more hypotheses as following:

Hypothesis 5: Integration mediates the relationship between communication and functional performance (FUNPER).

Hypothesis 6: Integration mediates the relationship between leader support and functional performance (FUNPER).

Hypothesis 7: Integration mediates the relationship between conflict and functional performance (FUNPER).

METHODOLOGY

This research follows the sequential stages of questionnaire development, sampling, and data analysis.

The questionnaire was developed based on previous studies. The communication construct (five items) and leader support (six items) are derived from Le Meunier-FitzHugh et al (2007). The conflict construct items are developed from adjusting the items of Mollenkoft et al (2000). Finally, the internal integration and functional performance items are adjusted based on the research by Sezen (2005).

The population consists of production managers in a variety of manufacturing sectors. The potential participants were identified from the database of the Vietnamese Ministry of Plan and Investment by a randomly stratified sampling. The data were collected through questionnaires sent in person to 500 production managers. In order to raise the reliability of measurement, respondents were asked to discuss their responses with others in the supply chain management department or functional executives as appropriate. After one month, a total of 178 completed responses were returned, and of these 178 responses, 26 incomplete responses were discarded. Accordingly, the analysis that follows and all reported statistics are based on a sample of 152 manufacturing organizations.

The data analysis was conducted through a strict process consisting of sequential steps. Firstly, Skewness and Kurtosis criteria were used to check multivariate normality of items of factors. Then these items' reliability was assessed using Cronbach's Alpha. Next, the validity of factors on the measurement was assessed by exploratory factorial analysis (EFA) and confirmatory factorial analysis (CFA). Furthermore, the assumption of variance homogeneity was examined by Levene's test. Then, correlation was examined to provide a first sight of the relationships among variables. Finally, research hypotheses for mediating relationships were tested. SPSS and AMOS were used for the data analysis process.

RESEARCH FINDINGS

Descriptive Statistics of Scales The *Min* and *Max* of the scores of variables range from 1 to 7 in general, which implies that there is no constraint on their variability. Their means fluctuated around the average mean of 4, ranging from the max of 4.30 to the min of 3.72. The standard deviation, which implies the variation of each variable, fluctuated around 1 with a max value of 1.243 and a min value of 0.875. Finally, all absolute values of skewness and kurtosis were less than their thresholds of 3 and 5 respectively. Therefore, these variables distributed normally.

Multivariate Normality Skewness and Kurtosis are two ways to examine multivariate normality. Means of skewness and kurtosis were -.51 and -.92 respectively. While skewness values ranged between -.0573 and .1546; that of kurtosis values were .5735 and .1437. All values of skewness and Kurtosis showed deviations from perfect normality, but were still lower than the threshold. All scales thus distributed normally and met the condition of multivariate normality. This sample was thus applicable to further multivariable data analysis.

Reliability This study used Cronbach's Alpha to test the reliability of scales. All the values were higher than the threshold of .7. In addition, most of the values of *Cronbach's Alpha of Item Deleted* were lower than their values of Cronbach's Alpha and their values of *Corrected Item-Total Correlation* were higher than the threshold of .25. Although some items had their values of *Cronbach's Alpha of Item Deleted* higher than their values of Cronbach's Alpha, their values of *Corrected Item-Total Correlation* were higher than the threshold of .25. The scales therefore satisfied the assumption of internal consistency reliability in general.

Validity Validity is tested by Exploratory Factorial Analysis (EFA) technique to provide insights into the underlying latent variables. The result of EFA performed by SPSS showed that all constructs have eigenvalues more than 1.

Analysis of Variance Levene's test was used to assess the tenability of the assumption of equal variances (homogeneity of variance). Levene's test looks at whether there are any significant differences between group variances and so a non-significant result is indicative

of the assumption being met (Field, 2005). Homogeneity of variance was significant in 5 variables at α of .05. It indicates that the variances of the sample's data were reasonably homogeneous across categories of firm size, industry type and ownership in general.

Hypothesis Testing This section examines the effect of leader support (leadsup), communication (com) and conflict (conf) on internal integration (inte) (H1, H2 & H3). Table 1 presents the output of the regression predicting the relationships among these variables.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	3.392	.468		7.253	.000		
Com	.104	.059	.109	1.776	.048	.831	1.203
Leadsup	-.294	.061	-.328	-4.783	.000	.774	1.293
Conf	.376	.062	.408	6.015	.000	.705	1.419

Table 1 The relationship between communication, leader support and conflict with internal integration

The findings in Table 1 indicate that three variables – leader support, conflict and communication - have significant relationships with internal integration. Therefore, H1, H2 and H3 are accepted.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	3.950	.404		9.784	.000		
Com	.151	.051	.198	2.978	.003	.620	1.613
Leadsup	-.287	.053	-.404	-5.415	.000	.751	1.331
Conf	.122	.054	.167	2.260	.025	.802	1.247

Table 2 The relationship between communication, leader support and conflict with internal integration (without internal integration in the regression)

The findings in Table 2 show that three variables – leader support, conflict and communication - also have significant relationships with firm performance.

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	3.498	.462		7.565	.000		
Com	.072	.059	.098	1.210	.228	.768	1.301
Leadsup	.137	.051	.180	2.700	.008	.599	1.668
Conf	-.248	.056	-.349	-4.408	.000	.718	1.392
Inte	.133	.068	.168	1.952	.043	.775	1.290

The summary table (not in this text) for the last regression provides the value of R and R^2 of .660 and .436. The value of R^2 is .436, indicating these variables (*leadsup*, *conf*, *com* and *inte*) can account for 43.6% of the variation in firm performance. F-ratio of 40.488, which is significant at $p < .001$, show that the regression model overall predicts firm performance significantly well. The output in Table 3 also shows that all the VIF values are far below threshold of 10 and all the tolerance statistics are higher than threshold of .2. These findings indicate that multicollinearity did not distort the regression model.

The findings in Table 3 verify that three variables – leader support, conflict and internal integration – have significant relationships with functional performance. Therefore, H4 is accepted. However, comparing the outputs of Table 2 and Table 3 show that the relationship between conflict and functional performance is significant but unchanged for both before and after adding the variable ‘*inte*’. Therefore, the level of integration does not mediate this correlation; whereas the significance of the relationships between *leadsup* and *com* are changed after putting *inte* into the regression. This means that the level of integration has an effect on these correlations. While integration partially mediates the effect of *leadsup* on functional performance, this variable fully mediates the relationship between *com* and functional performance because whereas the first relationship is still significant, the second correlation is not significant after adding the variable *inte*. In short, while H5 and H6 are accepted, H7 is rejected.

DISCUSSION AND CONCLUSION

This study has some limitations. First, it does not examine the relationship among antecedents of integration. Second, this paper only analyses relationships from the production manager’s perspective. It would be interesting to include other perspectives, such as the purchasing manager’s perspective. The survey was cross-sectional and so does not gather participants’ perspectives and how they change over time, which could help to show the dynamics of concepts such as conflict and communication. Nonetheless, the study has revealed some interesting insights into the complex relationships internal integration, its antecedents and firm performance.

This study confirms previous research on internal integration, which suggests a positive relationship between internal communication (Souder, 1988; Pagell, 2004; Le Meunier-FitzHugh & Piercy, 2007b), and leader support (Gupta et al., 1985; Le Meunier-FitzHugh & Piercy, 2007) with internal integration and a negative relationship between internal conflict and internal integration (Mollenkopf et al., 2000; Le Meunier-FitzHugh & Piercy, 2007a; Le Meunier-FitzHugh & Piercy, 2007b). This study is consistent with the supply chain literature that internal integration positively impacts functional performance (Vargas et al., 2000; Stank et al., 2001; Gimenez & Venture, 2003 & 2005; Sanders & Premus, 2005; Rodrigues et al., 2004; Germain & Iyer, 2006). Furthermore, this research examines the mediating effect of internal integration on the relationships between leader support and communication with functional performance.

These findings lead to a new conclusion for the literature on the relationship between antecedents of internal integration and functional performance. These antecedents not only impact internal integration but also have an effect on functional performance via integration. Increasing internal communication is therefore necessary for strengthening internal integration which may lead to increased functional performance. One of a manager’s important jobs is to find useful ways to improve internal integration, such as by encouraging closer physical proximity between functions by providing more spaces and opportunities for informal communication. Managers could also encourage staff to share information between

departments, such as feedback on functional performance and plans to help to increase the understanding of each department's objectives, which reduces the perceived differences and role ambiguity between departments.

Besides communication, leader support also plays an important role in increasing internal integration and functional performance via integration. First of all, leaders need to understand the expectations from different functions in the organisation. They should discuss and explore these expectations with the head of functions. Then, the leaders need to arrange meetings for these heads to sit down and co-operate to solve any problems. Furthermore, the leaders have to keep their support fairly constant for all functions in order to avoid conflict among the functions. These actions will help to enhance internal integration and may result in strengthening functional performance.

While internal communication and leader support enhance internal integration, internal conflict reduces this relationship. Therefore, conflict should be managed to an acceptable level. To limit conflict, all managers should understand the common goals of the firm. In addition, communication between departments should be increased so that people in one department can understand the objectives of other departments, which reduces the difference in objectives between the functions but still meets the organisation's overall goal. Any role ambiguity among departments should be reduced. More communication and less conflict encourage people in different departments to participate in cooperation activities.

This research, based on a questionnaire survey of production managers in Vietnam, has therefore shown the importance of three key antecedents - leader support, communication and conflict - to improve internal integration and functional (production) performance. In addition, it has shown that internal integration mediates the relationships between leader support and conflict with functional performance, but not the relationship between communication and functional performance. This provides a contribution to the literature by including both direct and indirect relationships in the research model and assessing whether integration is a mediator of the relationship between the antecedents identified and performance. The results have been discussed and suggestions made for managers based on the findings of this study.

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SHELF READY PACKAGING IN RETAILING

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ABSTRACT

The aim of the paper is to present the results of a Shelf ready packaging that was conducted in cooperation with a leading South-eastern European retailer. The study scope is focused on the logistics of packaging as the handling object of interest in retail. Data collection and analysis involved several observational and measurement visits of different sites and a combination of observations and interviews. Shelf ready packaging is a specific but integral part of retail operations that hasn't gained much attention on efficiency-side and operational performance. Slovenian retailer could save more than 2 million euros a year if percentage of Shelf ready packaging was increased from current 6.3 to 15 %.

INTRODUCTION

Although the retail industry is not the primary source of the innovation such as in information technology or development of new materials, it is nevertheless affected by them either directly or indirectly through altered market conditions. The most prominent example of this represents the widespread introduction of the internet which has empowered the consumers with the better availability and thoroughness of the information about all aspects of the products on offer – including, but not limited to price, contents and other characteristics or specifications (Goolsbee, 2001). Consumers have thus become much more informed in advance – and are having their decisions formed even before they arrive to the specified shop. This leaves the brick-and-mortar stores with less opportunity to influence or change the customer's intent while in-store. The fact that the customers can get all (or at least much more than in the past) of the information beforehand, means that stores have to adapt their role in the customers' buying decision process and re-evaluate and realign their core competitive advantages. Besides the obvious pressure to decrease prices and consequently the costs, there are also other side effects to this phenomenon. Since customers do not decide in-store as often as in the past (Bakos, 2001), they have also become less susceptible to promotional aspects of the packaging.

The majority of the changes that Shelf ready packaging (SRP) introduces are intended to reduce the time needed for the tasks that in-store employees are responsible for, while sustaining (and much less frequently improving) the conversion of the potential to actual buyers. There are five aspects that are usually cited as critical functional requirements that shelf-ready packaging should meet (ECR Europe project team, 2006):

- easy identification,
- easy open,
- easy dispose,
- easy shelf and
- easy shop.

The listed requirements are also distinguishing the ordinary secondary packaging from the one that is declared as shelf-ready packaging. Although we mentioned earlier that shelf-ready packaging often involves many other supply-chain processes and can incite larger changes in the overall organization of the production and distribution of the goods, it is also true that many enhancements are possible with little or no additional costs (Lundgre, Klaesson, 2009).

LITERATURE REVIEW

Retail industry is addressing challenges on several fronts – and one of them is by rethinking the role of the packaging of goods they are selling (Silayoi, Speece, 2004). After being neglected for too long the focus on the costs that are related to different types of packaging has been brought to more stringent attention by merchants. Since the time that staff needs for shelves replenishment is usually one of the highest among other tasks they perform, it became worth analysing whether this time could be reduced by designing the packaging in such a way that it would incur as minimal time for the store employee to prepare and put the products on the shelves as possible, while maintaining other important factors at the acceptable levels.

Since putting individual units of the products on the shelf is one part of the task that could be reformed, the shelf-ready packaging was developed as an answer to this problem. The concept itself is not new per sé, but when it was defined as a potentially important source of time and cost reduction, it became developed and named as such.

Björnemo et al. (2000) define a packaging as means to ensure safe and effective delivery of goods in desired condition to the end consumer. Packaging has many functions. According to German portal Transport Information Service packaging's functions are divided into three groups. Primary functions are protective, storage, loading and transport function. As Secondary functions they list sales, promotional, service and guarantee function. Tertiary functions are additional functions, connected with possibilities to reuse or recycle packaging. Lisec (2010) divides packaging based on its basic function to primary, secondary and tertiary packaging. Sales or primary packaging encloses goods. It contains one unit of goods, which is sold to end consumer. Group or secondary packaging encloses several units of goods and eases manipulating, storing, transporting and selling goods to end consumers. Transport or tertiary packaging encloses several units in sales or group packaging. It eases handling and transporting of goods and it provides damage protection.

According to Sagir and Jönson (2001) 75 % of goods handling time are used inside retail store, mostly to handle packaging. DULOG (in Sagir and Jönson, 2001) proposes that 16.2 % of final retail price reflects the costs of sales and goods handling. More than 62 % of these costs are a consequence of in-store packaging handling. Zelst et al. (2006) claim that 28 % of operational costs in retail supply chain of non-perishables are generated by handling in warehouse and 38 % by handling in store.

Common definition of SRP is that it is a packaging that usually contains more than one consumer selling unit to be placed on the store shelf in one motion, thus eliminating several other steps that would be required to stock each individual piece [6]. It should be added, nevertheless, that the concept is not encompassing solely the packaging, but should be evaluated in the context of wider scope of best practices that include the corresponding processes. The shelf-ready packaging thus determines also the primary, secondary and tertiary packaging where each is having multiple roles in the wider scheme of supply chain.

RESEARCH WORK

We believe SRP brings savings to retailers through lower labour costs, but on the other hand SRP increases producers' costs because of costlier packaging. According to MC Box's Krebsbach (in Pat Reynolds, 2012) using white linerboard instead of brown kraft increases costs by 20 %. Consequently purchasing departments question viability of SRP. Marketing departments tend to push SRP usage since it can serve also as a promoting tool. Retailers prefer SRP because it significantly shortens the replenishment process.

According to STi Group SRP increases labour efficiency in stores, on-shelf availability, brand enhancement, sales, eases shopping, code rotation and reduces damage. Exact figures are shown in Figure 1.

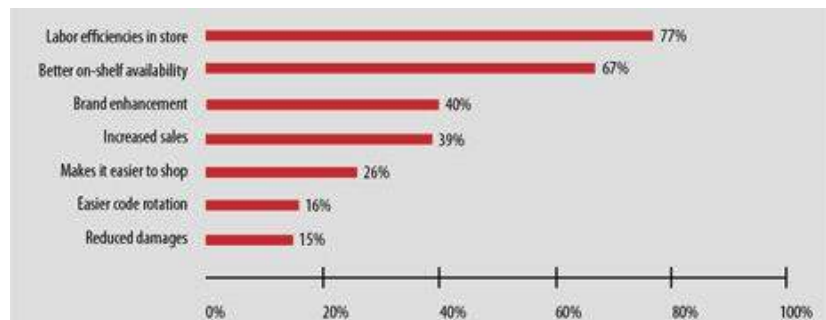


Figure 1: Advantages of SRP.

In research we analysed retail in-store logistic processes in one of the biggest Slovenian retailers. From their analysis they excluded serving lines and point-of-sales activities. They discovered that 46 % of total time is spent on shelf replenishment (Zafošnik et al., 2013). In research we conducted an experiment. We chose three products with SRP: coffee, paté and yogurt. Student with experience in retailing replenished shelves with independent products and the same amount of products in SRP. Other student measured replenishment time – unpacking and stacking SRP or individual products on the shelf. In their research students assumed SRP does not affect other processes – transporting, warehousing etc. (Zafošnik et al., 2013).

In Table 1 we present experiment's results. Replenishment procedure has been repeated several times for each product. In Table we show average times of replenishment by manual stacking (independent products, column A) and SRP stacking (same number of products in SRP, column B). In column C and D we display calculated time savings in seconds and percent. In column E we show cost savings, calculated from time savings in seconds and labour costs. We assume shopkeeper's labour costs with all welfare payments and taxes amount 5.85 €/h.

Product	Number of items ¹	Manual stacking time (A) [s]	SRP stacking time(B)	Time savings (C) ² [s]	Time savings (D) ³ [%]	Cost savings (E) ⁴ [€]
Coffee	40	116	32	84	72	13,7
Paté	24	37	12	25	68	4,1
Yoghurt	12	26	8	18	69	2,9

Table 1: Experiment

We calculated potential savings with simulation, in which they assumed all non-perishable products are coffee, paté and yoghurt. From the data obtained in experiment, they calculated overall time of replenishment with different shares of SRP. If Slovenian retailer increased share of SRP from current 6.3 % to 15 %, they would save more than 2 million € a year. This retailer has received more than 15 % of products in SRP packaging.

SRP packaging represents a unit in replenishment process. Shopkeeper should observe SRP and wait until it is emptied-out. In practice this would result in insufficient supplies or no supplies on shelves. This has been one of major constraints in SRP expansion. Retailers solve this problem with 2 or more facings. When there is less than half of products in SRPs, shopkeepers empty one SRP and move products to the other. Empty SRP is then replaced by full SRP.

Customers tend to take front products from SRP, while half-empty SRPs are unattractive. This is especially a problem on lower shelves, where it is hard to see in the back of SRP. In Figure 2 we show an innovative solution that is addressing this problem. Product pushing system is installed onto a shelf. SRP should have openings in the back and bottom side for the pushing system. Since the pushing system is not part of packaging and can be used for longer period of time, packaging is also cost-efficient. The photo was taken in September at Portuguese discount retailer.



Figure 2: Product pushing system

The experiment that was conducted clearly showed the advantage of SRP, especially regarding the shelf replenishment, but it is certainly not the only area that is affected by introduction of SRP. In the research of activities that are carried out in a typical retail store, we identified several types of tasks that are influenced by it. After the products are delivered to the store's warehouse, staff often needs to unpack the outer layer of the packaging, so that the individual SRP units are available to be transferred to the shelves. After they replenish them,

¹ Number of items in one SRP packaging

² $C = A - B$

³ $D = C \div A$

⁴ $E = C \times 0,001625$

they need to manipulate with the removed parts of the SRP, flatten them and take them to the recycle bin. The staff also needs to monitor whether the shelves should be replenished and they also have to reposition the products so that they are put to the front of the shelves. Among other tasks SRP can also partially affect the verification of "use by" days, and also the layout of the products on the shelves.

All those activities have the potential to be optimized by taking advantage of SRP, especially since the retailer does not have unified policy across all of its stores regarding to which extent and for which products SRP should be used.

Figure 3 shows another potential cost and time savings that may be achieved by SRP. As can be seen there is a peak between 12:00 and 14:00 where shelves replenishment is consuming a lot of human resources in the store. Reducing the time needed to refill the shelves by SRP might flatten this curve and reduce the time needed for this task to be accomplished.

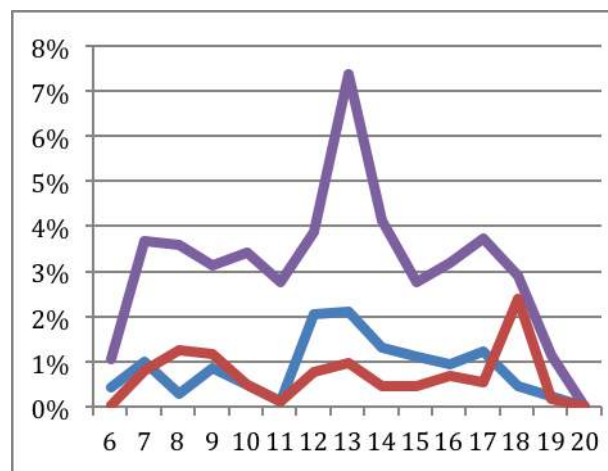


Figure 3: Graph of the percentage of time for picking (blue), filling shelves (purple) and packaging waste (red), depending on the hours

But while the SRP itself reduces the time (and costs) needed for shelf replenishment, its impact on sales is less obvious and transparent. The concern that has to be addressed is whether SRP affects the attractiveness of the products and whether it makes it any more difficult for the consumer to see and take the product away from the shelf. The SRP can also affect the visual presentation of the product and the consumers' perception of its brand.

Since the customers come in direct contact with the SRP, it should be carefully designed so that it clearly communicates its content (with proper form and the visual representation on its facing), and that it enables customers to take away individual units of the products easily. Since the SRP often serves also as a protection of the products during the transportation, there is a challenge to design it in a way that serves both of those conflicting purposes.

Another area that needs to be additionally researched is the impact of SRP on the market positioning of the retailer. Poorly designed and produced SRP may deteriorate retailer's perceived image and value among its customers what may not be a desired outcome. But on the other side producing several types of SRP of different quality and design levels may not be preferable by producers.

The advantages of SRP are undoubtable, but the real questions that the retailers face are about the criteria that should be set, so that SRP of individual types of

products could be weighted on. The model should therefore be designed that includes not only the strictly technical questions about the feasibility of the SRP introduction but also the wider impact that SRP is having on the sales and rentability of the retailers.

CONCLUSION

The shelf-ready packaging is certainly an innovative concept that enables retailers important cost reductions obtained especially by diminishing the time needed to replenish the shelves. Since SRP promotes sales, it brings benefits to producers and retailers. It reduces replenishing costs. Benefits outweigh higher packaging costs. We believe constraints like half-empty SRPs for example, could be surpassed with different innovative techniques. SRP demand will consequently grow all over the world.

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IDENTIFYING CUSTOMER VALUE IN SUPPLY CHAINS – THE PROCESS OF ANALYSIS

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ABSTRACT

Increasing competition and the parallel disintegration of supply chains have led organizations to the challenge of determining how to optimally maximize customer value creation while simultaneously minimizing risks and costs. In value creation, all four categories of benefit (economic, functional, emotional and symbolic) are needed to provide a complete offering for the customer. The purpose of this paper is to identify the different elements of customer value creation in supply chains. The main objective is to examine the process of customer value analysis. The process of analysis, which involves a form of workshop, is described in detail in the paper. The aim is to explore the identification of customer value in supply chains.

1. INTRODUCTION

Recognising the sources of customer value is essential for profitable business operations and efficient supply chain management. It is widely recognized that there is a clear link between customer value and competitive advantage (e.g., Slater and Narver, 1994; Webster, 1994a; Woodruff, 1997). Today, increasing competition and product diversity in the global business markets are leading companies to focus even more on customer value creation and the identification of customer value. Nonetheless, identifying sources of customer value is challenging. In many cases, customer value is linked to expectations and perceptions. Customer value is dynamic, it is not constant and customer perception of value changes over time. Furthermore, service quality is a relative issue and varies from one customer to another. Customers at different levels of the same organization have different views and requirements (Sarshar and Pitt, 2009).

Creating unique and individualized sources of customer value is one of the main targets of supply chain members' solutions (e.g., Mentzer et al., 2001; Langley and Holcomb, 1992). Suppliers must have an understanding of what their customers value, especially when customers are increasingly looking at purchasing as a way to increase profits and pressure suppliers to reduce prices (Anderson and Narus, 1998). Therefore, to have the ability to respond to near future market requirements, suppliers need to be a step ahead in planning for future sustainable solutions (Sarshar and Pitt, 2009).

This paper is based on part of a larger two-year project, "Determinants of value and vulnerability in customer-oriented service network (Custor)". The primary objective of the project is to determine how customer value is created in a multi-actor service supply network and identify its vulnerabilities. The goal is to provide a management model for service supply network value creation and vulnerability. This paper focuses on the identification of customer value and the determinants of customer value benefits and costs. It presents a method of identifying customer value in supply chains and introduces this process of analysis in detail. The analysis process was carried out in an expert group workshop, which was held in the beginning of the project, to increase the understanding about customer value benefits, to pinpoint what was preventing the creation of customer value and to test the process for analysing and identifying customer value. This paper's

analysis provides a basic framework and background to reach the project targets of the Custor project.

2. METHODOLOGY

The paper is based on a literature review and a case study in the form of a workshop. Workshops belong to the participatory research methods used to facilitate group processes to deal with actual problems concerning the group (Vidal, 2006; CIPAST, 2012). Since participatory methods are more likely to produce normative than analytic results, they can be used to produce general strategies rather than detailed plans (Vidal, 2006; Glenn, 2009). A participatory approach advocates actively involving the experts in decision-making processes (Slocum, 2003). The workshop described in this paper followed the basic principles and phases of the future workshops, which include the following (Vidal 2006):

- preparation (invitations, facilities, timetable, facilitators, orientation)
- critique (critical and open discussion of the current situation)
- fantasy (brainstorming, free visioning of the future and ideas for achieving the future)
- implementation (critical evaluation of ideas and development of strategy, action-plan elaboration)
- follow-up (reporting and dissemination of results)

In the workshop, the aim was to determine customer value and its creation in service supply chains. A detailed process was carried out to identify these determinants of customer value. The workshop participants were top managers from five case companies from different industry fields. The main characteristics of customer value and its meaning for the business were examined in the literature review.

The three following questions are answered in this paper: (1) How can the customer value in supply chains be identified? (2) What are the benefits and disadvantages of customer value? and (3) What is preventing the customer value creation? To answer these questions, the paper introduces the literature review and the workshop process about analysing customer value in supply chains. The role of customer value identification is also explored in a larger management and research process framework. The identification of customer value benefits and costs in supply chains are important for to a company's ability to develop business processes according to customer needs, to serve customers in the best way and to gain a competitive advantage. Identification is needed in managing the value service networks as well as for a deeper analysis and measurement of customer value vulnerabilities.

3. CUSTOMER VALUE CREATION IN SUPPLY CHAINS

Managing the customer service chain is the central aim of supply chain management. The goal is to efficiently meet the customers' service requirements. The success or failure can be determined by the level of customer value, which is the difference between the perceived benefits and the total costs incurred (e.g., Christopher, 2011). The challenge is to identify what customers value the most, what are the benefits and costs. While each customer has his or her own value perceptions, customer value is also dynamic; meaning that customer perception of value changes over time and, consequently, is not constant. Customers periodically change what they desire from service providers. For example, in business-to-business (B2B), the requirements and perspective of customers at the different levels of the organization are different. Therefore, to capture a holistic set of customer requirements, it is imperative for the service delivery providers to engage with the customers at different levels of the organization (Sarshar and Pitt, 2009).

As mentioned above, there is no single concept of value for any one customer and the perceptions between the customers and the suppliers differ as well (Sarshar and Pitti, 2009). Nonetheless, the customer always defines what is and is not valuable (Rintamäki et al., 2007). The company's task is to make value propositions to support customers in

their value-creating consumption activities (Vargo and Lusch, 2004). Smith and Wheeler (2002) believe that customers are looking for a unique service, which will exceed their expectations. Service quality varies from one customer to another and it can be enhanced either by meeting or exceeding the customers' expectations or by taking control of such expectations. Service quality is also a relative concept and it too is determined by the customer, not by the service provided (Sarshar et al., 2009). The five dimensions of service process quality can be presented as follows: dependability, responsiveness, authority, empathy and tangible evidence (Parasuraman et al., 1988).

According to Smith and Wheeler (2002), the most important attributes of customer value are people, product and/or service delivery, convenience, product features, services on offer, price, policies, procedures and promotion. Smith and Wheeler (2002) and Christopher et al. (2006) highlight three key issues to consider when identifying customer value: customer segmentation, customer retention and creating customer loyalty. Companies need to differentiate between customers in terms of profitability. Customer retention is more profitable than gaining new customers; moreover, highly satisfied customers are generally the ones who become loyal customers. Liu (2006) identifies three key types of value for customers: economic value, relational/support value and core/technical value. Anderson et al. (2006) classify value proposition into the following three types: all benefits, favourable points of difference and resonating focus.

Rintamäki et al. (2007) introduce a three-step framework for identifying customer value propositions: (1) identify the key dimensions of customer value, (2) develop the value proposition and (3) evaluate the value proposition for its ability to create competitive advantage. According to them, identifying customer value propositions begin with understanding the key dimensions of customer value that motivate the targeted customers. The key issue is to recognize symbolic, emotional, functional and economic customer value. An efficient customer value proposition taps into what customers experience and consider relevant, specifically, what creates real value for them. According to Sarshar and Pitt (2009), transparency of costs improves customer trust. Therefore, good communication is essential. In addition, good relationships are also seen as a critical component. A review of customer requirements involves both qualitative and quantitative data. Most benchmarking and customer surveys are quantitative in nature, hence missing important strategic issues.

4. PROCESS OF IDENTIFYING CUSTOMER VALUE

Identifying the customer value determinants in a supply chain is challenging. Each customer defines their own customer value and each has different value priorities. With this consideration, managers need to have a deep understanding of customer value creation, in order to know their customers and find the core competencies needed to achieve competitive advantage in multi-actor service networks. There is a clear need for a process to identify customer value in supply chains. This paper introduces one such method, in the form of an expert group workshop, to identify customer value in supply chains. The process is carried out step-by-step. It is essential to recognize both customer value benefits and customer value disadvantages in customer value creation. How customer value is created and what prevents the creation of customer value are vital questions for company managers.

The expert group workshop and process for identifying customer value consisted of four different phases. First, the customer value benefits were identified and the most important ones were classified according to functional, emotional, economic and symbolic benefits. This process was followed by considering how customer value is actually created. After recognizing these factors, the customer value disadvantages were determined. The process ended with an exploration of the customer value vulnerabilities – what prevents the customer value creation? This four-phased process enables a comprehensive approach and knowledge about customer value. The process of identifying customer value in supply chains is presented in figure 1.

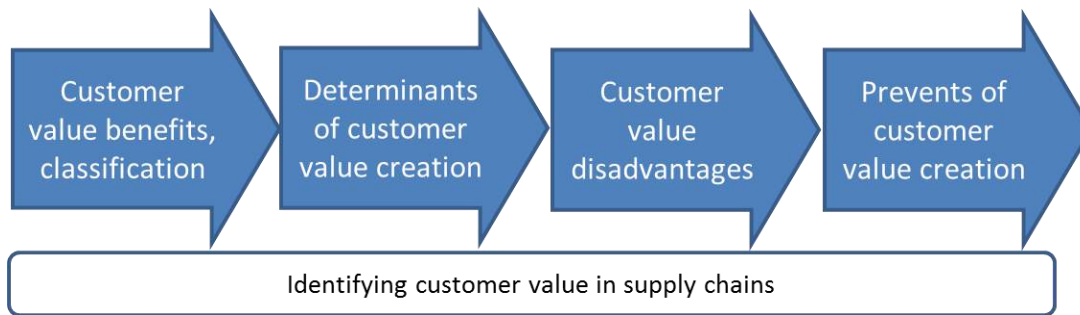


Figure 1. The process of identifying customer value in supply chains.

The six workshop participants represented managers and experts from five companies and industry fields. These companies can be roughly divided into three categories: traditional manufacturing oriented supply chain (one company), service-oriented manufacturing supply chain (three companies), and service supply chain (one company). The companies were additionally selected to obtain different perspectives of the value chain in terms of the position of the organization. The companies have both B2B and B2C, which simultaneously broaden the results impact and enable a more in-depth investigation of customer value benefits, disadvantages and identification.

In each phase, the participants were first asked to consider a specific question by themselves, write down all of their thoughts and ideas concerning that question on Post-it Notes and then share the answers with the whole group. The Post-it Notes were collected on posters on the wall and a group discussion followed. After the group discussion, possible complements for the answers were done. The process of identifying customer value determinants was started by considering the customer value benefits. In this first part of the workshop, the participants were asked to answer the question, "What are the benefits of customer value?" The participants were asked to consider the benefits based on their own business area and their customers. They wrote down all the possible benefits on the Post-it Notes. After finding the benefits, the five most important determinants were selected by voting. Each participant got three votes. In the second phase of the workshop, the determinants of customer value creation were explored. The participants were asked to think of determinants for those five major benefits found in the previous phase of the process. In the third phase, the customer value disadvantages were written down and in the last phase of the process, factors preventing customer value creation, 'prevents', were considered.

5. RESULTS OF THE WORKSHOP

The introduced workshop process was considered well suited for identifying customer value in supply chains. To introduce how the workshop process was working and evaluate the process, some of the primary results gained from the workshop are presented in this chapter. Each step of the process increased the understanding of customer value. Since the process starts with identifying customer value benefits, the first goal was to find the five most relevant benefits. According to experts, the most important customer value benefits were reliability, price, quality, ease of doing business and flexibility. Although 15 different benefits were identified, these five benefits were highlighted the most frequently. Considering the classification, reliability and price were clearly considered primarily symbolic values. Quality was variously seen as a symbolic, functional and economic value. Ease of doing business was classified as both a symbolic and economic value. Although flexibility was seen as a symbolic value, it was also seen as an emotional and economic value. All of the experts agreed that the classification of value determinants is multidimensional and many determinants can be classified under different categories, depending on the customer and the point of view. Nevertheless, value benefits can be simultaneously identified in different categories.

During the third phase of the workshop, the determinants of customer value creation were explored. This was done based on the five identified benefits, meaning that each benefit was considered separately. The participants found 57 determinants of customer value creation. The remarkable point was that some determinants were recognized simultaneously as different benefits. For example, quality and security of supply as a source of value were mentioned more than twice. The customer value benefits and determinants of customer value creation are presented in figure 2.

Reliability	Price	Quality	Ease of doing business	Flexibility
<ul style="list-style-type: none"> • Security of supply • Accuracy • Faultlessness • Sufficient capacity • Professional skills • Honesty • Previous experience • Keeping promises • Standardized processes • Accuracy of availability estimation • Interface management 	<ul style="list-style-type: none"> • Cheapest • Transparency • Low total costs • Reasonable purchasing price • Customer benefits • Supporting customer's business opportunities • Quality • Security of supply • Availability 	<ul style="list-style-type: none"> • Quality of service • Expertise • Response time • Product quality • Durability • Fine-tuning • Uniform quality • No extra effort needed from customer • Exceeding the agreed level of quality • Supporting customer's customer promise • Raw materials quality • Security of supply 	<ul style="list-style-type: none"> • Fast learning ability • Accessibility • Openness • Presence • Simplicity • Multichannel • Efficient time management • Seller's expertise • Clarity of options • Ready-made solutions • Reliability • Personality of service • Comfort of use 	<ul style="list-style-type: none"> • Living along with the customer • Change management • Easy to change schedules • No additional costs in case of schedule changes • Offering alternatives • Response time • Problem solving • Supporting customer's business • Ability to respond to cyclical and seasonal needs • Responsiveness • Commitment

Figure 2. The customer value benefits and determinants of customer value creation.

Sixty-two different customer value disadvantages were found. Reliability, for example, suffers from any kind of disruption in service, delivery or process. In addition, lack of expertise, as well as changing promises and schedules were also mentioned. Complex pricing, increasing costs, changing prices, changing market prices, and extra service costs are all examples related to price. Quality relates to lack of information, defects in quality, increasing costs, etc. If ordering takes too much effort or if availability is uncertain, the ease of doing business gets difficult and relates directly to customer value. Moreover, quality issues also play an important role in this case. Flexibility suffers variously if problem solving is not done together, if the understanding of customer operations is weak, if delivery times are long, or the product or service is planned poorly, etc. In the last phase of the workshop, the participants were asked to consider what was preventing customer value creation. Therefore, we can conclude that there are prevents both inside and outside the company, as well as in the service network in which the company is operating. The remarkable point here was that most of prevents were recognised as being inside the company.

6. IDENTIFICATION AS PART OF THE DEVELOPMENT PROCESS

The identification of customer value in supply chains is an essential element when managing the creation and vulnerability of the service value offering of supply networks. The sources of customer value need to be identified both to manage it and to determine the vulnerabilities of value creation. The research process in the Custor project is directed towards developing the value management model (Figure 3).

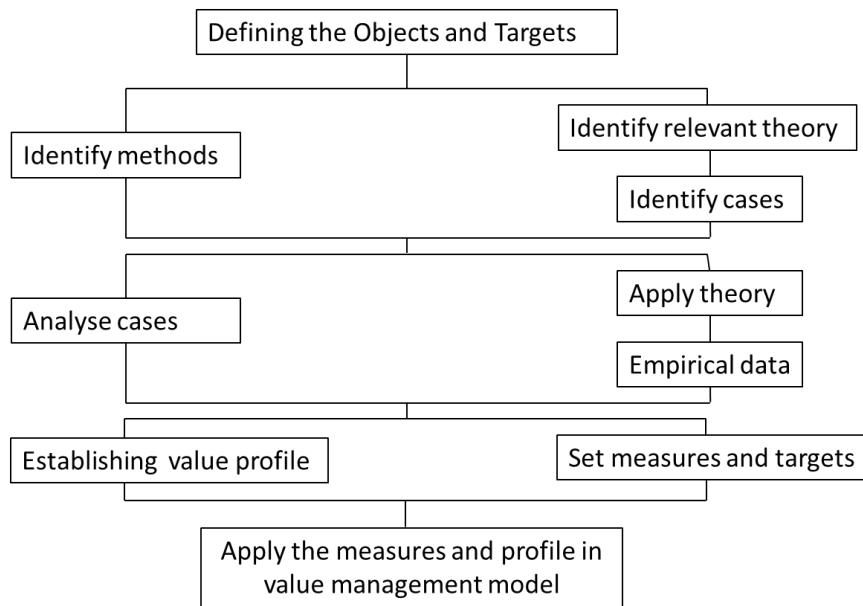


Figure 3. Research process of developing value management model.

Developing the management model for service supply network value creation and vulnerability is a multiphase process, which starts with defining the objects and targets and ends with applying the measures and profile in the value management model. After defining the objects and targets, the relevant theory, cases and methods are identified. This paper focuses on the part of the research process in which the methods of identifying customer value are explored, especially through the research questions:

- (1) How can the customer value in supply chains be identified?
- (2) What are the benefits and disadvantages of customer value?
- (3) What is preventing the customer value creation?

The third phase of the process consists of applying relevant theory, studying empirical data and analysing the chosen cases. Based on the analysis phase, the value profile can be established and measures and targets can be set. Created measures and profiles are then applied in value management model.

7. DISCUSSION AND CONCLUSIONS

As a research area, the importance of identifying the elements of customer value in supply chains is a growing topic due to the development of the business environment towards networked structures. All of the partners in the networks must have the capability to produce added value both to their partners' supply chains and to the whole network. Therefore, it is essential to recognize both the sources of customer values in demand driven supply networks and to identify the potential vulnerabilities as well. In global dynamic markets, company managers are forced to develop even more efficient supply chains to gain a competitive advantage. Understanding the customer and knowing the creation points of customer value provides tremendous potential to develop business processes in a cost efficient way.

Customer behaviour has also been changing with time and companies need to work hard to earn real customer loyalty. Based on the literature (e.g., Sarshar and Pitt, 2009), it is more important to focus on creating loyalty in existing customers than to generate new ones. The results of the workshop process emphasize this approach by highlighting standardized processes, diverse quality issues, ease of co-operation and flexibility, which are all characteristics of partnership relations. Of course, new customers cannot be forgotten. Different customers value different things, which makes customer value recognition challenging. The challenge is also to recognise the most valuable ones as well as the customer value vulnerabilities. To be able to explore the customer value

vulnerabilities, the value itself needs to be identified. Furthermore, the sources of customer value need to be identified to manage and pinpoint the vulnerabilities of value creation.

According to Rintamäki et al. (2007), the three-step framework for identifying customer value propositions starts with identifying the key dimensions of customer value, followed by the development of the value proposition and ending with the evaluation of the value proposition for its ability to create competitive advantage. In this paper, the recommendations on how companies can recognize customer value in their supply chains are presented. This process consists of four phases: (1) identifying customer value benefits, (2) identifying determinants of customer value creation, (3) identifying customer value disadvantages and (4) identifying prevents of customer value creation. The aim is to gain comprehensive knowledge about the customer value and to reach competitive advantage. In the first phase, the aim was to find all of the possible customer value benefits and, based on this knowledge, the determinants of customer value creation can be pinpointed. Customer value disadvantages and the prevents of customer value creation also form an essential part of the supply chain customer value analysis. Being aware of the customer value creation disadvantages and prevents enable the recognition and management of vulnerabilities. To obtain more detailed information, the analysis of process can be done in specific supply chains in detail.

The main finding of this study is that the workshop process was considered to be well suited for identifying customer value in supply chains. The process was carried out on a general basis to gain understanding and information about the customer value. Nonetheless, more deep and detailed information can be reached using the same process, as well as by exploring specific cases and supply chains in detail. The process of analysis demonstrates the meaning of customer value creation in supply chains. The importance of recognizing the preventing determinants for customer value creation is also highlighted.

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VALUE CREATION IN PRODUCT–SERVICE SUPPLY NETWORKS

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ABSTRACT

Today's leading enterprises operate in a global multi-actor environment, cooperating with suppliers, partners and other stakeholders in order to deliver services and/or products. It is a question of value creation in a global economy, of how to create value in buyer–seller relationships within global product–service networks. The traditional supply chain can be used for product deliveries, but locally delivered services require a network of collaboration partners. The unique characteristics of service include a high level of customer contact and influence, simultaneity of production and consumption, intangibility, non-storability, perishability, and labour intensity. This paper discusses the challenges when moving from a linear product supply chain to a product–service supply network. The aim of this paper is to increase the understanding of how companies manage their customer value creation within integrated product–service supply networks. When analysing the benefits of product–service offerings, we focus on two categories: tangible and intangible determinants.

Keywords: product–service systems, service supply networks, value creation

INTRODUCTION

In dynamic global business, cost, quality, and technology leadership are no longer sufficient for companies to secure crucial advantages (Bullinger et al. 2003). Companies in various industries are finding that they can no longer succeed just by offering excellent products and traditional after-sales service, and logistics, but have to differentiate themselves from their competitors by extending their range of service offerings and enhancing their customer value creation (Hemilä and Vilko, 2013; Kowalkowski et al. 2013). Supply chain management is concerned with the planning and management of activities from raw materials to the delivery of finished goods (e.g. Simchi-Levi et al. 2002). Companies today should manage both goods and also service deliveries by themselves or with a supplier network. A supply chain management approach may be suitable for traditional product offerings, but offerings enhancement to services requires more network collaboration and a different kind of knowledge than management of product flow. Holweg and Helo (2014) have extended the often restricted focus of supply chain management beyond the entire value chain, the system that includes all value-adding steps, from raw materials to the distribution system that delivers the product or service to the end customer (Holweg and Helo, 2014). Such a complex offering combining tangible goods and intangible services is called a hybrid value bundle, as defined by Schrödl and Turowski (2014). Classic supply chain management techniques fail because of the specific requirements of hybrid value bundles, e.g. strong customer integration, different product lifecycles of the individual components or incompatible product specification (ibid.). New kinds of management models are needed in the value creation of product–service networks. Value creation has the aim of capturing the maximum value added in financial terms; the supply chain view aims to design operationally efficient supply chains (Holweg and Helo, 2014). The financial value is not enough in consumer business, where people are more and more interested in brand, quality and emotional aspects when making purchase decisions (Rintamäki et al., 2007). Also, in a business to business context, both functional and economical (tangible) as well

as experiential and emotional (intangible) determinants are essential in understanding customer value creation. Most studies focus on the importance of creating customer value through an individual firm's efforts, ignoring the potential from the collaborative efforts among supply chain partners (Kim et al. 2013). There is a growing demand for further information about customer value creation and the management of value creation processes in a business-to-business context. This paper is based on the "Determinants of value and vulnerability in customer-oriented service network" CUSTOR-project. The aim of the CUSTOR-project is firstly to identify customer value determinants and their vulnerabilities in a multi-actor service supply network. Secondly, the project aims to analyse and set key performance indicators for value and vulnerability determinants. Thirdly, the aim is to provide a new management model for service supply network value creation and vulnerability. This paper focuses on the first part of the project, namely identifying customer value determinants in product-service supply networks. The objective of the paper is to increase the understanding of how companies manage their product-service offerings value creation within integrated product-service supply networks. When analysing product-service offerings benefits, we focus on two categories: tangible and intangible determinants (Rintamäki et al., 2007). Adding services to the product portfolio of a firm may bring benefits to the customer, but requires a reconsideration of the supply chain management approach (Bustinza et al. 2013).

METHODOLOGY

This study is based on the state-of-the-art of product-service networks value creation from the literature review and on the empirical case data from an expert group workshop. More specifically, we have used the literature findings when trying to find determinants for product-service value creation. The qualitative case study research approach was chosen in order to gain both theoretical and empirical insight into the value creation topic (Yin, 2003). We have conducted a case study with experts from five different companies from different industries as shown in Table 1. The experience and insights of the experts were considered essential in order to make in-depth sense of the phenomenon (Eisenhardt, 1989).

Table 1: Case companies

	Traditional manufacturing-oriented supply network	Service-oriented manufacturing supply network	Service supply network
Case 1	Offerings consist of own products with life-cycle service offerings. B2B		
Case 2		Combined concrete and construction service and product offering. B2C and B2B	
Case 3		Energy service provision by providing gas product and related services to customers. B2C and B2B	
Case 4			Logistics service provider with tailored solutions. B2B
Case 5			Global Logistics Service provider with integrated supply chain solutions. B2B
Case 6		Consumer electronics retailer with enhanced after-sales service offerings. B2C	

In the expert group workshop, the aim was to define customer value creation determinants in the case companies' product-service supply networks. Firstly, an expert group, based on their own experience, selected value creation focus areas that are the main topics for customer value. Secondly, detailed value creation determinants were selected for the focus areas. We have compared expert group findings with literature findings. The main research question in this research project was "How to identify the customer value creation determinants in product-service supply networks". In order to answer this question, this paper introduces the findings from literature, and compares these findings with workshop results.

FROM SUPPLY CHAINS TO PRODUCT-SERVICE SUPPLY NETWORKS

In dynamic competitive environments, cost, quality, and technology leadership are no longer sufficient for enterprises to be able to secure crucial advantages (Bullinger et al. 2003). Firms in various industries are finding that they can no longer succeed just by offering excellent products, traditional after-sales service, and logistics (Kowalkowski et al. 2013). So as to differentiate themselves from their competitors, firms have begun to extend their range of service offerings and to enhance their service orientation (ibid). Vargo and Lusch (2004) have argued the transition to be a movement from a goods-dominant (G-D logic) logic to a service-dominant logic (S-D logic). Although the current academic literature presents many definitions and terms for service business development (e.g. Kowalkowski et al. 2013), the common idea is that companies must change their entire business model from product orientation to service orientation. With the change in their business model, companies should be sure which kind of supplier network is needed to provide service offerings. IBM is a well-known example of a successful transformation from a high-tech product business into a service company by changing its whole customer value creation mindset and creating global service organization (e.g. Mathieu, 2001). In 1991, IBM was a \$65 billion company, of which less than \$6 billion was derived from services, and ten years later services alone generated more than 40% of IBM's \$86 billion sales (IBM, 2002), which clearly illustrates the importance of the new kind of customer value creation.

Ellram et al. (2004) have made "service extension" into a definition of SCM as "supply chain management is the management of information, processes, capacity, service performance and funds from the earliest supplier to the ultimate customer". The supply of a product-service offering differs from the supply of a tangible product because of so-called service IHIP characteristics (intangibility, heterogeneity, inseparability, and perishability) that must be considered in supply processes (e.g. Kelly and Storey, 2000). Services cannot be put into store, but should be produced and delivered at the same time. At a generic level, in tangible product deliveries a logistics service can be used, without having any other specific knowledge than just transport and cargo loading. In the service delivery – for example, installation, maintenance, remote control – specific knowledge, tools, or process know-how is needed in the realisation of service supply.

It can be argued that the strategy is of importance for the success of service business and service offerings development (Edvardsson et al. 2013; Witell and Löfgren, 2013). Strategic positioning is the starting point for a company creating a service business and product-service supply network. The company should define its own role in the network and its own knowledge, offerings and how to create value for the customer and for the whole product-service supply network.

VALUE CREATION IN PRODUCT-SERVICE SUPPLY NETWORKS

Value creation has been a widely discussed topic in marketing, operation management (OM), Supply Chain Management (SCM) and service sciences. In the SCM and OM sciences, the focus of the value creation operation has remained, aiming for a stable to operate and efficient supply chains (Holweg and Helo, 2014). The "value chain" concept was originally proposed by Porter, who takes a financial view of the sequential value

creation process in a network of firms (Porter, 1985). In this study, we are interested in how value is created and which kinds of determinants are meaningful for decision makers and practitioners. We argue that a deeper understanding of value determinants is the core of company success. The traditional view that value is embedded in offerings that are outputs of suppliers' processes has increasingly been challenged by the view that value emerges through the use of the offering in customers' value generating processes, as "value-in-use" (Aarikka-Stenroos and Jaakkola, 2012). Product-service suppliers can only make value propositions intended to support customers in their value-creating consumption activities (Vargo and Lusch, 2004). Customer value is always defined by customers' subjective perceptions and evaluations of the total customer experience (Rintamäki et al., 2007). A customer value proposition is an encapsulation of a strategic management decision on what the company believes its customers value the most, and what it is able to deliver in a way that gives it a competitive advantage (ibid.). In our research we have found that value proposition can be realised with a supplier network. The network members together can create value proposition, and every company can have its own value added offering. It is again strategic positioning of value network companies, as stated above.

Customer value propositions combine functional, economical, emotional, and symbolic customer value determinants (Rintamäki et al., 2007). Traditionally firms emphasized creating value through offering high quality product or services, and the value proposition was based on the features of product-service offerings. Product technical specification, capacity, performance, dimensions or other measurable determinants is an old-fashioned way to argue value for the customers. Today functional value is still valid and cannot be forgotten, but it is in many cases no longer a competitive advantage. Economic value has been a hot topic since mass customization and is still so today in times of global economic crisis. Offering low prices is no longer the preferred means to attract new customers. In consumer business, there is always a need for both luxury and low-cost products and services. Also in the B2B context, customers are willing to pay more, if they can acquire a more valuable product or service. In that case, value is something other than economic value. More firms have begun competing against each other by building brand equity, but industrial brand equity is quite a minor research topic (Leek and Christodoulides, 2012). Brand equity conveys a number of intangible benefits to buyers; it can increase both the buyer's confidence in, and their satisfaction with, their purchase decision, and can also reduce the level of risk and uncertainty in the purchase decision (ibid). Emotional value is not only about the brand, it is also feelings, experiences, reputation, trust, etc. The B2B purchase process has been more rational than the B2C purchase process, and emotions and feelings have not been so relevant. Today, in high competitive markets, product and service measurable determinants can be quite similar, so buyers include emotional determinants in decision making. In the future, the importance of symbolic value will rise. Consumers prefer recyclable materials, organic food, human rights in production, and other symbolic values. Consumer brands are focusing on symbolic value creation. In a B2B context, symbolic values are becoming more important, and even now industries have focused on CO₂ emissions and green technologies. It is clear that tangible elements are crucial in conveying value to buyers, but the role of emotional and symbolic value propositions is becoming more and more important in a B2B context (Rintamäki et al., 2007; Leek and Christodoulides, 2012)

RESULTS AND DISCUSSION

Services have become a driving force for the success of companies in various industries. Customers are requiring comprehensive product-service offerings from the suppliers. It is a question of value creation in a global economy, how to create value in buyer-seller relationships within global product-service networks. In the literature one can find the idea that tangible and intangible value determinants are crucial to the success of different industries. Buyers are using functional and economical determinants in purchase decisions (Leek and Christodoulides, 2012). When different suppliers' product and service offerings are comparable, features are quite similar and it is hard to distinguish between

them, the purchase decision is made according to emotional and symbolic values. We conducted a case study with an expert group of five top managers from different industrial contexts. We tried to find value creation determinants with experts in a workshop. First of all, the expert group found reliability to be the most important factor in the supplier–buyer relationship. The term ‘reliability’ includes both functional and emotional aspects. Functional reliability can be measurable, as security of supply, faultlessness, sufficient capacity. Emotional aspects in reliability are hard to measure. These kinds of determinants are professional skills, honesty and keeping promises, for example. Secondly, the experts raised economic issues and price as being valuable for customers. The cheapest price or lowest total cost is in some businesses the only way to get the deal. On the other hand, they added support for customer’s business opportunities, which means more integrated buyer–supplier collaboration. In close collaboration, the price might still be the dominant decision criterion. For traditional players, transparency is challenging, but in modern supplier–buyer collaboration it can be based on the open book method, where costs and profit margins are negotiated. Third value determinant was quality which is also quite traditional, but it also has measurable (tangible) and non-measurable (intangible) features. The fourth determinant was ease of doing business, which is a purely intangible issue, and it was interesting that experts took this kind of topic as a main value determinant. Ease of doing business is based on experiences from a supplier–buyer relationship with existing customers. It is hard to convince new or potential customer with the ease of doing business. The last main topic was flexibility, which is also an emotional and experimental issue. Table 2 below presents the five value creation elements with detailed determinants.

Table 2: Value determinants from expert group

Reliability	Price	Quality	Ease of doing business	Flexibility
Security of supply	Cheapest	Quality of service	Fast learning ability	Living with the customer
Accuracy	Transparency	Expertise	Accessibility	Change management
Faultlessness	Low total costs	Response time	Openness	Ability to easily change schedules
Sufficient capacity	Reasonable purchasing price	Product quality	Presence	No additional costs in case of schedule changes
Professional skills	Customer benefits	Durability	Simplicity	Offering alternatives
Honesty	Supporting customer's business opportunities	Fine-tuning	Multichannel	Response time
Previous experience	Quality	Uniform quality	Efficient time management	Problem solving
Keeping promises	Security of supply	No extra effort needed from customer	Seller’s expertise	Supporting customer's business
Standardized processes	Availability	Exceeding the agreed level of quality	Clarity of options	Ability to respond to cyclical and seasonal needs

Accuracy of availability estimation		Supporting customer's customer promise	Ready-made solutions	Responsiveness
Interface management		Raw materials quality	Reliability	Commitment
		Security of supply	Personality of service	
			Ease of use	

A product–service supply network requires the careful synchronisation of the supplier network in order to deliver a complete product–service proposition to the customer and to ensure customer value creation. Existing management methods that are primarily focused on the supply chain management for tangible goods are not suitable for fulfilling the specific requirements of hybrid value creation (Schrödl and Turowski, 2014). Rintamäki et al. (2007) have discussed the customer value proposition from one company perspective:

- increase the benefits and/or reduce the sacrifices that the customer perceives as relevant;
- build on competencies and resources that the company is able to utilize more effectively than its competitors;
- be recognizably different (unique) from the competition, resulting in a competitive advantage.

We argue that companies should focus on their core competences, strategic choices and select a supplier network with required competences for fulfilling customer needs and value propositions. From the product–service network point of view, companies should build on competencies and resources that their *network* is able to utilize more effectively than its competitors. By selecting competent partners, the network can realise the customer value proposition, not only for the individual company. The individual company's focusing strategy can lead to cost efficiency, higher quality and expertise. A network of individual companies with a focused offering can be recognizably different and unique from the competition.

CONCLUSIONS

In service networks, both functional (tangible) as well as experiential and emotional (intangible) determinants are essential in understanding customer value creation. Customer value is the perceived benefit a firm's customers may obtain traditionally from product quality, but more and more from brand associations, experiences and other intangible value creation determinants. Value creation requires the coordination of a complex multi-actor network of product and service providers. The literature review revealed the movement from traditional supply chains to product–service networks and the service value creation determinants within complex business environment. New kind of management models are needed in order to fulfil customer needs in product–service networks. The traditional supply chain management literature has been acknowledged not to be able to answer the challenges regarding service supply management (Ellram, et al. 2004). We have addressed practical issues from case study managers, namely what kind of value determinants seem to be important in different industrial contexts. Research continues with a detailed case analysis, that is to say measurement and KPIs in value alignment in product–service networks. When aiming to optimize customer value in a multi-actor environment with complex offerings, the operations often leave the companies vulnerable to various risks and costs within and outside of the network. Wu et al. (2006) have identified supply network risk and vulnerability factors and grouped them by the following categories: internal: controllable, partially controllable, and uncontrollable, and external: controllable, partial controllable, uncontrollable. Future

research will also take into account the vulnerabilities and risks related to value creation in product-service networks.

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HARMONIZATION OF ICT IN SUPPLY CHAIN MANAGEMENT SYSTEMS: STATUS QUO AND ADVANCED APPROACHES

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Abstract

In the past, many harmonization initiatives have been launched in transport logistics and supply chain management. But under the impulse of sectorial associations, the initiatives lead to focused "islands". Intelligent Cargo (iCargo), a research project funded by the European Union, aims to break down these boundaries and to develop a virtual business ecosystem where logistics and supply chain stakeholders from all modes can cooperate and collaborate easily in a harmonized way.

Keywords: iCargo, eFreight, Harmonization, Standardization, Common Framework, Data Exchange, Information Sharing

1 Introduction

Transport logistics, as the glue of global supply chains (SC), requires a reliable and continuous exchange of data and information. Complete data chains allow to track and trace (T&T) dispatched shipments. T&T provides essential information for SC planning. Many applications in use of SC stakeholders are "island applications" and, at least, are not able exchanging or processing information. Also, if an application is able to exchange data, the adaption of a data format (e. g. FORTRAS 100 standard) to another data format (e. g. to GEFCO standard) is not a matter of course. The SC stakeholder's applications and used standards are to various and an end-to-end supply chain is still a challenge.

The European Commission Framework Programme 7 project "Intelligent Cargo in Efficient and Sustainable Logistics Operations" (iCargo) deals with this challenge and aims at creating a virtual platform for cooperative and coordinative collaboration in transport logistics and supply chain management. The ambition is to build a business and supply chain management ecosystem which provides the means necessary for harmonization and the data information exchange between SC stakeholders. The iCargo ecosystem supports harmonized data exchange between SC partners on basis of web-based applications to make end-to-end transports visible and computable. Thereby, the ecosystem facilitates improved interoperability between the ICT systems used by SC stakeholders. iCargo enables stakeholders and (intelligent) objects to search for and find each other, engage in cooperation, exchange data and disengage after doing so. The data exchange allows synchronizing vehicle movements, to lower CO₂ emissions and to adapt of changing conditions (incl. dynamic (re-) planning and combination of services) and resource planning in the supply chain.

This paper at hand contributes to the understanding of a harmonized data exchange in a supply chain. The purpose of this paper is (a) to give an overview about past and ongoing approaches of harmonization initiatives in transport logistics and SC management and (b) to introduce iCargo as a specific measurement. The paper is organized as follows: In section 2 ICT-systems in use

get presented. In section 3 the iCargo business ecosystem gets introduced. Section 4 presents the promises of the iCargo efforts in harmonization of ICT in SC management.

2 e-Freight initiatives – ICT systems in use

In transport logistics and supply chain management a huge amount of ICT systems are used. Almost every SC stakeholder has two or more ICT systems in use and even the exchange of data to equal transport logistics providers is unmanageable (e.g. RIS to RIS, IATA to IATA, etc.). eFreight [1] is an initiative funded by the European Commission and develops a common framework to communicate necessary and sufficient information between the stakeholders involved in freight transport management. As figure 1 visualizes, the efforts comprise all transport modes with the target of simplification and harmonisation of regulatory requirements in transport logistics and supply chain management. eFreight aims to “develop a standard framework for freight information exchange (in cooperation with presently active major initiatives) covering all transport modes and all stakeholders in door-to-door logistic chains” [1].

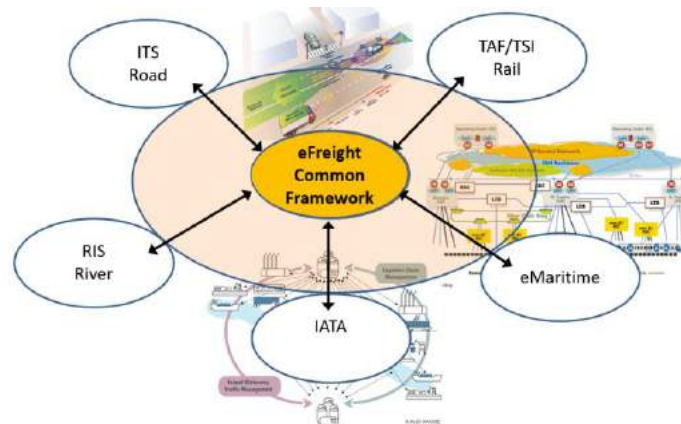


Figure 1: eFreight Common Framework

Originally initiated by the International Air Transport Association [2], eFreight became an industry-wide initiative involving transport logistics and supply chain management stakeholder. Thereby eFreight aims to develop ... [1]

- a standard framework for freight information exchange covering all transport modes
- an European Single Transport Document for carriage of goods with all the necessary legislative support, irrespective of mode
- a Single Window (single access point) for administrative procedures in all modes
- a simple, harmonized border crossings for all modes of transport for EU member states
- a simple procedures and the necessary infrastructure for establishing secure and efficient transport corridors between Europe, USA, and Asia

As figure 1 also visualizes, eFreight is an open platform for web services based on open standards which can unlock services from different logistics stakeholders in the intermodal transport chain. This platform provides a process model in a number of notations and domain entities for all logistics modalities to fulfill the vision of paperless freight transport processes. The electronic flow of information is linked to the physical flow of goods [1]. Thereby eFreight will support [1]:

- (1) the transport-users to identify and use direct or combined transport services
- (2) transport service providers in all transport modes to
 - a. provide information about their services and exchange information electronically
 - b. set up of (liner) service networks adhering to co-modality principles

- (3) facilitate the best possible use of the complete transport infrastructure
- (4) obtain in the simplest possible way the required information for monitoring compliance with applicable regulations, and to exchange information with other authorities for collaboration in security and environmental risk management

In the following subchapters, ICT-systems in use which eFreight comprises get introduced. As the reader can see, many standardization and harmonization initiatives have been launched under the impulse of sectorial associations. But these different approaches lead to focused "islands" of interoperability, driven by individual stakeholder priorities. However, logistics and supply chain actors need an extended, across different modes view.

2.1 Air: International Air Transport Association (IATA)

IATA is a private organization and advocacy group among international airlines. IATA's aim is to ensure safe, secure, reliable and economical air services. Among other projects, IATA is aiming to take the paper out of air cargo and to build and implement "an end-to-end paperless transportation process for the air cargo industry where paper documents are replaced with the exchange of electronic data" [3].

2.2 Sea: eMaritime

The European Union e-Maritime initiative aims to foster the use of advanced information technologies for working and doing business in the maritime transport sector [4].

2.3 River: River Information Systems [5]

[6] defines River Information Systems (RIS, Directive 2005/44/EC) as modern traffic management systems which facilitating and enhancing a swift electronic data transfer between water and shore through in-advance and real-time exchange of information. RIS are information technology related services, which aims to streamline the exchange of information between waterway operators and logistics stakeholder. The overall goals are to optimize traffic and transport processes, to provide local and regional traffic information for safety monitoring on tactical as well as strategical level, to optimize the resource management of the waterborne transport chain by enabling information exchange between vessels, lock and bridges, terminals and ports, etc.

2.4 Rail: TAF TSI

According to [7], Technical Specifications of Interoperability on Telematic Applications for Freight (TAF TSI, regulated in No 62/2006) is developed for rail transport providers to facilitate international exchange of information on cross-border rail-freight services. The TAF TSI initiative sets the functional and technical standards for exchanging information between infrastructure managers, railway undertakings and other stakeholders. The aim of TAF TSI is to contribute to an interoperable and cost-efficient information exchange system for Europe that enables the provision of high quality journey information [8]. The overall goal of TAF TSI is to define European-wide procedures and interfaces between all types of railway industry actors to increase efficiency, service quality, reduce freight handling costs and provide better customer information.

2.5 Road: Intelligent Transport Systems (ITS)

Intelligent transport systems (ITS) on roads have already been developed for more than 20 years and is still an emerging topic in the European Union: In road transport, EU's priorities are to deploy ITS and to support innovative freight transport services that contribute e. g. to reduce carbon dioxide emissions [9]. Their aim is to promote a mobility that is efficient, safe, secure and environmentally friendly [10]. In 2010, the EU adopted a framework (Directive 2010/40/4 [11]) to coordinate implementation of these systems (e. g. to establish interconnections, interoperability and continuity of services. Projects funded by the EU under the umbrella of eFreight are FREIGHTWISE, SMARTFREIGHT, RISING, DiSCwise, etc. Also Intelligent Cargo is a corner stone: "Intelligent cargo is an architectural

approach that builds on distribution of information and computational resources with the purpose of “making cargo information services available to the mass of potential users, by lowering adoption barriers related to costs, effort and information system requirements” [12]. Intelligent Cargo is about cargo that holds information about itself. The cargo is able to process and communicate information to stakeholders across its supply chains.

3 Intelligent Cargo in Efficient and Sustainable Global Logistics

Intelligent Cargo in Efficient and Sustainable Global Logistics Operations (iCargo) is a 42 month European Union project in Intelligent Transport Systems (ITS) and aims at supporting the evolution of the logistic industry towards a mature business ecosystem. It bases on cooperation between specialized supply chain actors to offer competitive and efficient door-to-door logistic solutions [13]. iCargo allows business ecosystem members to collect, share and harmonize status information through the different execution systems and devices operating along the logistic chain. The harmonization mechanism bases on cloud technology, while semantic software agents can be instructed to detect and react to specific kinds of events, e.g., by triggering re-planning [13]. The following subchapters will deep-in in the iCargo business ecosystem approach.

3.1 iCargo business approach

In the iCargo business approach, the logistics industry will evolve into a business ecosystem where SC stakeholders combining their resources and capabilities which provides following business level innovations:

- Collaborative planning
- Logistic chain composition
- Re-planning of logistic chains
- Monitoring of the environmental footprint

As figure 2 visualizes, the iCargo business ecosystem is an inclusive but decentralized network of SC stakeholders and resources and bases on shared rules. The iCargo ecosystem (highlighted in green) is a fabric and shall support systems and processes in cargo transportation chains [14]. The overall goal is to synchronize vehicle movements, adapt changing conditions and to combine services, resources and information from different stakeholders. The benefits of iCargo for clients are competitive performances and costs as well as lower CO2 emissions along the supply chain. Through the resource transparency, freight forwarders experience an increased possibility for harmonization and advanced planning and can coordinate different logistics services easily. iCargo follows the vision of increased accessibility of information with less software implementation.

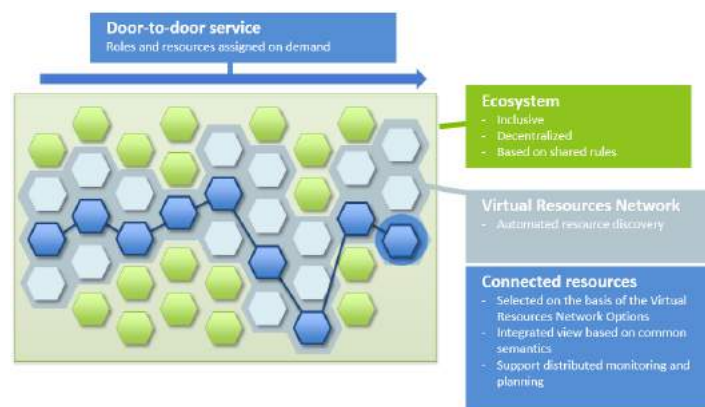


Figure 2: iCargo business ecosystem

Figure 3 presents the iCargo capabilities and consist of long term and operational planning, execution and completion services [13].

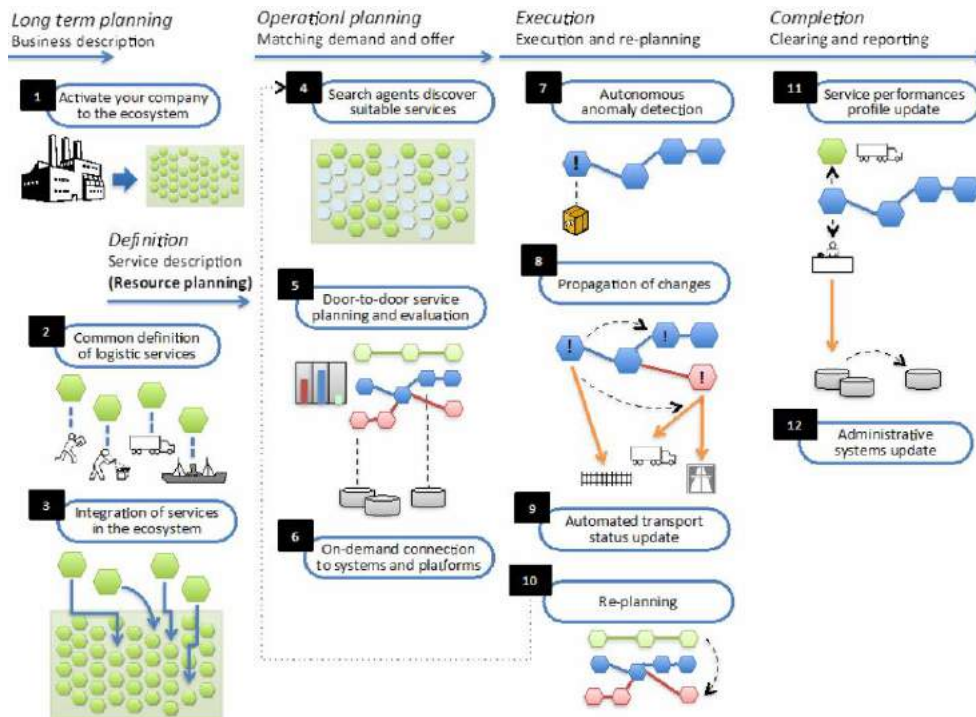


Figure 3: iCargo capabilities

- Long term planning or activation: To offer or demand logistic services, the iCargo ecosystem allow companies to specify a description of its business (business services) and its resource planning. Description of services which are offered by the company can be published and made available to consumers. The services are described in a harmonized way and integrated into the overall iCargo ecosystem.
- Operational planning or pre-service: Afterwards, The ecosystem partners can plan door-to-door services searching and composing automatically smaller services offered by other partners. This allows to arrange the most suitable solutions in terms of optimization of resources, costs and environmental impacts.

Once the door-to-door services are composed, smart connections between heterogeneous systems and platforms enable the harmonized exchange of data between the different IT resources involved in the logistic process.

- Execution phase: During the execution of the iCargo services, the entire process is (automatically) monitored. In case of specific exceptions, events are rapidly and automatically propagated through the entire logistic chain. iCargo functions allow re-planning on actual information to achieve a better optimization of the resources and the lowering of costs.
- Post-service: After the door-to door service completion, CO2 emissions and other kinds of performance indicators are collected and aggregated in order to update the profiles of the services used along the process. These functions increase the ability to compose, in the future, better door-to-door services.

3.2 Role and task allocation

iCargo consists of three main kinds of users and three supporting roles. Thereby, each role concentrates on its core capabilities, relying on other members of the ecosystem to provide complementary products and services. Roles bases on clear task allocation which are:

- Logistics Service Client (responsible for purchasing of logistics services),
- Freight Service Integrator (responsible for providing of combined logistics services),
- Logistics Service Provider (responsible for providing of transport and logistics services),
- Information Service Integrator (responsible for providing of the information infrastructure),
- Transportation Network Manager (3rd level party which provides traffic and infrastructure status information),
- Transport Regulator (ensures that all services are completed according to existing rules and regulations – nothing is possible without leadership from the top of the organization).

Concentration on core capabilities is only possible with an enhanced and continuous exchange of data and information. A generic adapter for local connection with user's ERP systems and back-offices is foreseen.

3.3 iCargo ecosystem infrastructure

The iCargo ecosystem infrastructure is a virtual structure that supports systems and processes in transport logistics. It connects existing networks, systems and devices to allow automated searching and matching of the offered services to the existing the demand. The structure provides the fundament for cooperation and collaboration as well as continuous interaction and information exchange between iCargo ecosystem members. The main idea behind the iCargo infrastructure is that it shall support the supply chain stakeholders to plan, execute and monitor logistics business processes.

The iCargo ecosystem is decentralized and adopts an open approach. There is no central authority that governs its operation. Further, an open information infrastructure is proposed which supports cooperation and collaboration in the ecosystem. Thereby ICT standards and protocols widely adopted by the business community will be used. Such standards and protocols include HTTP, XML, JSON, SOAP, etc.

The iCargo ecosystem infrastructure bases on the concept of semantic interoperability. It is the capability to run business processes seamlessly across organizational boundaries respectively the ability of two or more systems to exchange information and to use the information that has been exchanged. The iCargo semantic interoperability can help organizations to reduce the effort and shorten the time to operationalize and participate in new logistics trade lanes. Also, semantic architecture/interoperability provides a structured approach to increase the ability of diverse systems and organizations to work together in the supply chain. The semantic contains information that enables decision making in different stages (e. g. activation, pre service, during service and post service). The iCargo semantic interoperability goes beyond technical connectivity and includes the exchanged information and the specific business activities that relate to (the role of) parties in a collaboration.

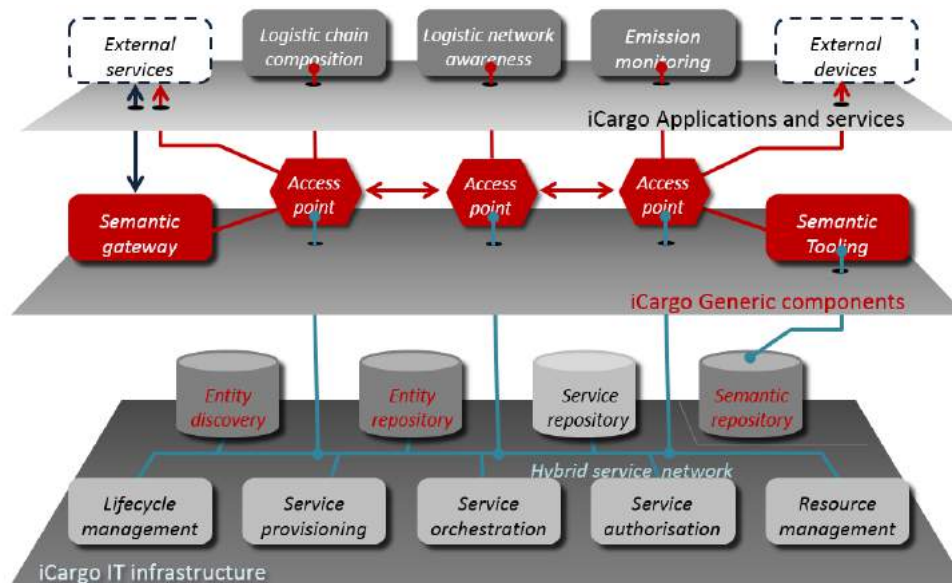


Figure 4: iCargo architecture [15]

As figure 4 visualizes, the iCargo architecture consists of three layers which are the application and services, generic components and the IT infrastructure. Application and services are interfaces to the users ERP system. Here, the users can get the direct benefits of the iCargo system. Generic components represent the ICT view and enable a user to use and define semantically enabled exchange protocols. The semantic gateways allow transforming semantic language into each other language via ontologies (creation of semantically enabled business services and processes).

- Ontologies are beneficial to execute technical components and have been acknowledged as a powerful means to foster collaboration. They improve communication and re-use of knowledge (shared understanding), facilitate the integration of existing systems (reference model) and support the engineering process of software solutions (automation). Access to such information enables an adaptive decision making process.
- Access points are standardized semantically enabled interfaces. They support collaboration in the ecosystem through three types of interfaces: 'logistics services offered by an organization', '(shared) data to logistics services' and 'business data to selected parties'.
- Semantic gateways support access points. Gateways are responsible for converting data from one data source to another.

The last layer (iCargo IT infrastructure) is about data storage, management and authorization are located.

4 Harmonization

While each of the stakeholders supply chain systems work in different fields of logistics, the common framework and the iCargo business ecosystem helps to harmonize the data and information chain. In summary, the iCargo business ecosystem enables (a) a better cooperation and collaboration in transport logistics and supply chain management. This leads to (b) a greater supply chain visibility and transparency. Also the chain experiences (c) increased agility and flexibility and develop itself to a resilient network.

4.1 Cooperation & Collaboration

As highlighted, the iCargo business ecosystem aims to increase cooperation and collaboration through data exchange. The World Economic Forum (WEF) [16] highlights that supply chain cooperation and collaboration is an emerging need and trend. Supply chain managers (should) move away from agnostic outsourcing

towards long-term partnerships: the willingness to work in partnerships is imperative in many supply chains [17].

Cooperation and collaboration can take many forms and range from informal discussion to strategic alliances [18]. But according to [18], cooperation and collaboration can only be achieved in a visible supply chain, where all members exchange relevant information and work together to solve mutual problems. Sharing relevant "information throughout the supply chain is the basis of visibility, which means the extent to which one member of the supply chain can see what is happening at all points in the chain" [18]. iCargo is able to collect data from different systems and provide them for and from different stakeholder in a harmonized way. Cooperation and collaboration are essential characteristics of resilience.

4.2 Visibility and transparency

A chain without cooperation and collaboration does not provide SC visibility and transparency. Invisible and intransparent SC's are more risky than one with free information flows [18]. SC visibility and transparency enables the goal of a demand-driven SC; also it reduces SC risks, both upstream and downstream of operations [18].

The iCargo concept of semantics and ontologies refers to a seamless and complete data exchange which enhances network-wide visibility and transparency. The iCargo access points act as sentinels, which provide quality information. This again leads to manage contradictory requirements of good proceduralization and good planning. Visibility and transparency develops a chains agility and flexibility – all are characteristics of resilience [19].

4.3 Agility & Flexibility

Supply chain agility and flexibility in the iCargo concept is supported by the functions of collaborative planning, re-planning and re-definition:

- The iCargo collaborative planning allows ecosystem members to send and receive data and information from and to its partners. The receipt of advanced data enhances the organization's ability for adaptive thinking.
- Re-planning and re-definition, e. g. by real-time status updates and event notifications, is a further characteristic of agile and flexible supply chains. The functions of re-planning and re-definition make an ecosystem more productive, predictable, economically efficient, and controllable.
- The seamless availability of information about logistics objects allows a shift from reactive to proactive supply chain management. While reactive management contains unclear objectives and goals as well as different agendas, proactive management enables the organizations to work with others (collaboration and cooperation in a partnership), have clear directions and clear objectives in response and recovery. Proactive management allows the realignment of done decisions (redefinition of what it means to be successful) and interchangeability.
- Real-time data and event notification help and create benefits for ecosystem members to build up preparedness at the micro level. Preparedness on the micro-level is important. For example, best performers pay close attention to current operations. Preparedness on the micro-level is also a characteristic of resilient supply chains.

4.4 Standardization

Several institutions (e. g. World Economic Forum [16], etc.) and authors (e. g. Sheffi [20], [21], McDonald [22], etc.) recognized the importance of transport logistics and SC standards. Standardization as tool for harmonization leads to the ability of stronger co-ordination of business processes, automation of routine or complex functions, etc. within a supply chain. iCargo are aware that many

standards have been developed for the logistics sector. iCargo takes this into account and integrates existing standards and technologies where possible. In iCargo, ecosystem members can rely on a harmonized process and data quality. The use of the iCargo ecosystem as a standard helps stakeholders to increase the accessibility of data and transport logistics relevant information.

The iCargo ecosystem considers common interfaces and protocols which allow combining the ecosystem members and logistic objects contributions (products and services, IT services, etc.). These interfaces and protocols bases on international and business community wide adopted regulations and contributes to increased communication and exchange of data. A strong partnership with SC stakeholder and regulators is a further characteristic of resilient organization.

5 Conclusion

Future logistics and supply chain management is characterized by the emerging trend of extended collaboration and cooperation between supply chain stakeholders: integrated supply chains become more and more important. This trend requires data and information sharing along the supply chain. Organizations are demanded to maintain an intimate connection with the business environment. The lack of cooperation, collaboration and communication heighten the supply chain stakeholders' susceptibility to disruption and consequently decrease organizational and supply chain resilience. As this paper shows, harmonization of ICT systems via the eFreight common framework and the iCargo business ecosystem enables a smooth cooperation, collaboration and communication in a supply chain. iCargo allows supply chain actors an active collaborative planning and logistic chain composition basing on real-time data.

Acknowledgement

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A STUDY ON THE AUTO PALLET FEEDING SYSTEM FOR PALLETIZING OPERATION

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ABSTRACT

Due to the increasing demand of small and light products and lack of labour for material handling in warehouse, the demand for automatic palletizing system has been increased. In this paper, we present a new type of automatic palletizer with dispatching rules to improve the efficiency of palletizing. We also provide the performance of the suggested rules by computer simulation.

Keywords:

Pallet, Palletizer, Auto Pallet Feeding System, Dispatching Rule

1. INTRODUCTION

Due to industrial development and increasing demand, the market for small and light products such as jewellery, semiconductor, LCD, electronic components, parts of automobile, etc. is expanding. Meanwhile, the supply of labour for material handling has not been sufficient in warehouse. Particularly, the shortage of worker for packaging and storing cargos takes 42% of the whole shortage of labour in warehouses of South Korea. (Choi et al, 2011)

To deal with this kind of challenges, many warehouses are adopting automatic material handling systems which can quickly handle many products with a few workers. Palletizer is a kind of packaging technology identifying the properties of various freights such as volume, type, shape, etc. and loading those freights on a pallet with high speed. According to Packaging Digest, one of the packaging magazine in United States, the global market for palletizing machine is expected to grow 6 % annually until 2017 which is about 0.706 billion dollars (Packaging Digest, 2011).

There have been bright prospects for the demand of advanced palletizers: NIST (National Institute of Standard and Technology) reported that in the near future, there will be a rising demand on palletizer particularly for loading the various type of products simultaneously to cope with the change of environment (Madhavan et al. 2012). And as the aging phenomenon of labour force is getting intensified, palletizers with more high efficiency are expected to receive more attentions. In this study, we designed an Auto Pallet Feeding System (APFS) that stores various types of pallets and supplies them to a palletizer whereas conventional palletizers have no capability to supply empty pallets automatically. This feature makes palletizers operate continuously without interruptions caused by waiting of empty pallets. Also we developed dispatching rules which reduce setup time for changing the pallet type. These works in this research, in result, can increase the speed and the efficiency of palletizing works.

This paper is organized as the followings. In the second chapter, studies on palletizers and dispatching rules were reviewed. In the third chapter, the new of palletizer was introduced and explained. In the fourth chapter, dispatching rules

for improving operations of the proposed palletizer were presented. We demonstrated the performance of the developed dispatching rules with computer simulation in the fifth chapter. In the final chapter, we drew the conclusion of this study and proposed directions for future research.

2. LITERATURE REVIEW

There have been many researches on palletizers and dispatching rules. But most of the research have been focused on the loading patterns such as stack algorithms. The loading pattern is a rule that defines the number and the position of products to be palletized considering the types of pallet. There are few studies related to the innovative machine for palletizing like APFS. Also most of existing studies on dispatching rules focus on the improvement of whole process instead of specific equipment. This study focuses on the dispatching rule for a palletizer. Table 1 shows the summary of studies conducted previously.

Subject	Contents of research	Reference	Implication
Palletizer	To suggest Auto Pallet Feeding System for air cargo terminal	Kang, 2010	Almost studies focus on conventional palletizing system.
	Integrated software for simulating and monitoring the works of a palletizer	Argenti et al., 2010	
	To monitor works with various sensor	Weichert et al., 2013	
	Stack up solution	Eldmir et al., 2004	
	Simulation of palletizing	Vasudevan et al., 2009	
	Optimization of Performance parameter	Lambiase et al., 2003	
	Stack up algorithm	Rethmann et al., 2001	
	To introduce a conveyor type palletizer	Zegler, 2011	
Dispatching Rule	Fuzzy logic based dispatching rule for flow shop	Petroni et al. 2002	There are few studies on the improvement of particular equipment.
	Simulation of dispatching rule for FMS	Ishii et al, 1994	
	Dispatching rule for scheduling	Azadeh et al., 2013	
	Dispatching rule for flow shop optimization	El-Bouri et al., 2011	
	Dispatching rule for scheduling	Baykasoğlu et al., 2010	
	To combine dispatching rule and forecasting for multiple scheduling	Tung Dang, 2013	
	Cost based dispatching rule for scheduling	Jayamohan et al., 2004	
	To combine dispatching rule and production plan	Hicks et al., 2006	
	Dispatching rule for process configuration method	Rhee et al., 2007	
	Dispatching rule for SCM	Rhee et al., 2005	
	Dispatching rule for job shop scheduling	Moon et al., 2009	

TABLE 1: Summary of related research

3. PALLETIZER WITH AUTO PALLET FEEDING SYSTEM

3.1 Auto Pallet Feeding System

The palletizer designed in this research supplies pallets by Auto Pallet Feeding system and palletizes single-type products transferred from a conveyor belt. After palletizing the products, the pallet and the products are released and then, wrapped by wrapping machine. All these process operate automatically without manual labour. The whole palletizing system consists of five parts; Auto Pallet Feeding system (APFS); Flexible Goods Conveying module; Cargo Aligning and Loading module; Pallet Release Module; and Wrapping module as shown in Figure 1. The following shows details of each part.

- Auto Pallet Feeding system: Supplies an empty pallet to Cargo Aligning and Loading module.
- Flexible Goods Conveying module: Conveys products to be palletized to Cargo Aligning and Loading module.
- Cargo Aligning and Loading module: Aligns the products in accordance with a loading pattern and loads the products on the pallet.
- Pallet Release module: Exports products that have been loaded on the pallet.
- Wrapping module: Wraps the loaded cargos and the pallet with films.

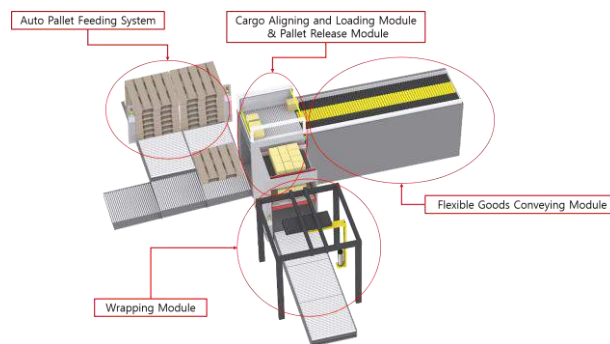


Figure 1: Palletizer equipped with Auto Pallet Feeding System

In conventional system, empty pallets are supplied to palletizer by forklifts which need human labour. It is a time-consuming task for workers because the workers have to insert an empty pallet whenever the palletizer finishes single palletizing task, which may cause a long interruption for palletizer unless the workers do not continuously pay attention to the palletizer. But the palletizer in this paper do not have to wait empty pallets because APFS stores enough pallets and supplies the pallets continuously without human labour with the aide of sensors. APFS also can supply various kinds of pallets dynamically in accordance with customer orders. APFS includes some pallet stacks, conveyors equipped with Power Base, fixing device, sensors and some devises for control. Each pallet stack stores same kinds of pallet and has their own sub-modules such as conveyor equipped with Power Base, fixing device etc. Figure 2 depicts the operation of APFS. To supply an empty pallet to the palletizer, APFS lifts and holds one pallet stack with Power Base and fixing device for a while. Then it extracts the lowest pallet with conveyor. The following steps show more details about the operation.

- Step 1. Power Base lifts up a pallet stack.
- Step 2. Pallets (except for the lowest pallet) is held by Fix Pallet.
- Step 3. The lowest pallet descends with Power Base.
- Step 4. The lowest pallet is transferred and Power Base ascends again.
- Step 5. Fixing device moves back and the pallet stack descends with Power Base.

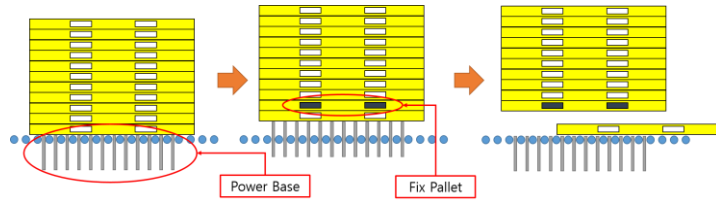


Figure 2: Operation of Auto Pallet Feeding System

3.2 Operational process of the palletizing system

The proposed palletizing system requires relatively complicated interactions among APFS and other diverse modules. If the system receives an order that requires a specific type of pallet, the system checks whether it has enough quantity or not. If the system has enough pallets, the pallet is extracted from APFS and inserted into Cargo Aligning and Loading module. In Cargo Aligning and Loading module, the height of the pallet is adjusted to the height of products. While the pallets moves, products are arranged on the alignment plate. When the alignment is completed, the products are conveyed onto the pallet. Then, the pallet is descended in some measure to load the next level of products. The aligning, conveying and descending process are repeated till full loading. If all products are loaded, the products are released and wrapped. When the wrapping ends, the storage level of pallets is checked again. If the level is lower than safety stock, workers are notified for a supplement.

4. DISPATCHING RULE FOR PALLETIZER

The designed palletizing system has flexibility to operate with many types of pallet. But to change the pallet type, the palletizer needs some setup time according to the specific pallet type which has different size and shape. Considering the setup loss, we made two dispatching rules to improve the performance of the palletizer.

In the first rule, works are primarily sequenced in order of due time and then processing time. In the rule, works that have impending due time have high priority to be processed. If there are works that have the same due time, a work that has shorter processing time has higher priority.

Figure 3 shows an example of the first rule. Each orders has due time and expected processing time. In this paper, the due time is defined as an interval between the starting time of the whole operation and the deadline of each order. The processing time is a period for which the palletizer is being occupied by an order and this period is calculated based on the pallet type and the amount of products to be palletized per an order. At first, order is aligned based on due time (30, 60 and 90). Then, order 1 and 4 are sequenced by processing time in ascending sort (0.26 and 5.84).

Primary Criterion: Ascending order

Priority	Order No	Due Time (min)	Processing Time (min)
1	1	30	0.26
2	4	30	5.84
3	3	60	1.68
4	5	60	8.20
5	7	90	0.76
6	6	90	5.66

Secondary Criterion: Ascending order

Figure 3: Example of the first dispatching rule

In the second rule, setup time is considered. The second rule rearranges orders sequenced by the first rule to reduce the generation of setup time. Figure 4 shows the example of the second rule. First, orders are sequenced by the first rule (①). Second, orders that have impending due time are assigned preferably by the due time to be kept (②, ③). If the accumulated processing time of all assigned orders ($18 = 3.5 + 4.6 + 4.4 + 5.5$) does not exceed the due time (i.e. 30) and the spare time (i.e. $12 = 30 - 18$) is enough, the orders that do not accompany the setup time are assigned even if the orders have relatively lower priority. In this case, the orders with pallet type A do not accompany the setup time (④).

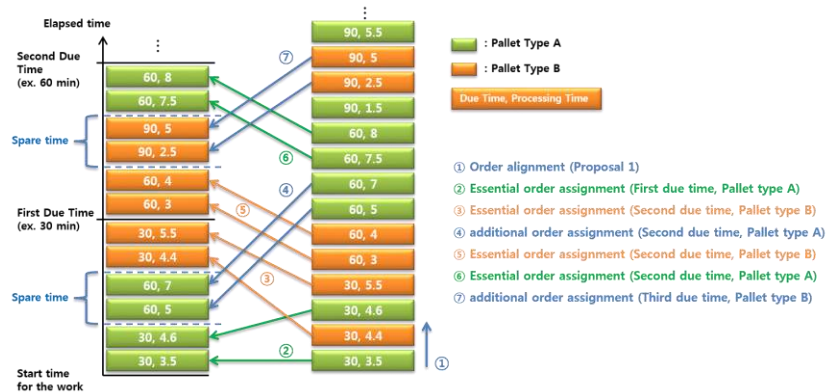


Figure 4: Example of the second dispatching rule

5. SIMULATION

5.1 Design of simulation

To analyze and demonstrate the performance of the proposed dispatching rules, we generated random order lists and tested the results with some performance index. The test program was developed by Microsoft C#. As-is case and existing dispatching rules were also tested for comparative objective (Sule, 1997). Table 2 and Table 3 presents the scenarios and performance indexes defined in this paper. In case 3 and 4, pallet type that has short unit loading time has higher priority. The unit loading time is a time period to load one level of products on pallet and the period is determined by loading pattern.

20 order lists were randomly generated and 120 runs of simulation was performed (20 runs for each case) and each order list had 100 orders. We supposed that orders could have one of 30, 60, 90 ... 510 and 540 minutes as due time respectively and need one of two pallet types in even proportion.

Case	Dispatching Rule	Description
Case 1	Fist In Fist Out (FIFO)	by chronological order. (As-is case)
Case 2	Earliest Due Date (EDD)	in order of due date (due time) i.e. it is sequenced in ascending sort
Case 3	Pallet Type	sequenced by pallet type
Case 4	EDD + Pallet Type	EDD first, if there are orders with same due times prioritize them by pallet type
Case 5	Proposed rule 1	EDD first, if there are orders with same due times, prioritize them by processing time in ascending sort
Case 6	Proposed rule 2	It tries to shorten setup time on the basis of the proposed rule 1

TABLE 2: Scenarios for simulation

Performance Index	Description
Working time	Working time for palletizing 100 orders
The number of delayed orders	The number of orders that could not observe its due time
Total delayed time	The sum of delayed time of delayed orders

TABLE 3: Performance index for simulation

5.2 Analysis of simulation results

Figure 5 shows the result of the simulation. Values in the figure 5 are the average of 20 repetition per each case. The values of working time were presented from 480 minutes to facilitate the comparison of results.

Case 1 represents operation with a basic method, FIFO.

Case 2 shows a result that the number and the total time of delayed orders are decreased remarkably in comparison with case 1. It means that just simple dispatching rules can make big improvements on the efficiency of operation compared to FIFO.

Case 3 shows a result that the proposed rule minimized setup time, which resulted in the shortest working time among all cases. But this rule is not suitable for work orders with due time because this rule do not deliberate the due time at all.

Case 4 shows the importance of considering setup time and due time at the same time. The result shows there was improvement in terms of all factors in comparison with case 2. This rule can be used in many applications where setup time has to be handled.

Case 5 shows a result that the working time is longer than case 4 but the number of delayed order is smaller than case 4. The rule of this case took the processing time into consideration instead of the pallet type which was considered in case 4. Therefore, the results prove that sequencing by processing time can help decreasing the delayed orders whereas considering setup time can help making improvement on working time. It is expected that the effectiveness of the two methods would be different as the features of order lists.

In case 6, the rule showed the most superior performance in the two performance indices, the number of delayed orders and total delayed time. Although the rule demonstrated the second best performance in working time, it can be concluded that the rule can surpass other rules in point of overall performance because the due time was not thought in case 3 where the best working time was achieved.



Figure 5: Result of simulation

6. CONCLUSION AND FUTURE RESEARCH

In this Paper, we studied technology to enhance the efficiency of operation for palletizing. We designed Auto Pallet Feeding System that supplies various types of pallet to a palletizer automatically in order to reduce overall palletizing time. Then we developed dispatching rules to improve the performance of palletizer equipped with Auto Pallet Feeding System. Computer simulation was used to compare the performance of each dispatching rule. Currently, we considered only two types of pallet and in the future, various types of pallets should be considered to be applied in real world case.

ACKNOWLEDGEMENT

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THE QUALITY OF OUTSOURCED LOGISTICS SERVICE: A COLLECTIVIST CULTURE PERSPECTIVE

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ABSTRACT

The purpose of the study is to explore on the elements of outsourced logistics service quality and how the users' satisfaction was formed within the Malaysian culture context. This qualitative study was based on five semi-structured interviews which were carried out with the executive officers and department managers of four logistics providers firms and one manufacturer. The data were analyzed using thematic analysis method. Rather than the organization's performance-related factors, the results revealed that, within the Malaysian national culture context, there are influence of the cultural element towards customer satisfaction. There are four (4) logistics service quality elements identified include timeliness, task accuracy and the condition of the product, and the quality of key contact personnel. There are eight (8) other elements leading to satisfaction which is not within the original logistics service quality theory. They include efficient, consistent service, responsiveness, ensuring customers' reputation, sensitive to other people feelings, taking blame to ensure satisfaction, emotional closeness between personnel and the family as a base of identity. The emerging elements provides the key insights on the elements which lead to satisfaction in the context of Malaysian logistics service users. Rather than the organization's performance-related factors, the results revealed that, within the Malaysian national culture context, there are influence of the cultural element towards customer satisfaction.

INTRODUCTION

Many authors identified and addressed that there are differences on how theories are functioning in various national culture (Hofstede, 1993; Kristal, Mark, & Sheu, 2008; Schermerhorn, 1994; Abdullah, 1996; Childerhouse et al., 2010). National culture is defined as the collective programming of the mind that distinguishes the members of one group or category of people from others. Mentzer, Myers, & Cheung (2004) had acknowledged that it is important to expand the knowledge on how logistics service quality and customer satisfaction functioned in different national culture.

Mentzer et al., (2004) addressed that logistics activities are subject to culturally influenced preferences prevalent across the globe, especially the general influences such as timeliness and responsiveness. Mentzer et al., (2004) added that the majority of study are emphasizing on the identification of customer character related to segmentation of tangible goods, rather than services. Riddle (1992) stated that firms which are able to master the cultural elements through learning and training have the opportunity and advantage to perform well in the market. There are several works conducted to understand cultural values function in business, for example Yang, (2011) have studied in detail about the importance of Guangxi (Chinese cultural value) in businesses. Specifically there are a limited number of works available to understand logistics service quality and customer satisfaction in a collectivist society.

Malaysia is a multiracial and multicultural society, with a total population of approximately 25 million people. The Malays, Chinese and Indians who are 65.5%, 25.6% and 7.5% respectively (EPU, 2012) are the major ethnic groups while the other 1.6% comprises of other indigenous groups. The Malays and other indigenous groups are the Bumiputera (son of the soil) which the Malays form the largest group. With multiple cultures, there are underlying beliefs that have shaped the values

mainly among Malays (budi complex) and Chinese (Confucianism) business culture (Abdullah, 1996; Storz, 1999). Based on the Hofstede et al., (2010) in the national culture index, Malaysia is a country with high power distance and the consist of collectivist society.

The core question that guided this study can be stated as follows: Do the Malaysian cultural values have any influence on the manufacturers' satisfaction towards the quality of outsourced logistics service? The purpose of this paper is to contribute to the theoretical understanding on the components of quality of logistics service and how does the customer satisfaction emerged among the Malaysian manufacturers. The remainder of the article is structured as follows: First it reviews the extant literature relevant to national culture and logistics service quality. Then the methodology and the technique of data analysis is presented. Next the findings are discussed and summarised. The paper concludes with a discussion of theoretical and managerial implications and directions for further research.

LITERATURE REVIEW

National Culture and Logistics & Supply Chain Management Study

Globalization are mentioned as the main reason that heightened the concerns about importance of understanding cultural differences. Table 1 presents the summary of logistics and supply chain research related to national culture study. In logistics and supply chain context, listed works have acknowledged the significant impact of cultural differences and promote to extend the understanding into various discipline and theories.

Table 1: Summary of Logistics and Supply Chain Research Related to National Culture Study

Author	Approach and Context of Study	Theoretical Origin	Variables	Results
Mentzer et al., (2004)	Conceptual / Global Context	Logistics Service Quality	National and regional characteristics, Organizational Characteristics, Perception of order placement activities, Perception of order receipt, Satisfaction level response	While the fundamentals of logistics service are frequently addressed, understanding the application of logistics service strategies in a global context is still in the early stages of development. It is the role of future research to continue to investigate the influence of LSQ in a global context, particularly addressing the research propositions presented
Schoenherr, (2009)	Literature Review. Global Logistics and supply chain management	Challenges of Global Logistics and Supply Chain Management	NIL	There are 4 predominant themes emerged in the global study; Important highlights are that there is indication that an approach that works perfectly in one country may lead to a considerable failure in another country. Author suggested future research to continue explore and update specific national logistics and supply chain management settings
Laskowska-rutkowska, (2009)	Literature Review. Supply Chain Management	National Culture, Organizational Culture, Supply Chain	NIL	National and organizational culture have a significant impact on the success of cooperation between companies in the supply chain. - Countries whose traditional culture has favoured

				cooperation may benefit from their "cultural value added." – On the other hand, countries where strong individualism and a confrontational approach predominate may find themselves in a less favourable position. In this case, the chances that a partnership in the supply chain will be successful may be increased by the creation of an organizational culture focused on cooperation and by the use of tools that help define partnership goals and its optimum "depth."
Childerhouse et al., (2010)	Survey, Global Supply Chain Management	National Culture	Anthropological approach observing SCM behaviour within natural setting. behaviour type	Culture significantly affect Supply Chain Management practices.

Logistics Service Quality and Customer Satisfaction

The original Logistics Service Quality work by Mentzer, Flint, & Hult, (2001) consists of nine (9) constructs to determine customer satisfaction. It includes Personnel Contact Quality, Order Release Quantity, Information Quality, Ordering Procedures, Order Accuracy, Order Condition, Order Quality, Timeliness and Order Discrepancy Handling. In different cultural settings, there are possibility that there are more factors when it involves different national culture. Logistics service quality theory was developed from the views of western organizations (Customers of Defense Logistics America) which is from the view of individualist countries and lower power distance (Hofstede et al., 2010). It is important to note that there are significant differences between both Individualist and collectivist in term of preferences and cultural values. Table 2 presents the key differences between collectivist and individualist society's language, personality and behavior.

Table 2: Key Differences between Collectivist and Individualist Societies Language, personality and behaviour

COLLECTIVIST	INDIVIDUALIST
Use the word "I" is avoided	Use of the word "I" is encouraged
Interdependent self	Independent self
On personality tests, people score more introvert	On personality tests, people score more extravert
Showing sadness is encouraged and happiness discouraged	Showing happiness is encouraged and sadness is discouraged
Slower walking speed	Faster walking speed
Consumption patterns show dependence on others	Consumption patterns show self-supporting lifestyles
Social network is primary source of information	Media is primary source of information
A smaller share of both private and public income is spent on healthcare	A large share of both private and public income is spent on healthcare
People with disabilities are a shame on the family and should be kept out of sight	People with disabilities should participate as much as possible in normal life

Source: Hofstede. G, Hofstede G.J, Minkov, M., (2010) Cultures and Organizations, Software of the Minds, Intercultural Cooperation and Its Importance for Survival

Previous work has concluded that there are contradicting results from well-established theories when it involves cultural values of Malaysian (Faisal & Jaafar, 2011; Schermerhorn, 1994). For example in the relationship development and long

term relationship, Faisal & Jaafar (2011) mentioned that, the technical aspect such as the quality of service provided and punctuality was not significant in securing future project with the same customer. In fact, it was the relational elements such as a personal relationship, emotion, values and social interaction that were most vital. While most studies suggest balance of power is crucial for good relationship, the study by Faisal & Jaafar (2011) have proven otherwise where in the Malaysian culture where power distance is acceptable, and it is contributors to faster and good relationships. The study indicates that the existing inter organizational relationship models in the literature did not accord with Malaysian organizations. Faisal & Jaafar (2011) suggested considering a more culturally sensitive models which fit particular race.

METHODOLOGY

Five companies were interviewed for preliminary research. Four (4) companies are logistics providers and one of them is logistics users. Interviews held took about 16 minutes to an hour. Each interview recorded by using a voice recorder and at the end of the interview data were analyzed ad verbatim. Table 2 is a summary of the individuals and companies who have been interviewed. Interview questions are in semi-structured form. Question asked covers on how customers are getting satisfied or dissatisfied with the service provided.

Table 2: Summary of Company

	Type of Organization			Designation	Experience
1	Logistics Warehousing	Providers	Company	A Head of Department	5 Years
2	Logistics Transport	Providers	Company	B Head of Department	2 Years
3	Logistics Forwarding	Providers	Company C	Freight Sales Executive	2 Years
4	Logistics Transporter	Provider	Company	D Operation Assistant	2 Years
5	Logistics Users	Manufacturer	E	Shipping Executives	2 Years

FINDINGS

The following part present the findings of the research followed by discussion and conclusions.

Logistics service quality affecting customer satisfaction

In the interviews four (4) item similar to LSQ items mentioned by informants, while there are eight (8) emerging item being mentioned as not originated from original LSQ item and that it is potentially the antecedents to customer satisfaction.

Timeliness, condition of the product moved and task accuracy are the basic common required by users

Regardless on the process or activities (e.g., loading, unloading, staging, transfer, packing) punctuality is very crucial and it goes along with ensuring goods are intact, unbroken and accurate. These elements are usually monitored as the users' key performance index. Company B mentioned that on time delivery is the essential element of logistics service. Company B indicated that *"Among Key Performance Index monitored is on time delivery..."* Company C shared the same view where he indicated *"..Must arrive as promised..."* While company D provide examples of what he mention as a good timeliness will make them satisfied: *"Ok, there's many vendors, some of them are OK, some are not, so the which is OK usually when they arrive at customer they hit on time delivery, we'll be satisfied if they are able to achieve it. We'll continue to request for their trucks..."* Company D added that: *"...time is important if you go to any company your customer will definitely give you time,*

because they need product as promised to ensure the warehouse running smoothly, any delay within the operation will cause more chained delay effect..."

Wrong information, incomplete information, confusing information are non-tolerable, be it either verbally or written information, it must be clearly communicated and delivered as promised. Customer also appreciates the providers if they are updating if there are any delays rather than keeping it in silence. *"if they promised to arrive within three days, so the things must arrive within three days, or if they cannot they need to notify us immediately, the crucial part is to inform customers exactly if there are any issues at ports or customs if not they're in trouble."* In five interviews all companies indicated that it is basic that the accuracy of each task does play a significant part in their activities, as most of the activities is within warehousing and require the person to arrange products as requested for further delivery; thus the accuracy is critical.

Efficient in dealing with difficulties and crisis

Users have more confidence on their providers if they are able to conduct the job efficiently. Especially when there are difficulties or crisis. Users are not in favour of dealing with the logistics related problems as they expect everything related to logistics is done by the 3PL. The efficient providers which put less trouble to the customer are one of the reasons to make the users satisfy. Manufacturers E mentioned that *"The way they handle complaints and problems solving, so they are good at it, and they ensure that the same thing won't happen..."*

Consistent service

Unstable performance of outsourced logistics service is not favourable by the logistics users, customer preferred providers which maintain their performance overtime, not providers which show inconsistencies of service. This is evident in the interview. Whereby manufacturers E indicated *"Our previous freight forwarders are not consistent, sometimes they are good sometimes they perform badly; thus we have changed to our current 3PL they are more consistent..."*

Responsiveness

It is describing the 3PL to have a fast response, worldwide coverage, updated rates, good care, consolidated offers, variety services, fast and have the willingness to fulfil customer requirement. Company B and E highlighted on the value of the business be able to support last minute requests. Next sub element of responsiveness is Good care and willingness: Manufacturer E mention that: *Even within the last minute they'll say "Ok, boleh boleh" (Ok, yes we can) so to me we're like indebted to them, we feel comfort dealing with them. They're very efficient, and we don't mind paying them any amount."* The commitment and interest showed by providers is also part of responsiveness. Their effort to ensure the task is done well is important to users. According to Manufacturer E: *Some shipment at T Logistics they don't really bother much, when they receive documents, sometimes we're wondering why our shipment is still en route? They don't put an effort to push or expedite the shipment, which is why we decide to slow down using T logistics. They have the best technologies but not aligned with their employee's performance. So we decided not to use them.*

Quality of key contact personnel

This element refers to the impression of informants towards the quality of key contact personnel. It includes the personnel make effort to understand the situation. Designated key contact personnel solving the problems and the good knowledge of experience of the key contact personnel. Company A explained *"...it is important for key contact personnel to alert on their calls for service because there are a lot of providers out there if they don't pick up our phone calls we will get another provider".* Manufacturer E in expressing the value of key contact personnel highlighted that *"it is the way the contact personnel work which make the overall process fast, if the contact personnel "mengular" (lit. snake, lazy) every subsequent process will be affected...The good thing is they can advise us on the Customs procedure, the ZB1, ZB4 (Customs forms). Like us sometimes we do trading activities, so once the*

product arrived we will change the product labels and then we will export it, so our 3PL are willing to help us on this with a very low costs. That's why we like them, they can advise us in a lot of related things"

Emotional closeness between boundary personnel

Personal relationship means that both key personnel in logistics service providers and users are more than just business partner. The key person of 3PL companies has a personal and emotional closeness. It is to the extent that when the key person transfer to other company, the customers too. Company B indicates that: *"due to a poor relationship with the customer we are not able to continue the service with our customer, yes the business is not that profitable but we still need businesses, but the problem is our Business Development didn't do their job to build up good relationship and rapport with a customer, so we lost the business'.* Company C also highlighted on the close relationship between the sales executive with his customer whereby *"when this guy resigned and moved to other companies, his customer also moved. When he decided to return to the company, his customer returned too."*

Taking the blame to ensure satisfaction

Just to make the customer happy and to secure business continuity, service providers are willing to admit mistakes that actually caused by their customer. While customer must have realized that it is actually their own fault, the willingness of service providers to put such commitment are one of the points the customer sustain with the same providers. As indicated by company C *"Especially when it involve oil and gas companies, for example, they transport from United States to Kemaman (Malaysia), and there is a mistake, where the product were sent to Taiwan. The mistake is actually clearly not our mistake. But we take the blame; we even need to make an apology and bear the cost. On top of that, we have to give something as an appreciation. We're trying to avoid them from penalizing us due to delay, or worst if they go for other service providers.*

Be sensitive to other people feeling

This element is similar to the concept of 'jaga hati' (caring) which is embedded in the Malaysia cultural value. The act of 'jaga hati' by not making sour face during the service encounters is not directly related to the technical operation or the service. However, it is one of the elements which may cause dissatisfaction. Company D stated that *"...We need to be friendly with our service provider, it is common, we cannot make 'sour faces' (angry faces) or else if any problem occur it will be hard to discuss, because we actually need their help to assist us, if they cannot support us we will fail..."*

Ensuring customers' reputation

3PL performance affects the reputation of their users. As an example if the 3PL delays, the receiving company (which is the manufacturer which used the 3PL service) will blame the manufacturers not their 3PL providers. Thus, reputation is important for manufacturers, and they are willing to spend just to ensure that their reputation are well taken care. This element is mentioned by manufacturer E *"We don't mind to spend for speed services, this is to ensure our reputation towards our customers, we must 'jaga nama' (ensure reputation) through this we can convince them and gather bigger projects. Whatever our 3PL want to do to get the job done we don't care" The most important thing is no hidden charges and fulfil what they have promised. Or else I will "Taruk cukup cukup" (lit. beat to death in Northern Malaysia dialect)."*

The family as a base of identity

Family as a base of identity refers to transforming formal premises such as office to an informal family oriented environment. Family oriented communication may alter the atmosphere to a friendlier manner and easily to gain trust. Logistics service providers C indicates that *"Example one of our customer, which is wholly Malay company, while our person in charge is Chinese. But if anything happen we will pass it to Malay sales executive because it is much easier to deal with. For Malay usually at first we will address them as 'Tuan' (Mister) or 'Puan' (Madam/Mrs) but after one*

or two month when we get used to we will start calling them 'akak' (sister) or 'abang' (brother). So the relationship bond is much stronger compared to the Chinese they will keep on using Mr to address the customer which is a sign that the relationship bond is weaker. The same goes with Chinese customer the relationship and trust is much more easier to be developed when Chinese sale take care of it"

DISCUSSION

From the preliminary findings, there are four (4) logistics service quality elements identified timeliness, task accuracy, condition of the product, and the quality of key contact personnel. The elements such as Timeliness, Information Quality, condition of product and quality of the contact person is slightly different from the work of Mentzer (2001) whereby the conceptual definition of each component is from the perspective of various users towards various outsourced logistics service. Unlike the original work of Mentzer, it is gathered from the view of multiple users towards one single provider. Thus, this study supports on the understanding that logistics service quality theory evaluation are subject to the network complexity. There are eight (8) other elements leading to satisfaction which is not within the original logistics service quality theory. They include efficient, consistent service, responsiveness, ensuring customers' reputation, sensitive to other people feelings, taking blame to ensure satisfaction, emotional closeness between personnel and the family as a base of identity. These findings provide key insights and as an indicator that earlier studies by Faisal & Jaafar (2011) and Abdullah, (1996) appears to be vital in the context of logistics service providers and users evaluation. The importance of these cultural-related elements was investigated further in the process of collecting the main data.

CONCLUSION

From this exploratory study, we can conclude that there are different elements of logistics service quality and customer satisfaction when it is functioning in the Malaysian National Culture. These unique phenomena require an in-depth understanding to enhance and take advantage on the capability and potential. Future study should add up more manufacturers' viewpoint on the same context. Depending on the type of logistics service used, the service quality components varies. The findings signify that it is important to delve further into the subject matters, which is to investigate the logistics service quality, customer satisfaction in Malaysia national culture.

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On the Relationship of Global Supply Chains and Product Design

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Abstract

The aim of the paper is to capture the principles of platform products and the structure of the supply chain on a firm's profitability. We model a firm with operations in two countries (termed as an international enterprise). Manufacturing and product design factors incorporated in the model include factory location, inventory, economies of scale, level of product attributes, and postponement. Marketing factors include product positioning and pricing. The framework also includes international factors such as the exchange rate and transportation cost. We model and compare eight operational options that the firm may adopt in this context. The first two options are based on the principles of platform products and are termed core product options. In these options, the international enterprise manufactures a "core product" in a single facility located in one of the countries. Under the first core product option, this facility also performs additional operations on the core product to develop custom-tailored products. Under the second core product option, customization of the core product takes place in facilities located in both countries. The other six options are characterized by standardization/customization of product and pricing policies as well as centralization/decentralization of the production function. The main result of the analysis is that under certain production-related conditions, the core product options dominate the other six manufacturing-marketing options. This result has significant managerial implications since it suggests that platform products implemented by the core product options exploit the best of both worlds; customized pricing and product policies as well as savings derived from economies of scale from the centralized production of the core product.

Keywords: Platform Products, International Issues, Manufacturing-Marketing Interface, Product Design, Postponement.

1 Introduction

It is common to find companies that have operation in more than one country. These operations involve activities in manufacturing, marketing, distribution, new product development or combination of those. The nature and the extent of these operations performed in each country vary from company to company. This has led to a typology of companies with operations in more than one country (Bartlett and Ghoshal, 1989). In order to facilitate the analysis and discussion in this paper, henceforth, we term as an *International Enterprise* (IE) a company that has operations (either manufacturing or marketing or both) in more than one country.

Management of IEs has to make decisions along a number of dimensions concerning its manufacturing and marketing functions (Yip, 1989). Manufacturing-related decisions include factory location, management of the global supply chain, inventory, economies of scale, product design, and postponement. Marketing-related decisions include whether the IE should customize or standardize its products and pricing policies. The above decisions have to be made after taking into consideration such international factors as the exchange rate, transportation cost, and import taxes. Apparently, the complexity of the international business arena requires the above crucial decisions to be made by the company as a whole, with all business functions participating in the decision-making process.

The international facility location problem deals with the *configuration* and *coordination* of the value-added activities (Porter, 1990). Configuration refers to the degree of concentration and dispersion of activities in the value added chain. On the other hand, coordination of the activities around the globe deals with information sharing among the activities, the allocation of responsibility, and alignment of effort. The design of the network of facilities must also examine the impact of the network on the international supply chain, from the procurement of the raw materials, their transformation into intermediate products and subsequently into final products, their storing and their delivery to customers through a distribution system.

The marketing function of an IE must make the strategic choice whether the IE should offer a standardized or a customized product worldwide (Kumar and Hadjinicola, 2000). Levitt (1983) states that due to the emergence of global consumers and the homogenization of preferences, a global corporation "sells the same things in the same way everywhere." Other researchers though, challenge this view by arguing that substantial heterogeneity across countries prevents the adoption of standardized marketing programs (Douglas and Wind, 1987). In addition, the marketing function must decide whether to adopt standardized or customized marketing programs across countries such as pricing and promotional programs.

The purpose of this paper is to model and compare eight Manufacturing-Marketing (MM) options that an IE can adopt. These MM options emerge by considering factors from the manufacturing and marketing functions. Manufacturing factors include factory location, inventory, economies of scale, product design, and postponement, while marketing factors include product positioning and pricing (Hadjinicola and Kumar, 1997). The modeling framework also includes international factors such as the exchange rate, transportation cost and import taxes. The modeling framework is carried out for IEs that have operations in two countries. More specifically we address the question: Given a specific competitive environment characterized by a given number of competitors that can adopt any of the MM options presented in this paper, which MM option should an IE adopt to obtain maximum profits?

Table 1 presents ten MM options that an IE can adopt. Under the first two options, termed *core product options*, the IE manufactures a "core product" in one of the two countries. In the first core product option, the facility in this country performs additional operations on the core product to develop custom-tailored products that meet the needs of the local and foreign markets. The final products are also shipped to the other country. Under the second core product option, the core product is shipped to the production facility in the second country to be customized. Customization of the core product can be additional machining, assembly processes, or simple attachment of components. The other eight options are characterized by the following three dimensions: (1) the IE offers a standardized or a customized product design; (2) the IE customizes its pricing policy or uses a uniform pricing policy; (3) the IE centralizes its production to a single facility in one country or decentralizes its production to facilities located in each country. The two MM options that deal with centralized or decentralized production and customized products that are sold at uniform prices are not considered as feasible. This is justified by the fact that customized products have different features leading to different production costs and eventually different pricing policies.

Manufacturing-marketing Options	Product	Price	Manufacturing
1	Core product-customized finished products	Customized	Centralized production of core product- centralized customization of finished products
2	Core product-customized finished products	Customized	Centralized production of core product-decentralized customization of finished products
3	Customized finished products	Customized	Decentralized production of finished products
4	Customized finished products	Customized	Centralized production of finished products
5	Standardized finished products	Customized	Centralized production of finished product
6	Standardized finished product	Customized	Decentralized production of finished product
7	Standardized finished product	Standardized	Centralized production of finished product
8	Standardized finished product	Standardized	Decentralized production of finished product
9 (not valid)	Customized finished products	Standardized	Decentralized production of finished products
10 (not valid)	Customized finished products	Standardized	Centralized production of finished products

Table 1. Options for international enterprises defined by manufacturing, marketing, and product architecture elements.

2 Supply Chain Structures for International Enterprises

Details on the modelling aspect of the paper can be obtained from Hadjinicola and Kumar (2002).

2.1 Centralized Production of Core Product-Centralized Customization (Core-Centr)

Under the core-product approach, a uniform "central" product is designed that can accept a number of standard attachments, parts or components. The combination of attachments to the core product allows it to meet performance criteria and preferences of local consumers. Adaptations on the core product can vary from simple assembly operations to more complex machining operations. The core product is usually centrally produced in order to exploit savings from economies of scale. Additional operations on the core product may be performed in the same facility that the core product is produced, or in production/distribution facilities located in foreign markets. The core product is also referred to as platform product in the automobile industry (Robertson and Ulrich, 1998) or as a generic product in the electronics industry (Lee et al. 1993).

2.2 Centralized Production of Core Product-Decentralized Customization (Core-Decentr)

Under the *Core-Decentr* option, the core product is produced in country 1. The facility in country 1 is further responsible for adapting the core product into a customized product that meets the needs of consumers in country 1. In addition, the core product is shipped to the production facility of country 2 which adapts the core product into a customized product that meets the needs of consumers in this country. This option is adopted by HP for its Deskjets (Lee et al., 1993)

2.3 Decentralized Production-Customized Product-Customized Prices (Decentr-Cust-Cust)

The subsidiaries of an IE adopting this option are solely responsible for the production and development of the marketing programs for the country they serve. As such, products are customized to the needs of local consumers and their production takes place in facilities located in each country. Prices in each country are customized and are dependent on the product features and the income of the consumers in each country. This option is synonymous to a multinational corporation which follows a decentralized policy where local subsidiaries are given the autonomy to design and produce their own products as well as determine their pricing policies (Bartlett and Ghoshal, 1989).

2.4 Centralized Production-Customized Product-Customized Prices (Centr-Cust-Cust)

Under this option, the IE manufactures customized products for both countries it serves in a central facility located in country 1. The product targeted for country 2 is shipped from the facility in country 1 to country 2. The IE also follows a price customization policy.

2.5 Centralized Production-Standardized Product-Customized Prices (Centr-Stand-Cust)

Under the *Centr-Stand-Cust* option, the IE offers a standardized product across the two countries. The standardized product is produced in a facility located in country 1 and then shipped to country 2. This option requires centralized decision-making since the IE needs to design and produce a product with such features that yield the maximum total profits. Centralized decision making may be viewed as a measure of coordination and tighter control. Prices of the standardized product are customized for each country.

2.6 Decentralized Production-Standardized Product-Customized Prices (*Decentr-Stand-Cust*)

Under this option the IE offers a standardized product to the consumers of the two countries. The standardized product is manufactured in production facilities located in both countries. As a result, each production facility supplies the local market it serves with the standardized product. Prices of the standardized product are customized for each country.

2.7 Centralized Production-Standardized Product-Standardized Prices (*Centr-Stand-Stand*)

One of the issues that arise in cases where the IE offers a standardized product is the standardization of prices across countries. Standardization of prices in the case where the IE offers dissimilar products across countries is not pursued since differences in product features result in differences in production costs and eventually prices. The *Centr-Stand-Cust* option, previously described, can adopt the standardized pricing policy.

2.8 Decentralized Production-Standardized Product-Standardized Prices (*Decentr-Stand-Stand*)

An IE which adopts the *Decentr-Stand-Cust* option may also employ a standardized pricing policy .

Examples of companies following this option are companies dealing with commodities. Oil and cement companies are classic examples since their product is fairly standardized, with the prohibitive transportation cost forcing the companies to locate facilities around the globe.

3 Analysis and Discussion

Proposition 1 *The following hold true for the profit Π of any IE:*

- (1) $\Pi^{\text{Core-Decentr}} \geq \Pi^{\text{Centr-Stand-Cust}} \geq \Pi^{\text{Centr-Stand-Stand}}$,
- (2.1) $\Pi^{\text{Core-Decentr}} \geq \Pi^{\text{Decentr-Cust-Cust}}$, under certain conditions,
- (2.2) $\Pi^{\text{Decentr-Cust-Cust}} \geq \Pi^{\text{Decentr-Stand-Cust}} \geq \Pi^{\text{Decentr-Stand-Stand}}$,
- (3) $\Pi^{\text{Core-Centr}} \geq \Pi^{\text{Centr-Cust-Cust}}$, under certain conditions.

Proof of Proposition 1: Can be obtained from authors.

From parts (1) and (2.2) of Proposition 1, we see that $\Pi^{\text{Centr-Stand-Cust}} \geq \Pi^{\text{Centr-Stand-Stand}}$ and $\Pi^{\text{Decentr-Stand-Cust}} \geq \Pi^{\text{Decentr-Stand-Stand}}$. This shows that if an IE adopts the option of uniform pricing its standardized product, regardless of its production configuration, it would generate equal or less profits than when customizing the price of the standardized product across the two countries. The intuitive reason for this phenomenon is that price customisation enables the IE to exploit differences in the reservation prices and price sensitivity of consumers across countries. As such, the IE increases its profitability by exploiting local consumers' buying capability to the maximum possible degree.

From part (2.2) of the proposition we also see that $\Pi^{\text{Decentr-Cust-Cust}} \geq \Pi^{\text{Decentr-Stand-Cust}}$. The explanation for this result lies in two facts. First, decentralized production of a standardized product does not yield the maximum cost savings from economies of scale. Second, customized products, in any type of production environment, enhance the propensity of consumers to purchase the product, which further results in improved revenues. As a result, under the *Decentr-Cust-Cust*, the IE produces customized products in facilities located in the two countries. If the benefits derived from the improved sales of the customized products do not exceed the costs of customization, then the IE will be forced to decentrally produce a standardized product, thus adopting the *Decentr-Stand-Cust* option. Note that the above comparison of the two options does not take into consideration the costs of designing the products. For example, options offering a standardized product may benefit from economies of design and thus allow for lower product prices. On the other hand, options offering customized products may be burdened by the cost of designing more products and the amortization of such cost may result in higher product prices.

Part (1) of the proposition shows that $\Pi^{\text{Core-Decentr}} \geq \Pi^{\text{Centr-Stand-Cust}}$. The key to understanding why the *Core-Decentr* option may yield equal or more profits than the *Centr-Stand-Cust* option, is the fact that the *Centr-Stand-Cust* option can be seen as a special case of the *Core-Decentr* option. We know that the core product's attribute levels are less than or equal to those of the customized products offered in the two countries. At the extreme case, the core product can be the product offered in one of the countries. Assume, without the loss of generality, that the core product is the same as the product offered in country 1, the country where it is manufactured. Then, this core product is shipped to country 2 to be custom-tailored. If the benefits derived from customizing the product in country 2 are less than the cost of customization, then the optimal product policy is to market the core product itself in country 2 which is equivalent to the *Centr-Stand-Cust* option. In other words, the minimum profits that the *Core-Decentr* option can generate are those of the *Centr-Stand-Cust* option.

From part (3) of the proposition we see that $\Pi^{\text{Core-Centr}} \geq \Pi^{\text{Centr-Cust-Cust}}$. The intuition behind this result lies in the fact that the differentiating factor among the two options is the production of the core product since both options offer customized products at customized prices. Both options customize their products in country 1 and subsequently, the customized product for country 2 is shipped to this country from country 1. Now, under the *Core-Centr* option, if the benefits derived from the production of the core product are not significant enough due to high production costs, the IE will not produce the core product but it will simply produce centrally the two customized products. This of course is equivalent to adopting the *Centr-Cust-Cust* option.

Part (2.1) shows that $\Pi^{\text{Core-Decentr}} \geq \Pi^{\text{Decentr-Cust-Cust}}$ under certain production-related conditions. The intuition behind this result is that at the extreme case, the *Core-Decentr* option will not ship from country 1 to country 2 any form of core product for further customization, i.e., the core product is vacuous. This may occur in environments where the savings derived from the centralized production of the core product are not sufficient to compensate for high transportation costs and import taxes of the core product. In this case, the subsidiary in country 2 will have to produce the customized product for country 2 from scratch since there is no core product. This is equivalent to the *Decentr-Cust-Cust* option. In other words, the minimum profits that the *Core-Decentr* option can generate are those of the *Decentr-Cust-Cust* option.

The results of Proposition 1 have significant implications on the choice of MM options adopted by an IE. The proposition for example, indicates that, under certain production-related conditions, two of the eight MM options considered generate higher or equal profits than the other six options, regardless of the number and nature of competitors. If the conditions are not met, the proposition indicates that the IE will have to structure itself in accordance to one of the following four options: *Core-Centr*, *Core-Decentr*, *Decentr-Cust-Cust*, *Centr-Cust-Cust*. Note that the above four "dominant" options deal with customized product and pricing policies. The choice will depend on the profitability comparison of the above four options in the specific environment that the IE operates.

In the analysis presented in this paper, we have assumed that the transportation cost and import taxes are the same whether the IE exports the core product or finished products. This may not be true since governments provide incentives to IEs to manufacture their products locally by reducing import taxes on raw materials and semi-finished goods. As a result, in such environments, the core product strategies may yield higher profits. In addition, the issue of the cost of product development is critical for an IE's profitability and must be taken into consideration when adopting an option. For example, customized product policies may require higher research and development costs than standardized product policies.

4. Conclusion

Companies with operations in more than one country, termed International Enterprises, have to make a number of decisions concerning their manufacturing and marketing functions. In this paper, we have considered a number of these factors in a single model in order to examine the profitability of eight options an international enterprise can adopt. The analysis is performed in a competitive environment for a two-country scenario. We identify the options that if adopted by IEs will result to higher profitability. In summary, options that adopt core or platform products as well as options adopting customized products lead to higher profitability.

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Section 4: Complexity, Risk and Uncertainty

THE RELATIONSHIP BETWEEN LOGISTICS CAPABILITIES AND SUPPLY CHAIN UNCERTAINTIES AND RISKS IN THE THIRD PARTY LOGISTICS: A CONCEPTUAL FRAMEWORK

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Abstract

Third party logistics (3PL) has become a popular topic in supply chain and logistics. Many companies use 3PL to deliver and manage their logistics function in a supply chain. One of the advantages of implementing 3PL solution is uncertainty and risk transfer, which is one of the major uncertainty and risk management strategies. However the supply chain uncertainties and risks still exist and 3PLs have to manage these uncertainties and risks. There is fewer well-defined tools and techniques for Supply Chain Risk Management (SCRM). Managers are experienced, knowledgeable and have appropriate altitudes in their industries, but they are not effective. This paper aims to investigate logistics capabilities, supply chain uncertainties and risks in the 3PLs, and to develop a conceptual framework of role of logistics capabilities for mitigating supply chain uncertainties and risks systematically in the 3PL based on resource based view (RBV). This would result in the development of a practical guidance for practitioners developing and deploying logistics capabilities to support and enable their supply chain risk management strategies from a RBV perspective.

Introduction

Supply chain management is becoming a crucial competitive factor in today's competitive business world. The supply chain is not a chain of business with one to one, business to business relationships. Instead, it is a complex network of multiple businesses and relationships (Lai, Ngai & Cheng 2004). Logistics has been an important part of a supply chain network, and logistics function is a linkage of different parties in a supply chain (Cowles 2012). More importantly, a 3PL transaction is complex compared to other one to one business transactions, often more than two different parties may be involved in the same 3PL transaction. The supply chain and logistics complexity increases the supply chain uncertainty and risk (Simangunsong, Hendry & Stevenson 2012). And also the worldwide trend in globalisation have led to companies outsourcing their logistics function to 3PL companies, many companies realised the advantages of using 3PL, one of significant advantages of using 3PL is transferring the supply chain uncertainties and risks to the 3PLs (Zsidisin & Ritchie 2009). However, 3PL companies have to manage these various uncertainties and risks, such as loss, damage or delay.

Supply chain uncertainty and risk is an issue in supply chain and logistics (Prater 2005). Supply chain uncertainty is often used interchangeably in practice with the term - supply chain risk (Peck 2006). And supply chains risks are related to the uncertainty and they are inseparable (Simangunsong, Hendry & Stevenson 2012; Sanchez-Rodrigues et al. 2008; McManus & Hastings 2006; Aven 2011). Moreover, due to increased globalisation, higher customer expectations,

environment volatility, and shorter product and technology life cycles, supply chains are more easily exposed to uncertainties and risks (Christopher & Peck 2004).

Supply chain uncertainty and risk influence decision makers in the supply chain resulting in ineffectiveness (Vorst & Beulens 2002). Although managers are usually aware of the everyday risks their supply chains are exposed to, due to the high-probability of risk occurrence, many businesses that do not have a supply chain risk management (SCRM) in place (Andreas 2013). Many supply chain uncertainties and risks have been identified, however lacking of resolution of supply chain uncertainties and risks is a problem. And the problem has been raised in previous studies (Simangunsong, Hendry & Stevenson 2012; Sanchez-Rodrigues, Potter & Naim 2010).

This paper proposes a RBV approach to mitigate supply chain risks and uncertainties systematically by adopting logistics capabilities in the 3PLs. The remainder of this paper is organised as follows. A literature review presented in three sections overviews of third party logistics, logistics capability, and supply chain uncertainty and risk. Then following section presents a conceptual framework with hypothesis development. Final section draws conclusion and further research opportunities.

Literature Review

Third-party Logistics

A supply chain may be broken down into three basic segments: sourcing, manufacturing and delivery (Prater, Biehl & Smith 2001). Obviously, delivery is an important part of supply chains. A third-party logistics provider (abbreviated 3PL provider, or sometimes TPL) is a firm that provides a one stop shop service to its customers of outsourced logistics and delivery service for part, or all of their supply chain management functions (Cowles 2012). 3PL providers can be seen as supportive supply chain members, they are companies that simply provide resources, knowledge, utilities or assets for the primary members of the supply chain (Lambert, Cooper & Pagh 1998). This implies that logistics service providers should support alternative supply chain strategies include supply chain risk management strategy. Further, the role of 3PL companies is a linkage of different parties in a supply chain. Therefore it is significant to focus on the 3PLs in order to add value to an entire supply chain.

Many businesses do not have a Supply Chain Risk Management (SCRM) (Andreas 2013). One of the supply chain risk management strategies is transferring the uncertainties and risks to the 3PLs (Zsidisin & Ritchie 2009). There are managers who are experienced, knowledgeable and have appropriate altitudes in their industries but are not effective (Carmichael et al. 2011). Thus, the managers in the 3PL providers have to effectively manage these supply chain uncertainties and risks in order to have smooth operations of every link in the supply chain. Doing right things in the right way is what makes for an effective manager. The effective manager is one who uses effective managerial behaviour, and maximise

on this through further effective development and learning (Carmichael et al. 2011). Therefore managers in 3PL need to be aware of effective and efficient supply chain risk management.

Logistics Capability

Firms can gain and sustain competitive advantages by developing and deploying valuable resources and capabilities (Wernerfelt 1984). Capabilities are complex bundles of skills and accumulated knowledge, exercised through organisational processes, which enable firms to coordinate activities and make use of their assets. Capability is the ability to make use of resource to perform some task or activity and the resource is anything tangible or intangible owned or acquired by a firm. One of the main objectives for firms applying a RBV is to identify their capabilities and develop them further (Day 1994).

Logistics capability is an important concept in the 3PL companies. 3PLs are different from other businesses, the logistics services, which are provided by 3PL companies, required high level of logistics capability to carry out the outcome of delivery and meet customer's needs (Lai, Ngai & Cheng 2004). And when the external environment is unstable, a firm's own resources and capabilities may be easier to control (Grant 1991). Logistics capabilities comprise a series of abilities, capacities, skills, and intelligences, which are critical to logistics companies and the logistics companies cannot operate normally without appropriate logistics capabilities (Morash & Lynch 2002).

Logistics capabilities play a distinctive role (the one leading to sustainable competitive advantage) in the integrative strategic process due to the expected benefits of improving firm efficiency and effectiveness leading to long-term firm profitability and survival (Mentzer, Soonhong & Bobbit 2004). Three important logistics capabilities dimensions, which include flexibility, innovation, and responsiveness, have been found in previous studies (Hayes, Wheelwright & Clark 1988). A typical response to uncertainty is to build flexibility into the supply chain (Prater, Biehl & Smith 2001). Flexibility reflects an organisation's ability to effectively adapt or respond to change (Prater, Biehl & Smith 2001). Furthermore, Supply chain flexibility has been suggested as an approach for coping with supply chain uncertainty (Prater, Biehl & Smith 2001), and increase flexibility can mitigate supply chain risks (Chopra & Sodhi 2004). Innovation capability is one of the important logistics capabilities (Morash 1997). Innovation capability was defined as the firm's ability to continuously transform knowledge and ideas into new products, processes and systems for the benefit of the firm (Lawson & Samson 2001). More importantly, building an innovative culture, innovative processes and innovation capability is the key to managing and mitigating supply chain risks (Dani 2010). Responsiveness is another key logistics capabilities (Morash 1997). And increase responsiveness is one of the mitigation approaches for supply chain risk management (Chopra & Sodhi 2004). Customer service is an important business function to response external customers in logistics transport companies.

Supply Chain Uncertainty and Risk

Risk and uncertainty is a major topic in the supply chain literature (Prater 2005; Sanchez-Rodrigues et al. 2008; Simangunsong, Hendry & Stevenson 2012). The definition of supply chain uncertainty is "decision-making situations in the supply-chain in which the decision-maker does not know definitely what to decide as he / she is indistinct about the objectives; lacks information about (or understanding of) the supply-chain or its environment; lacks information processing capacities; is unable to accurately predict the impact of possible control actions on supply-chain behaviour; or lacks effective control actions (non-controllability)" (Vorst & Beulens 2002, p. 413). And risk may be defined through uncertainties. For example risk is uncertainty about and severity of the consequences and associated uncertainties (Aven 2011).

It is not necessary to distinguish between supply chain uncertainty and risk, uncertainty increases the risk within supply chains, and risk is a consequence of the external and internal uncertainties (Prater 2005; McManus & Hastings 2006). Supply chain uncertainties and risks can be categorised in many different ways and from different perspectives (Christopher & Peck 2004). Over the past decade, some authors started paying attention to supply chain risk and uncertainty in transport and logistics operations, for example Sanchez-Rodrigues et al. (2008) establishing a transport operation focused uncertainty model. Sanchez-Rodrigues, Potter and Naim (2010) evaluating the causes of uncertainty in logistics operations.

For managers, risk is a threat that something might happen to disrupt normal activities or stop things happening as planned (Waters 2011). Uncertainty in the functioning of any of the links may lead to additional costs, damages and delays / disruptions may hamper the performance output of the supply chain (Patil, Shrotri & Dandekar 2012; Najmi & Makui 2012). Moreover, managers have to manage both uncertainties and risks simultaneously in a real world environment. Therefore, it is important to consider risk and uncertainty simultaneously. The concept of mitigation is common in the risk management literature, and risk mitigation has the same perspective as a coping with uncertainty strategy (Simangunsong, Hendry & Stevenson 2012).

This paper divides supply chain uncertainties and risks in 3PL companies into four categories, logistics uncertainty and risk, information uncertainty and risk, customer-related uncertainty and risk, and environment uncertainty and risk (Simangunsong, Hendry & Stevenson 2012; Sanchez-Rodrigues, Potter & Naim 2010). There are different logistics uncertainties and risks in the supply chain literature (Simangunsong, Hendry & Stevenson 2012; Sanchez-Rodrigues, Potter & Naim 2010). Logistics uncertainty and risk may broadly be categorised as the potential disturbances to the flow of goods. Information is the facilitator in the smooth functioning of the supply chain. The sources of information uncertainty and risk addressed in the supply chain literature (Guo, Fang & Whinston 2006; Cucchiella & Gastaldi 2006; Blackhurst, Scheibe & Johnson 2008). Customer-related uncertainty and risk are most likely caused between the logistics companies and customers. In the supply chain literature, there are various customer related

uncertainties and risks (Sodhi & Lee 2007; Sanchez-Rodrigues, Potter & Naim 2010). Environment uncertainty and risk may arise due to the interactions between the supply chain network and its environment (McKinnon & Ge 2004).

Proposed Framework and Hypothesis Development

This research comprises two main constructs: logistics capabilities, and supply chain uncertainties and risks. Logistics capabilities in this paper comprise three dimensions: innovation, responsiveness, and flexibility. The four categories of supply chain uncertainties and risks included logistics uncertainty and risk, information uncertainty and risk, customer-related uncertainty and risk, and environment uncertainty and risk, are employed to assess the supply chain uncertainties and risks in 3PL. The overall research conceptual framework is illustrated in Figure 1. Four research hypotheses are derived as follows.

Logistics Capabilities on Logistics Uncertainty and Risk

Innovation capability has been widely involved in the logistics industry, such as packaging innovation decreased the risk of damaging goods in transportation (Daniel & Fredrik 2011). Responsiveness addresses supply chain risk (Martin & Denis 2001), for example, prompt response to customers' requirements may reduce the risk of delay in delivery time (Christopher & Lee 2004). Flexibility capability in this paper represents an ability of flexibility to process a delivery. Supply chain flexibility is an approach for mitigating supply chain uncertainty and risk (Prater, Biehl & Smith 2001). Therefore;

H1. *There is an association between logistics capabilities and logistics uncertainty and risk in the 3PL.*

Logistics Capabilities on Information Uncertainty and Risk

Flexible logistics operational procedures and systems may reduce the risk of information accuracy, visibility and accessibility (Christopher & Lee 2004). Prompt response to customers' requirements may also reduce the risk of delay or unavailability of the information (Morash 2001), for example DHL Express customer service provides advance shipment notification for regular freight and provides advanced problem notification for irregular or problem freight (split or loss freight). Innovation capability is one of the most important factors in logistics capacities to cope information uncertainty and risk. New technology and innovative solution may help 3PL to against the information uncertainty and risk. Therefore;

H2. *There is an association between logistics capabilities and information uncertainty and risk in the 3PL.*

Logistics Capabilities on Customer-Related Uncertainty and Risk

Logistics innovation is critical for strengthening the LSP-customer relationship, generating customer loyalty (Wagner & Sutter 2012). Flexible logistics capabilities comprise personnel skills and quality of personnel; they may improve the customer satisfaction. Good logistics capabilities represent a flexible customer service and

fast response in customer support. Furthermore, good customer service quality improves the customer satisfaction in 3PL companies. A good relationship between 3PL and customers may reduce the customer related uncertainty and risk. Therefore;

H3. *There is an association between logistics capabilities and customer-related uncertainty and risk in the 3PL.*

Logistics Capabilities on Environment Uncertainty and Risk

Using new technology and innovation to mitigate environment uncertainty and risk have been promoted in previous studies (Hayes, Wheelwright & Clark 1988). One example of innovation reducing environment uncertainty and risk is logistics companies introduced flexible fuel factor or fuel surcharge to against unstable fuel price. Good service flexibility to meet customers’ need may also reduce the risk and uncertainty of road congestion delay (McKinnon & Ge 2004). Furthermore, flexible schedule may improve the fuel efficiency and reduce delays (McKinnon & Ge 2004). Therefore;

H4. *There is an association between logistics capabilities and environment uncertainty and risk in the 3PL.*

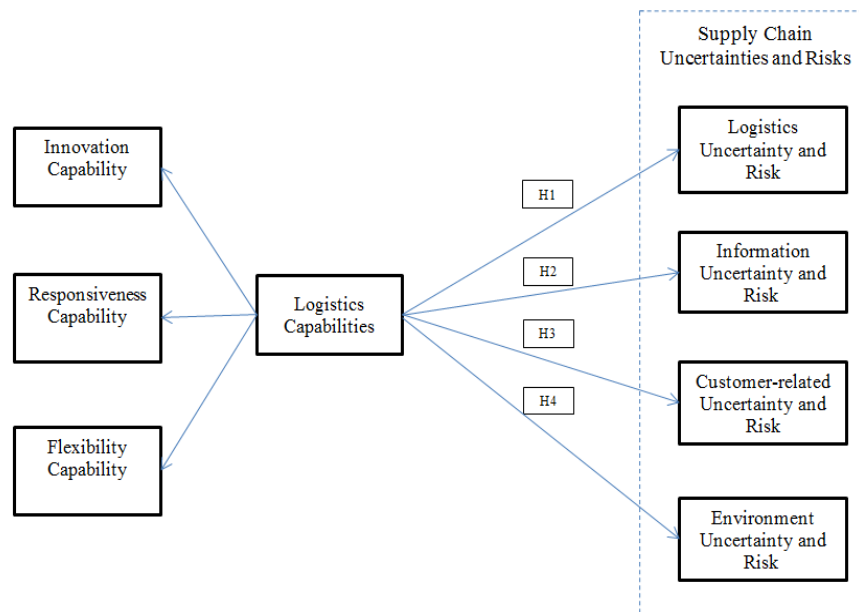


Figure 1 Research Conceptual Frameworks

Discussion and Future Research

This paper attempts to mitigate supply chain uncertainties and risks systematically by deploying appropriate logistics capabilities in the 3PL. Mitigation is one of the important supply chain risk management strategies. Furthermore, mitigating supply chain uncertainty and risks does not try to influence or alter the source of uncertainty. Instead, it tries to find ways to adapt and hence minimise

the impact of uncertainty and risk (Simangunsong, Hendry & Stevenson 2012). Mitigation approaches included increase capability, increase responsiveness, and increase flexibility (Chopra & Sodhi 2004).

It is imperative to mitigate the supply chain uncertainty and risk (Andreas & Carl Marcus 2012; Christopher & Peck 2004; Peck 2006; Zsidisin & Ritchie 2009). As supply chain risks increase, the need also increases for companies to develop logistics processes and capabilities that can enable them to be ready (capable) of providing an efficient and effective response and continuing with business as planned (Serhiy & Mary 2009). And a resource that is valuable in a particular industry or at a particular time might fail to have the same value in a different industry (Collis & Montgomery 1995). For example logistics capabilities play a vital role in 3PL.

The RBV sees companies as very different collections of physical and intangible assets and capabilities. No two companies are alike because no two companies have had the same set of experiences; acquire the same assets and skills, or built the same organisational cultures. These assets and capabilities determine how efficiently and effectively a company performs its functional activities, included logistics activities. Following this logic, a company will be positioned to succeed if it has best and most appropriate stock of resources for its business and strategy. The valuable resource may be an organizational capability embedded in a company's routines, processes, and culture (Collis & Montgomery 1995). Furthermore, the sources of uncertainty and risk are various in companies, and many sources of uncertainty and risk are still unknown (Simangunsong, Hendry & Stevenson 2012). Therefore, a RBV approach may be an appropriate technique and tool for SCRM in a real world environment.

Andreas and Carl Marcus (2012) and Sanchez-Rodrigues, Potter and Naim (2010) argue different mitigation approaches should be researched to manage the supply chain and uncertainty. Different logistics companies may face different supply chain uncertainties and risks based on vulnerabilities and circumstance, and it is difficult to provide a standardised resolution to cope all different kinds of uncertainties and risks. However, using these companies' capabilities and resources to manage supply chain uncertainties and risks is possible. Therefore, this study proposes a RBV approach to manage supply chain uncertainties and risks.

Logistics capability and supply chain uncertainty and risk are important concepts in supply chain and logistics. However, there is less attention has been paid to the relationship between them. Logistics capabilities have been shown to be valuable factors in enabling firms to respond and manage problems in an efficient and effective manner (Andreas 2013; Christopher & Peck 2004). Further, logistics capability is an important ability of control and responding to unexpected events or supply chain disruptions, which more likely were caused by supply chain uncertainty and risk (Peck 2006; Serhiy & Mary 2009). The paper investigates the role of logistics capabilities for mitigating supply chain uncertainty and risk in 3PLs and provides a conceptual framework. This provides insights for managers to focus

on their logistics capabilities to mitigate the uncertainties and risks in a real operating environment.

Supply chain risk management approach should be examined in a holistic system or enterprise-wide view. Therefore, further research can be conducted to investigate the different types of firm capabilities for mitigating different types of supply chain uncertainties and risks, and overall impacts of supply chain uncertainties and risks in a supply chain or firm.

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RETHINKING "TRANSFORMATION" IN FRESH FOOD CHAINS

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ABSTRACT

An end-to-end banana import flow from Costa Rica to Norway is described based on a framework enhancing particularities of goods transformation. The transvection model enhances that transformation is stepwise as well as associated with utility. Analysis reveals particularities of banana supply regarding fresh food preservation aims, impacting on logistics practice. Uncertainty is in the case associated with supply and not customer demand. Efficiencies are associated with complex interaction between product time, form, place features as well as markets.

INTRODUCTION

This study directs focus to particularities of fresh food chains. Due to food safety and quality concerns coupled with traceability requirements, an end-to-end perspective is usually required. This implies heightened importance of supply chain management (SCM), with its core focus on intra- and inter-organizational integration and flow coordination, as theoretical approach to supply development. Supplies of fresh foods include the challenge of handling materials perishability, often coupled with end-user demands that the product should be fresh and resemble in most cases as much as possible the original state of the food as raw-material, e.g. upon harvest or catch. Food preservation emerges accordingly as key customer value factor impacting on how this value objective is created through a multi-tier chain of actors. In this type of supply chain production involves at its first stage farming, fishing or wild catches. This stage is followed by intermittent forms of manufacturing and logistics and finally retailing of food related services where fresh foods are provided to the final user and then at end consummated. Normally value is created through goods transforming processes. In fresh foods, where preservation is a fundamental aim, this implies a need to rethink understanding "transformation". As in all supply chains information supports value creating flows of goods. With a divergent aim to preserve the focal material resource object in the goods flow, it is also imminent to consider how this impacts on the flow of information.

This study provides a case description of import of bananas from Costa Rica to Norway, with detailed description of transformation in the flow of bananas and how this flow is supported by an information flow. This case provides empirical foundation for rethinking logistics conceptually in cases of fresh foods. The purpose of this paper is accordingly to model, based on the provided case, value creation of fresh foods through an end-to-end supply chain as balancing of change and non-change factors associated with value creation to provide customer value. Since the paper is organized with a detailed and relatively large case description, the literature review and analysis is accordingly brief.

LITERATURE REVIEW

Aldersons (1965) "transvection" is applied to approach the logic of transformation from an end-to-end perspective. Supply flows are in the transvection modelled as a piecemeal process where product transformations are directed by intermittent decision-making events (termed "sorts"). The transvection model includes conceptual balancing of transactions with operations. While transactions provide a customer-oriented purpose to flows, transvections provide logistical description. Purpose is associated with end-user product form, place and time utility. This classification of utility associated with customer value will be applied to analyse how value is created in association to combined transformation of time, place

and form features of the food material in the flow of goods. Product value is, in accordance with the transvection; a modelled sequentially dependent cumulative effort. This is in accordance with Thompson's (1967) interdependency theory, typical for physical distribution. This approach has been applied in case studies of end-to-end foods networks (Engelseth 2012a). It may evoke how foods are through a series of stages transformed including packaging (Engelseth 2012b) and represents also a cross-section between marketing and logistics with its focus on end-user utility as supply purpose (Engelseth & Felzensztein 2012). In relation to market competitiveness, how fresh foods are transformed as interacting features of changing time, place and form features, its cost features as well as the benefits created, supports differentiation. The applied transvection-based research model is shown in figure 1 below:

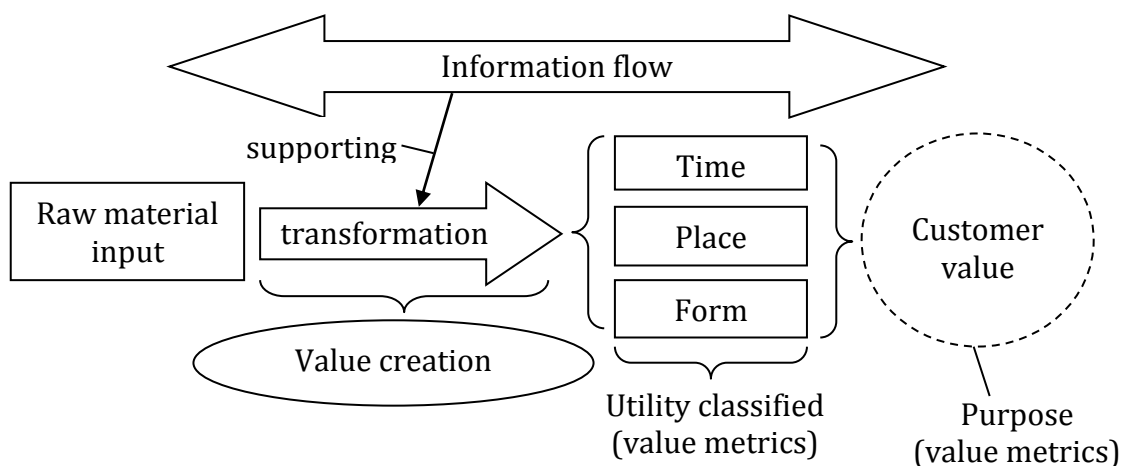


Figure 1. Research model.

This research model is applied to structure the case description as well as guide analysis. Utility is technically observable, while customer value is associated with customer perception; both are value-related metrics, but different.

METHOD

The empirical foundation of this study is a case study of banana import in a complete supply chain (Engelseth 2007). This data is applied to create the case description influenced by the research model shown in figure 1. Data in the original study was collected using a semi-structured interview technique by listing the topics rather than questions for each interview. This initial research project where these data are derived from consisted of 63 interviews with members of four different fresh food products (strawberries, milk, fish and the actual bananas) with focus on package use to support the information flow through a complete supply chain. Approximately 25 of these interviews provide relatively direct foundation for the constructing the following case narrative adapted to the provided analytical framework. These interviews can be grouped in five: 1) different actors directly involved in the chain, 2) supporting actors, 3) packaging suppliers, 4) transport companies, and 5) more generic actors such as information system suppliers, standardisation organisations (such as GS1), government food quality inspectors, industrial federations and media.

THE BANANA IMPORT CASE

The studied banana chain starts in Costa Rica. Being a climacteric fruit, the banana is harvested in its unripe condition. The banana with its soft peel and structure is vulnerable to damage from the environment during harvesting, transportation, and storage. To prolong the lifetime of bananas demands cold

storage at 13-14 degrees C is required before going through a production process at a banana ripening facility. This temperature is regulated to ensure ripening adjusted to the transport time. After leaving the banana ripening facility, the banana requires a storage temperature of 15 degrees C. The colour of the banana peel changes from green to yellow to black depending on the degree of ripeness. Based on the colour of the banana peel, a particular banana's stage of ripeness may be roughly determined. Bananas are certified by government standards into different classes. The class 1 bananas must have a minimum finger length of at least 20 cm. and the cosmetic bruises must be smaller than 2 sq. cm. Dole, however, does not permit its bananas to have bruises that are larger than 1 sq. cm. Bananas may be damaged by growing conditions as well during distribution.

Bananas are packed to protect and transport these type of goods. Each packaging type containing the same type of bananas has a unique global trade item number (GTIN) product code. Clusters of bananas are placed into a see-through plastic bag at the banana plantation in the tropics, and put into a box for export to Norway measuring 50 cm. in length, 40 cm. in width and 24 cm. in height. Each box of this dimension is specified to carry 18,4 kilos, and this weight standard is printed on the box indicating the actual weight lies within an accepted standard deviation of this weight. Banana boxes are placed onto ISO standard shipping pallets measuring 120 cm x 100 cm. 6 boxes are placed on each level of the pallet and 48 boxes are stacked onto one pallet weighing 980 kg, of which the bananas weigh 878 kg making them a relatively heavy fruit and vegetable product. The boxes are then fastened to the pallet with strapping wire. The box has holes on its side allowing for ventilation of the goods. This is especially important when bananas are in the ripening facility. The production, which is carried out by providing a combination of temperature regulation and ethylene gas, can then take place there without unpacking the boxes. Figure 2 below shows the supply network involved in supporting the studied flow of bananas.

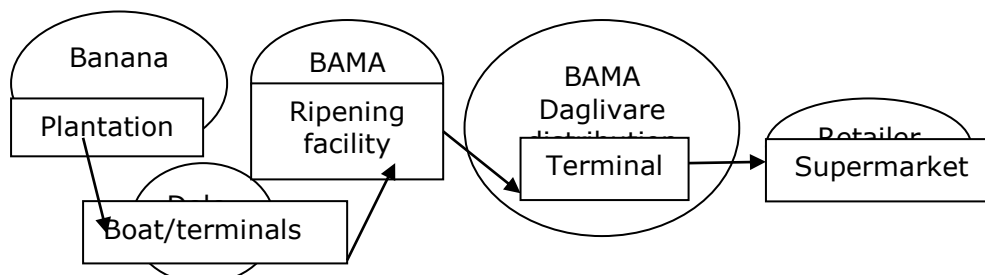


Figure 2. The transformation of bananas and its packaging from Costa Rica to Norway

Bananas are picked manually in an unripe condition. Bunches of bananas are rinsed, dried, cut into clusters; a small brand-label sticker is attached to each banana, the banana is placed in a plastic bag and packed into boxes. The label is a small, brightly coloured sticker containing the international fruits company logo indicating the country of origin. Packing bananas is a manual process that demands experienced labour. A total of 48 boxes are then stacked 6 on each level onto pallets and strapped together using one strap for each level. Long plastic corner boards are fastened in the height of the pallet of goods to secure the goods further. Each pallet is labelled to assure tracking based on a bar-coded identification number.

Four vessels are chartered to handle the transport from Costa Rica and Columbia to Hamburg. Each vessel is given a time frame of 4 weeks to make the return trip. The ships average about 12 000 DWT each, and carry an average of 4500 pallets of bananas and are reefer (climate control facilitated) ships carrying only bananas. The transport by ship takes 12 days but may be delayed due to heavy weather in

the North Atlantic. The specialised "banana ship" has a slanted bow providing minimal resistance in the water and is designed to move at 22 knots, which is a relatively high speed for a cargo vessel. The temperature is set at 13,3C, and the oxygen level is reduced from the normal 20% to 2-3%. A representative of the fruits producer described this process of reducing the level of oxygen as "putting the banana to sleep". This inhibits the occurrence of product quality failure due to uncontrolled ripening and also gives the banana an additional day or two before the ripening process starts. To avoid transport damage and to direct the cold air into the storage compartment, the mode of stowing the goods is vital. The goods are placed as close to each other as possible and pieces of cardboard, foam, and large, red airbags are used to fill in the spaces left open between the pallets. Especially the forward, slanted compartment is difficult to stow. Each compartment also has a number of pillars making stowing more difficult. The storage compartments are refrigerated while reefer containers on deck are connected to the ship's electrical power supply. Other competing banana distributors often use one of the storage hatches on the vessel. The different firms alternate using the forward storage hatch. During transport, the temperature in the storage compartments is continuously registered and controlled and the bananas ripen gradually. The vessel arrives at the Hamburg terminal about 7:00 every Monday. Upon arrival, the pallets are registered using the bar-coded labels on the pallet, and a temperature control is carried out. At the Dole terminal in Hamburg, quality control is carried out of samples from this shipment. The pallets are unloaded layer by layer, one compartment after the other. Bananas destined for Norway are among the first to be unloaded since the vessel carrying these goods leaves at 13:30 from Kiel, about a 2 hours drive from Hamburg. All the pallets of bananas on the arriving ship are considered interchangeable and no destination information is provided on the pallets or boxes.

The transport from Hamburg to the banana ripening in Oslo facility takes one day and starts each Monday in Hamburg. BAMA orders complete truckloads or containers provided by Color Line operating the Kiel-Oslo ferry line. 30% of the order is in truckloads taking the road across bridges through Denmark and Sweden, and; and the rest in containers used on the ferry route. Each container holds 24 pallets, thus 10 Reefer containers represent an order of 11520 boxes of bananas. A weekly delivery to the ripening facility at Ulven consists of approximately 30 000 boxes. This amounts to approximately 25% of the bananas delivered by the vessels calling at the fruit company's facility in Hamburg. Production and handling at the ripening facility

All bananas arrive on pallets on Tuesdays at the Oslo banana ripening facility. The Norwegian fruits and vegetables wholesaler has previously rented and may still use the services of a banana ripening facility in Gothenburg, Sweden. In Norway, there is a shortage of such capacity. The facility runs at 110-120% of normal capacity continuously all year. This facility consists of 26 rooms that are adjusted to provide varying progression rates in the ripening process. Each room stores up to 24 pallets and contain up to 1152 crates in total. The holes in the sides of the cardboard boxes allows for the injection of ethylene, a natural gas. In addition, the ripening facility regulates the temperature to speed up or slow down the ripening process. At this facility, the bananas ripen in 6 days on average. The ripening process may be shortened or prolonged by 2 days depending on the temperature applied. At the ripening facility, the treatment of bananas is highly automated. When the trucks or containers arrive, these are unloaded, the documents checked and compared with labels for each pallet, and the pallets are placed into the storage compartments. A visual control is done to see if any of the boxes are damaged. A temperature control of one of the boxes is carried out as well. Bananas are loaded onto trucks containing a combination of other goods

from the fruits and vegetables wholesaler terminal located a few kilometres away from the banana ripening facility. Outbound trucks are loaded in accordance with orders registered in whole or half-pallets of bananas.

Bananas are distributed in Norway to a set of 20 regional fruits and vegetables wholesaler distribution centre terminals. There they are controlled by counting the number of boxes received. A visual control of the state of the boxes is done and a temperature control is carried out manually. Bananas are stored at a designated place in the terminal, the same as with all the products distributed year-round. Here, the bananas may be stored up to one for a very limited number of days, less than a week. They are then distributed to the retailers as a part of a mixed consignment of different fruits and vegetable products loaded onto pallets. These consignments are built up manually at the distribution centre based on picking lists based on yesterday's incoming customer orders. These orders are registered as number boxes of bananas. The bananas are received at the store either on pallets, or in individual boxes on pallets together with other goods. However, bananas are delivered all year, and almost every delivery throughout the year contains at least one box of bananas. Dole bananas are unpacked for the first time usually by person responsible for produce in the supermarket, and are then placed on a display shelf. Sometimes, if capacity is limited, bananas are displayed in the box placed on the floor of the store. This form of display hampers the promotional effect of the visual display of bananas. At the store, the sticker on the banana is the only label visible to the consumer.

The international fruits company's planning department in Hamburg handles long-term production planning of banana production in cooperation with its plantation suppliers; to balance supply with demand. This information is communicated between different departments of the international fruits supplier. The European department in Hamburg close to markets handling sales uses primarily its business relationship with its administrative department in San Jose, Costa Rica to coordinate sales with production. The San Jose office plays a role as a logistics actor within the international fruits company and handles orders and supplies of bananas and other marketing and goods handling offices located closer to markets worldwide. The main customers of bananas of this company are found in Europe and North America. In Costa Rica, the San Jose office maintains a business relationship with a subsidiary company within the fruits supplier corporate conglomerate. This company owns and runs banana plantations, the trucks that transport bananas and the banana packing stations. This predominantly production-oriented company has also its main office in San Jose, Costa Rica, and is responsible for the ownership of its facilities and long-term quality of the services it provides. It does not handle the day-to-day operations at its plantations. Each plantation is an independent firm that may or may not be directly owned by the international fruits supplier. The independent plantations are tied to the international supplier through contracting. Information regarding production is channelled through the logistics department in Costa Rica to the Hamburg sales office. Production of bananas in Costa Rica is stable and based on forecasts supplied by the San Jose department of the international fruits supplier. The international fruits company owns and operates also a factory producing the specially adapted banana packaging.

At the end of each year, the Norwegian fruits and vegetables wholesaler's international trading department provides the Hamburg office of the international fruits company with a week-by-week specified forecast of the expected orders for the coming year. There is no contract regulating the business relationship between these companies. The office in Hamburg compiles orders from all its European customers. These plans are fed into a common information system and sent to the San Jose office. Ordering bananas by the retailer involves a daily

procedure where a number boxes are specific on an ordering list together with other products supplies by the Norwegian fruits and vegetables wholesaler. Large shops may be supplies 6 times a week, the smaller and less centrally located ones more infrequently. Bananas are ordered by the number of boxes, pallets or half-pallets. Each day before 15:00 in the afternoon, the person in charge of produce at the supermarket checks the current supply of bananas, and can tell by the colour of the bananas whether some should be replaced. This person then fills in the order-list and sends it using an electronic data interchange (EDI) resource to the distribution centre. The distribution centre again collects daily orders and based on these order supplies of bananas. These may be supplied on a daily basis if needed. The trading office of the Norwegian fruits and vegetable wholesaler confirms or adjusts orders according to the annual forecast of bananas once a week. These order confirmations or adjustments are placed 8 weeks before delivery. Normally, they are adjusted to within 10% of an average of the annual predetermined forecast. The customers of the international fruits supplier strive, according to its representative in Hamburg, to place orders as close to the annual plans as possible. This order is coordinated with orders from other customers of Dole Hamburg and adjusted in the information system resource. This new, adjusted total demand for bananas is then sent to the San Jose department in Costa Rica where data are coordinated with orders from other sales offices around the world. Based on this information harvesting plans for each plantation are created, giving them the information needed to have the necessary amount of packaging materials and create transport plans within Costa Rica for the designated week. Based on the 8-week order adjustment from the different importers including the Norwegian fruits and vegetables wholesaler, bananas are first earmarked with ribbons at the plantation where they are harvested. Many vessels sail from Costa Rica to various world-wide destinations with banana cargo on different days of the week. Therefore, harvesting and transport in Costa Rica are carried out continuously. The ship bound for Hamburg sails every Wednesday from Moin. Customers may adjust orders within 3 days of the ship's departure in order to alter harvest volumes of bananas. About 24 hours prior to sailing, the bananas designated for transport are harvested, packed, and transported to the port where they are continuously loaded until the planned volume has been loaded on board. The San Jose office of the international fruits supplier sends the goods handlers at Moin transport documents and a stowing plan. These are created based on drawings of specific units of packaging required to be unloaded in a certain sequence upon arrival in Hamburg. Also, the Hamburg office of the international fruits supplier makes stowing plans to secure the correct stowage of goods to secure against transport damage. The San Jose office also supplies the Hamburg office with documents containing the necessary product information in accordance with EU demands.

Four documents are created for the transport: a bill of lading, a manifest describing the goods in further detail, a document stating the fruits' sanitary condition, provided by the Costa Rican Government, and a document proving the country of origin of the bananas (called GSP). These documents are faxed to the Hamburg office and copies are sent to Dole at Moin to follow the vessel. The original documents are sent by the San Jose office DFFI to Dole Hamburg via courier and arrive after two days. The bananas are still owned by the fruits supplier and are therefore also this company's responsibility upon arrival. These bananas may be traded among different actors in the international fruits supplier's global industrial network of customers; this also includes the quantities earmarked for specific customers. Every Thursday and Friday, while the goods are at sea, the international fruits supplier has its sales days for these bananas. The exact amount of bananas registered in specific sizes of boxes combined into pallets is then sold to various importers. The Norwegian fruits and vegetables wholesaler's product manager is responsible for operating the banana ripening

facility in Oslo. Goods are collected after purchase at the terminal in Hamburg ex works. Then goods are designated into consignments for either container (Color Line ferry) or truck transport. Transport documents are created and provided to the transportation providers. Upon arrival at the banana ripening facility, the products are temperature-controlled and the volume is checked against documents. Transportation damage is registered and may be used as a basis for a complaint to Dole Hamburg. This very seldom occurs. Information about the received volume of bananas is registered in the information system of the Norwegian fruits and vegetables wholesaler including the temperature log and product damage.

Incoming supply of bananas is registered in the Norwegian fruits and vegetables wholesaler's information system and coordinated with orders recorded in its sales system. These orders measured in boxes of bananas represent aggregate retail demand and is communicated by the distribution centres. However, bananas are at this time being kept at the banana ripening facility, and the daily volume ready for supply may be manipulated a few days in advance by adjusting the temperature in the various compartments of the facility. If the supply is too high, the wholesaler's trading department may offer promotional campaigns to the distribution centres, meaning reduced price by accepting a higher volume. A salesman at the distribution centre carries this form of promotion out by phone with the produce responsible person at the specific supermarket. The banana product manager in cooperation with supermarket chain representatives, plans larger promotional campaigns: larger volumes of bananas are offered at a lower price. Unexpected excess supply may also be sold on the open market at Økern Torg in Oslo. Small, independent fruit and vegetable retailers usually then retail these products through small independent shops.

ANALYSIS AND CONCLUSION

Analysis is directed by the research model provided in figure 1. Transformation is analysed in relation to types of utility; time, place and form, all associated in an intertwined manner with value creation since goods utility is also intertwined with customer value perceptions. Markets and supply are shown as in a state of continuous interaction through supply. Information interconnects actors including markets, with the goods flow. Information is used to manipulate transformation in time place and form. This is a particularity of banana supply associated with prolonged transport time as well as that bananas are traded on a commodity market with fluctuating prices and limited product differentiation. Bananas are transformed mainly in the following manner to secure customer value:

1. **Value creation through form transformation:** Being a climacteric fruit, the case describes how this technical feature of the product is manipulated regarding harvest, packing, transport, treatment in at the ripening facility and retail. The aim is in the case of this climacteric fruit not directly preservation, but a desired future state. To secure this desired state of ripeness upon arrival at the store, bananas undergo a complex mechanical treatment of increasing and decreasing the pace of ripening.
2. **Value Creation through place transformation:** This involves transport over long distances and handling within a designated facility. Bananas are produced in location distant from the consummation. This entails a fundamental need for transport to ensure customer value. The studied Cavendish type banana is through breeding well adapted to long distance transport.
3. **Value creation through time transformation:** While most fresh foods do not permit storage, the Cavendish banana is bred to use the prolonged time between harvest and retail to become the product consumers in the

markets desire. Bananas are not stored in a normal fashion, but are manipulated through altering the speed of ripening during transport and handling. This pace is determined by information regarding time of deliver to customers. These customer may be organised in several tires entailing need to fine-tune this timing so that delivery to the customer is matched with the role of the customer as wholesaler or retailer.

This classification represents a model of how bananas are supplied. This model reveals that if "logistics" is limited to a theoretical cubical concerned with storage, transport and handling activities, logistics is clearly of little use in the development of efficiencies in the distribution of bananas. Changes in the time, place and form features of bananas are clearly interwoven. The supply operation is also clearly dependent on exchange. Transactions are very fluid in the case, and features of transacting are also interwoven with banana delivery. Regarding customer value, in the case this feature is relatively predictable; there are only very minor changes in how consumers value "good bananas" and banana demand is relatively stable through the year, and year after year demand is stable in the studied Norwegian market. Uncertainty is therefore mainly associated with supply features; not demand features. The case accordingly reveals a clear need in the case of inter-continental banana supply at an operational level to consider features of agriculture, market, logistics and food processing. As indicated, these functions are in the case neither combined nor sequentially organised. The industry has already learned to cope with the complex interaction between these factors. From a theoretic perspective, this model lacks. A question arises as to how this theoretical understanding may provide new insight into improving banana supply operations. The applied theoretical framework based on Alderson's (1965) transvection model in this study is relatively simple in the form illustrated in figure 1. This calls for further conceptual refinement of this approach. Further literature review into processes-based change in operations as well as customer value as purpose of supply may provide more detail to the framework. In addition the role of exchange in relation to transformation should be theoretically further elaborated. This should enhance data collection in future complete fresh food chain case studies as well as analysis.

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LOGISTICS EFFICIENCY AND CORRUPTION: EVIDENCE FROM EMERGING MARKETS IN ASIA

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ABSTRACT

Today, there is a strong focus on improving logistics capabilities and efficiency for greater trade competitiveness but in emerging economies, the issue of informal logistics facilitation or corruption remains a thorny issue. Improving corruption control greatly enhances a country's logistics efficiency. This study posits that a relationship exists between logistics efficiency and corruption. Drawing from a sample of emerging and developed economies from 2005 to 2012, this study employs the revealed competitiveness model and panel data econometric method to empirically investigate the relationship between corruption and logistics efficiency. The results show that the relationship between logistics efficiency and corruption exhibits concavity for emerging markets in Asia but is convex for advanced economies. Our work contributes to the greater picture of trade competitiveness, logistics efficiency and corruption. The results will enable emerging economies which are developing rapidly to understand their position on logistics competitiveness. Policy makers can place more importance on their weaknesses and improve their logistics by implementing new strategies and craft economic policies to lower cost for a long-term corruption-free network.

Keywords: Logistics efficiency, Corruption, Emerging markets, Asia, Panel data, Econometric

1. INTRODUCTION

Emerging markets, especially in Asia, have witnessed relatively strong economic growth. However, many of the emerging economies, if not all, have developing legacy logistics systems (Razzaque, 1997). A World Bank Enterprise Survey of firms in Sub-Saharan Africa reported bribe payments for goods facilitation of between 2.5% and 4.5% of sales (Clarke, 2011). The report suggests that, on the average, enterprises spend between 7% and 10% of their costs on logistics (IMD, 2005). Indeed, logistics cost can account for a significant share of a nation's GDP, in some cases by as much as 9%-30% (Wilson, 2013). Research has revealed a correlation between corruption and emerging countries (Uhlenbruck et al., 2006), distorting their business environments. In short, countries with better logistics performance deliver to sustain a healthy economic growth and expansion (see Figure 1). Many studies have examined the relationship between corruption and economic growth, and some have reported that corruption leads to sub-optimal economic growth rates due to the misallocation of resources (Barreto, 2000). No doubt, corruption has a negative effect on a county's economic efficiency (Halkos & Tzeremes, 2010). However, few studies have specifically considered the effect of corruption on logistics efficiency. In this study, we posit that a relationship exists between logistics efficiency and corruption. We treat logistics efficiency as a proxy for good logistics performance.

2. LITERATURE REVIEW

2.1. Logistics efficiency and Corruption

Logistics excellence has become a powerful source of competitive differentiation for firms (Mentzer et al., 2001). Good logistics performance has been viewed as a conduit for reducing costs (Pawlika et al., 2011), and to increasing competitiveness by adding value and increasing productivity. Lieb (1992) indicated that, for a consumer, cost and service are the two main factors of logistics competitiveness. The price of a service is only

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discussed after qualified logistics suppliers have been decided (Lieb & Randall, 1996). In this regard, efficient logistics operation can provide firms with a competitive advantage (Arvis et al., 2007). Likewise, at the national level, logistics efficiency is imperative for competitiveness. Corruption is more than a constraint for a nation's logistics infrastructure development as corruption impedes (logistics infrastructure) investment (Mauro, 1995). Corruption is also a significant problem which results in increased cost for society (Lee & Oh, 2007) especially as logistics efficiency is closely linked to industrial development (Turner et al., 2004). Corruption is omnipresent, it is "not the same everywhere" (Rodriguez et al., 2005) since it depends on a country's level of maturity. Halkos and Tzeremes (2010) have empirically examined the effects of corruption on national economic efficiency, revealing a U-shaped relationship between a country's corruption perception level and economic efficiency.

3. RESEARCH METHOD

3.1. Data

To measure logistics efficiency, the balance of payments (BOP) from 2005 to 2012 provided by the International Monetary Fund (IMF, 2013) is used. The database related to the logistics industry provides figures on transportation services, which are divided into three categories: passenger transportation, freight services, and other forms of logistics. Passenger transportation is not relevant to cargo logistics, so it has been excluded from cargo transportation services. The Corruption Perception Index (CPI) from 2005-2012 provided by Transparency International (TI) (2013) provides a good proxy to measure a country's level of corruption.

3.2. Revealed Competitiveness

Balassa's (1965) revealed comparative advantage (RCA), originated from the comparison of the difference between cost and price, is a way to assess the competitive structure across countries. However, previous studies have failed to consider importation, which may affect the competitiveness of these countries. Therefore, this research adopts the revealed competitiveness (RC) index to measure the logistics efficiency of the emerging and advanced economies. The RC can be defined as follows:

$$RC = \ln\left(\frac{X_{ij} / X_i}{X_j / X}\right) - \ln\left(\frac{M_{ij} / M_i}{M_j / M}\right) \quad (1)$$

X_{ij} : country i 's export value of service j

M_{ij} : country i 's import value of service j

X_j : service j 's total worldwide export value

M_j : service j 's total worldwide import value

X_i : total export value of country i 's goods and services

M_i : total import value of country i 's goods and services

X : total global export value of goods and services

M : total global import value of goods and services

In this paper, we will use RC as a measure of notional logistics efficiency (LE) for a particular product/industry. An LE value of Country A greater than the LE value of Country B indicates that Country A is relatively more competitive than B. When the LE value of a particular product / industry of a country exceeds 0, a country is said to have a comparative advantage in product/industry i ; by contrast, a value of less than 0 is taken to signify an uncompetitive position.

3.3. Panel Data Econometric Methods

The CPI index measures a country's degree of transparency using a 10-point Likert scale with 0= highly corrupt and 10 = least corrupt. We turn it into a logistics facilitation index (LFI) using, $LFI = 10 - CPI$, where 0= informal logistics facilitation (corruption) is least practiced, and 10 = informal logistics facilitation is most practiced. The Box-Cox test is performed to select the functional relationship between LE and the LFI as shown in equation (2):

$$LE_{it} = \alpha_i + \gamma_t + \beta_1 LFI + \beta_2 (LFI)_{it}^2 + \varepsilon_{it} \quad (2)$$

α_i : country specific intercepts;

γ_t : time specific intercepts and countries are indexed by i and time periods by t

ε_{it} : error term.

The turning point (TP) of the LFI is $TP = -\beta_1/2\beta_2$. Panel data econometric methods are employed to estimate equation (2). The first method is the fixed effects (FE) model, which includes both dummy variables and the FE regression. The second method is to adopt a random effects (RE) model. This model assumes that the slopes of different countries are the same while the intercepts are different.

4. RESULTS

We present the LE status of the sub-sectors of the logistics industry in the countries studied: transportation, freight and other forms of logistics activities. Finally, we discuss the relationship between LE and corruption. Table 1 reports the inter-factor correlation matrix, mean, and standard deviation for the study variables.

4.1. Logistics efficiency

As shown in Table 2, from 2005-2012, the United Kingdom, Korea, United States, France and Japan had LE coefficients greater than one, a favorable indication of the competitiveness of their transportation services sector. Therefore, these countries could be considered to be competitive. Korea has demonstrated economic growth in recent years, and has also benefitted from inter-port competition in East Asia (Yap & Lam, 2006). Lebanon, Qatar, Oman, Saudi Arabia and Bangladesh, on the other hand, are among the lower-ranked LE countries. Germany and Lebanon and Sri Lanka's logistics efficiency have improved in recent years, suggesting an improvement in competitiveness.

4.2. Panel data econometric methods

In the second stage, we divide the countries into advanced and emerging economies. Limited by the panel data provided by the IMF and TI, countries with insufficient data are removed. Therefore, in terms of the transportation services, only 23 countries are included (7 for advanced and 16 for emerging).

In Table 3, the FE and RE models indicate the presence of a U-shaped curve for all countries, and emerging countries, and the parameter estimates as well as the t-statistics are similar. Specifically, the TP in the RE formulation is 6.0175 for the global model, 5.1990 for emerging markets, and 6.1806 for advanced economies. Hausman's test reveals that the country intercepts and the LFI correlate in the dataset of the global and advanced economies. It also shows that the RE model could not be consistently estimated. Therefore, there is a correlation between the intercept and the predictive variables, which results in an error. This suggests that there are variables which are related to the LFI but these are not considered (Halkos & Tzeremes, 2010). Both the RE and FE models have good predictability on the global and advanced economies. The elasticity estimates conform to the estimated U-shaped curve.

Figure 2 shows the relationship between LFI and LE of all countries, emerging markets, and the advanced countries. The relationship of LE and LFI for the advanced countries is convex. From the elasticity of the LE, the estimates conform to a U-shaped curve for emerging markets. Likewise, the Logistics Performance Index (LPI) depends on the LFI. In particular, a lower LFI, i.e. more transparent logistics procedures and process leads to a high LPI. The G7 economies have lower LFI, i.e. they practiced least informal logistics facilitation or corruption.

As shown in Figure 3, there is a negative correlation between LFI and LPI. The countries in our sample can be divided into six groups. Group I are the G7 countries, namely, Canada, France, Germany, Japan, the United Kingdom and United States with low levels of corruption and very good logistics performance. Group II are countries with low levels of corruption and average logistics performance. This group contains Qatar. Group III are Italy (G7), Bahrain, China, India, Korea, Kuwait, Malaysia, Oman, and Thailand have average corruption and logistics performance. They need to improve governance to stay competitive. Group IV, (Indonesia and Philippines), comprises mainly countries that are highly corrupt and with average logistics performance. Group V are countries with average corruption and poor logistics performance. This group contains Jordan and Sri

Lanka. Finally, Bangladesh, Kazakhstan, Lebanon, and Pakistan with highly corrupt and poor logistics performance are in the Group VI. Figure 4 shows the relationship between LFI and LPI by region, with nine regions divided into three groups. G7 is in Group I (low level of corruption and high logistics performance). East Asia, Southeast Asia, and Middle East Asia are in Group II (median level of corruption and median logistics performance). South Asia and Central Asia are in Group III (high level of corruption and low logistics performance).

LE and LPI are positively correlated and the countries are divided into five groups (Figure 5). Group I (high LE and high LPI) comprises France, Japan, the United Kingdom, and United States from G7. Group II (median LE and high LPI) contains Canada and Germany. Group III (high LE and median LPI includes Korea from emerging markets. Group IV (median LE and median LPI) includes Italy from G7, and China, India, Indonesia, Kuwait, Malaysia and the Philippines from emerging markets. Group V (low LE and median LPI) comprises Oman, Qatar, Saudi Arabia, and Thailand. These four countries should improve their transportation services sector. Group VI (median LE and low LPI) contains Kazakhstan, Jordan, Pakistan and Sri Lanka. These four countries should improve their LPI. Finally Group VII (Low LE and low LPI) includes Bangladesh and Lebanon.

Figure 6 shows the relationship between LE and LPI by region, with six regions divided in three groups. G7 and East Asia are in Group I (high LE and high LPI). Central Asia is in Group 2 (median LE and low LPI). Southeast Asia and Middle East Asia and South Asia are in Group3 (low LE and low LPI).

5. DISCUSSION

In the first stage, we focus on logistics efficiency and provide a better understanding of a nation's logistics efficiency status. The United Kingdom, Korea, United States, France and Japan have high efficiency levels between 2005 and 2012. Germany, Lebanon and Sri Lanka's logistics efficiency show considerable improvement in recent years. In the second stage, when the corruption level is high, informal logistics facilitation in the emerging countries is made easier, albeit their competitiveness decreases with the level of corruption. When corruption is eliminated, competitiveness increases again. This suggests that when the logistics competitiveness reaches a certain level, corruption may become an obstacle. However, for the advanced countries, the relationship of LE and LFI is convex. Several reasons explain this phenomenon.

First, corruption and bribery are universal. When an economy is undergoing transformation, a central government can establish a long-term corrupt network between itself and large enterprises (Rock & Bonnett, 2004). These large firms contribute to a large portion of GDP, so corruption has a positive effect on some industries' efficiency. When a country is more export-orient, MNCs may tend to be less concerned about corruption (Lee & Hong, 2012). However, panel data studies suggest that the harm to efficiency and investment still persists. Second, most instances of corruption involve high-dollar procurement processes. Managers will increase logistics efficiency so as to solicit more bribes, and corruption is efficiency enhancing (Barreto, 2000). The efficiency created is an economic illusion as corporations are likely to raise prices to compensate for the cost incurred. Customers ultimately pay for the price of corruption. Third, some countries lack a strong legal framework. This encourages opportunism (Hoskisson et al., 2000; Nelson et al., 1998). As long as the cost of bribery is lower than the marginal revenue, enterprises will consider that action to be beneficial. This can improve efficiency initially, but with the improvement in the corruption level, logistics competitiveness decreases. Thus, the improvement is only temporary. Finally, in emerging countries, central governments are poor at managing and developing strategies. Businesses use corruption to influence policies. This lowers the risk for the company and minimizes uncertainty. In advanced countries, this tendency is reduced. In the third stage, we verify the relationship between LE, LFI, and LPI. We find that G7 are considered to be benchmarks in the sector. The countries located in East Asia have better LE and LPI

performance. Further, there is positive U-shaped relationship between LE and LPI.

6. CONCLUSION

The primary contribution of this research is that the logistics efficiency of the advanced countries and of emerging countries is mapped. The RC indicators are able to analyze only the state of industry based on the import and export of goods. Most studies that target logistics efficiency analyze economies at different development stages in the same pool without considering other variables. We find that higher levels of corruption increase logistics efficiency in emerging markets. Moving forward, research can analyze economies at different levels of development separately, or categorize economies based on the structure proposed by Rodriguez *et al.* (2005). Simply comparing the logistics competitiveness of different countries cannot reveal much. Other logistics sectors can be investigated further.

Note: Tables 1-3 and Figures 1-6 have been removed from the conference paper. They are available from the authors upon request. Yen-Chun Jim Wu is the corresponding author and can be reached at wuyenchun@gmail.com.

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EXPLORING SUPPLY CHAIN SUSTAINABILITY RISKS OF UK FASHION RETAILERS

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ABSTRACT

Purpose

This paper reports on a work-in-progress PhD research study identifying how UK fashion retailers are managing supply chain sustainability risks. Sustainability is a growing debate in the fashion sector, which is global and highly fragmented. It has been blamed for its heavy use of chemicals, reliance upon natural resources, to name a few of the issues making the industry vulnerable to unforeseeable threats (Caniato et al. 2012). This can cause serious operational disruptions and the potential shut-down of business. Further, advancements in IT and the growing power of social and environmental organizations have increased consumer visibility of supply chain operations. Hence, consumers today are more aware of the environmental and social impacts of products they are buying (Anderson and Anderson, 2009).

Methodology

This research adopted a multiple case study approach (Yin, 2009). Six UK fashion manufacturers/retailers of luxury fashion brands were selected and the selection criteria enabled the exploration of sustainability risks over a number of years and the changing nature of risk and management strategies. Four companies have been investigated to date using semi-structured interviews conducted with forty supply chain, design, sourcing, sustainability and risk management managers. Thematic analysis was used to analyse the data and report the findings to date on a within-case basis.

Findings

The following factors were identified as the key risks to the future sustainability of UK fashion supply chains: Innovation management, brand image, culture and organizational design. This paper shows that UK fashion companies are more susceptible to sustainability risks and highlights ways in which companies from this volatile sector can better respond to the growing challenges of sustainability risks. This research can be of value to other supply chains operating in similar volatile and short lifecycle markets such as high-tech electronics sector where sustainability risk management tools and strategies could be adapted to improve understanding and preparedness for managing sustainability risks.

Research Limitations

This study only focuses on the UK fashion sector and is in-progress, thus findings are limited to this sector.

Practical Implications

Sustainability risk management tools and strategies suggested in this paper will enable UK fashion companies to manage sustainability risks, reduce costs, ensure operational continuity and overall supply chain profitability.

Category

Research Paper

Keywords

Sustainability, risk, sustainability risk, fashion, supply chain management

INTRODUCTION

Much has been written about fashion supply chains in recent years pertaining to the offshoring of production and sourcing by UK retailers to other countries including inter alia Asia as well as the attendant risks to such activities. Also, there is an increasing focus on sustainability issues in global businesses and fashion supply chains are not immune to these issues, particularly when wider issues of corporate and social responsibility are included. And yet, the consideration of sustainability and its impact on risk pertaining to supply chains of UK fashion retailers has not been actively pursued. This paper presents work-to-date on a PhD research study at the Logistics Institute, Hull University Business School investigating this interaction.

BACKGROUND THEORY

Fashion supply chains

In the last few years, fashion supply chains have received much interest from supply chain researchers (Barnes and Lea-Greenwood, 2010; Brun and Castelli, 2008) due to their increasingly dynamic, complex and volatile nature. According to Christopher et al. (2004, p. 367) "*fashion is a broad term that typically encompasses any product or market where there is the element of style that is likely to be short lived.*" This definition further differentiates and highlights characteristics of fashion products on the grounds of short life cycle, high demand volatility, low predictability and high impulse buying and implies that fashion products must be available with minimum errors in terms of volume and product mix. Since product life cycles are short, unsold products will incur extra inventory costs for retailers. Further, proximity to market is key factor to identify popular designs and making changes during mid-season (Christopher et al. 2004). This in part requires strategies of agility, responsiveness and flexibility.

Due to the market's highly competitive nature, retail concentration and over capacity (Christopher et al. 2004; Brun and Castelli, 2008), the success of fashion retailer requires them to increase their market sensitivity by reducing cycle times and ensuring product availability. This in part can be achieved by designing market-oriented business strategy, increasing ability to respond to market signals and designing demand driven supply chain. These factors are necessary in any modern supply chain however vital in the fashion sector to survive (Christopher et al. 2004). However, fashion defies conventions, instead of long term relationships and cooperation, fashion supply chain operating mechanisms are largely based upon current market need and what can generate highest margins by capturing demand on time (Christopher et al. 2004).

Risk management

Outsourcing, globalization, improved infrastructure and information technology, cheap labour and raw material (Manuj and Mentzer, 2008) have extended supply chains to longer and complex networks. This has consequently increased supply chain vulnerability, fragility and frequent operational disruptions. To add this, are the factors such as, shorter product life cycles, reduction of supplier base, buffers and inventories, increased demand for on time deliveries, change in consumer tastes and preferences, technology shifts or supplier priorities. A heightened interest in supply chain risk management (SCRM) is attributed to the recent increase in high profile manmade and natural incidents such as, terrorist attacks, wars, earthquakes and economic crisis. Further, it has become nearly impossible to predict risks or assign probabilities due to changing profile of risk events. Recent examples are 2013's Bangladeshi factory collapse, the missing Malaysian airline, and the European horse meat scandal.

The aim of SCRM is to survive (Pujawan and Geraldin, 2009), avoid delays, reduce costs, improve customer service, avoid major disasters and operational disruptions, increase the

chances of quick recovery and enhance resilience (Christopher and Peck, 2004). SCRM research has reported numerous risk sources (Harland et al. 2003; Tummala and Schoenherr, 2011). However, in demand-driven and volatile supply chains such as fashion supply chains, three primary types of risks: financial, chaos and market related have been specifically noted in the literature (Anderson and Anderson, 2009; Christopher et al. 2004).

Risk management approaches largely depends upon the nature of market, industry, organizational structure and attitude, strategy, culture, leadership and geographic area in which organization is operating (Harland et al. 2003). Therefore, risk management should take into consideration all these factors while designing risk management strategies.

Supply chain structures and philosophies of lean, JIT and streamlining flows to eliminate buffers and redundancies have enabled global supply chains to be operationally efficient but at the same time have increased risks substantially. This is mainly attributed to the already designed supply chain structures and strategies under stable environmental assumptions. Therefore, some research suggested a move from dynamic to structural flexibility by designing adaptable supply chains where performance measurement integrates flexibility, adaptability, responsiveness and agility rather than traditional accounting measures for performance evaluation on the base of financial parameters (Christopher and Holweg, 2011).

Risk management research in the context of global supply chains in demand-driven, volatile and short product life cycle industries such as fashion is still lacking. Further, in a complex, unpredictable and unstable supply chain context risk management needs wider approaches than relatively stable environment quantitative and statistical tools and should be supported with qualitative approaches and subjective assumptions. For such complex and unstable business environments heavy reliance on narrow and one-sided quantitative information will be imperfect for decision making which could also lead to unexpected chain of risks while trying to manage by applying these models (Gaudenzi and Borghesi, 2006).

Sustainability

The earliest articulation of sustainable development was captured in the 1987 Brundtland Report and defined as "development that meets the needs of the present world without compromising the ability of the future generations to meet their own" (Grant et al. 2013: 31). The application of sustainability concept in supply chain management led the researchers to coin different terminologies such as, sustainable, green and environmental supply chain management (Carter and Rogers, 2008). The application of sustainability in supply chain functional areas such as logistics and distribution, purchasing and sourcing is fairly well developed as compared to its holistic application in total and extended supply chain context (Grant et al. 2013).

A company is as sustainable as its suppliers (Grant et al. 2013). This has led supply chains to consider the holistic application of concept from end-to-end. Further, supply chains are under intense pressure from multiple stakeholders, to integrate sustainability into operations in order to avoid liabilities (Mollenkopf, 2006). Legislation, such as end of life take-back directive and take-back regulation, REACH, WEEE and IPPC has further broadened the scope in supply chain management. Today, end purchasers such as retailers are responsible to ensure that suppliers and supply chain partners have decent working conditions, source products from ethical sources, manufacture products with least environmental impact and distribute with minimum pollution and emissions.

In order to integrate sustainability into supply chain different tools are in place such as life-cycle assessment and costing, design for remanufacturing and disassembly or modular design, design for recycling, energy recovery and life cycle extension. Further, the concept

of closed loop supply chain design also gained interest lately. At the core of this concept, is the idea of designing, with supply chain partners, a circular economy where most of the used products, residual materials, scrapes and waste materials are collected recycled, conditioned and re-used to improve material efficiency and profitability (Neto et al. 2010).

Sustainability is becoming an interesting area of research in fashion supply chains. Fashion supply chains are increasingly global in nature, with manufacturing in fragmented small and medium plants mainly in Asia and retail concentration in Europe. This requires movement of products and materials around the globe, resulting high concerns and pressure from sustainability perspective. Caniato et al. (2012) argue that the sector's environmental impact is particularly high in relation to its global volume, accounting for 4% of world's exports and employees 9.3% workforce in the world.

Combining Sustainability and Risk

Risk and sustainability are widely discussed concepts in supply chain management discipline, however, in isolated and standalone fashion. Further, an integrated discussion of sustainability risk is missing in supply chain management literature. Sustainability and risk have been under discussion for a long time but not as a unified concept. Anderson and Anderson (2009) maintain that risk based information should be an input for sustainability decision making while sustainability related information should be part of risk management process, to ensure the long term sustainability of a project.

The combined discussion of both has only recently gained coverage in the literature and yet there is no consensus on what it is. How it can be defined and what are its underlying principles? How it impacts the operational performance of supply chains and how it can be managed? The above discussion reflects that fashion supply chains are highly complex, global and requires new supply chains strategies of agility, responsiveness and demand driven. Although, risk and sustainability have been discussed in fashion supply chain contexts, existing accounts are very limited and isolated in their discussion of sustainability risk. Further, this review has not revealed any research on 'sustainability risk' in UK fashion supply chains which led to a gap in our knowledge. Accordingly, the following research questions have been derived for this research:

1. How do UK fashion retailers define sustainability risk in the context of their supply chains?
2. How do UK fashion retailers manage sustainability and/or risk in their supply chains?
3. Why might UK fashion retailers not be managing sustainability and/or risk in their supply chains?

Research Methodology

Due to the exploratory nature of this research, an inductive multiple case-study research method is adapted to empirically investigate the complex phenomenon of sustainability risk in context of UK fashion supply chains (Yin, 2009). Overall, six case companies were selected for this research. However, at this stage the research process has only been able to access and collect data from four companies. The case companies were selected on the basis of their presence and carrying out major operations in the UK from manufacturing, retail and distribution perspective.

A semi-structured interview protocol was developed to collect primary data for this research, together with an analysis of secondary data sourced from the companies themselves. Three pilot interviews were conducted to enhance the validity and reliability of the protocol. Interviewees were selected based upon purposive sampling, due to their direct relevance to the research topic, knowledge and ability to answer research question. Respondents

included supply chain, purchasing or sourcing, risk management, sustainability, and design managers. To date, 40 in-depth interviews has been conducted at an average duration of interview was fifty minutes. Interviews were recorded, transcribed and later verified by the interviewees.

The four companies have been disguised and following is a brief description of each. CC1 is well known fashion shoe manufacturer and the early 2000s huge losses and operating costs forced them to cease shoe manufacturing in the United Kingdom and moved all production to Asia. CC1 sells to luxury brands but also market its own branded products, which are distributed through its own UK and international retail outlets, online and through sales agents around the globe. CC2 is a textile manufacturer and known as the world's best designer knitwear and longest-running factory manufacturer in England. CC2 sources all raw materials while manufacturing takes place in the UK factory. It sells to luxury brands but also market its own branded products, which are distributed through its own UK retail outlet, online and through sales agents around the globe. CC3 is a manufacturer and owns factories in China and Turkey. CC3 has its own four major fashion brands and broadly deals in tights and women wear. CC3 sells its products through its own retail store, supermarkets and international fashion brands. Innovation, quality and service are major focus as a manufacturer. CC4 is a Scottish manufacturer of cashmere and woollen accessories. CC4's philosophy is to be at the top end of the quality market and it sources raw material fibre from different countries but almost all production takes place in company-owned manufacturing sites in the UK. It sells to luxury brands but also markets its own branded products, which are distributed through its own UK retail outlets, online and through sales agents around the globe.

Thematic analysis was employed to analyse the collected data and to find major themes. As noted above, this research study is in-progress with two more case companies yet to be interviewed. Therefore, at this stage it is not possible to apply cross-case analysis techniques. However, below are the within-case analyses to date.

WITHIN-CASE ANALYSIS

Defining sustainability risk

Respondents defined risk and sustainability by using different terminologies depending upon their functions, processes, organizational context and values. These subjectively expressed notions of risk (Mitchell, 1999) in terms of business continuity and longevity, viability and sustained operations, which largely resembles with the sustainability definition by Costanza and Patten (1995). However, surprisingly the traditional definitions of sustainable development and triple bottom-line were least expressed by the respondents. This finding supports Grant et al. who highlighted one definition of sustainability as capable of being sustained and capable of being maintained, or green is green, i.e. "being green means, sustainable initiatives should be considered in conjunction with the economic case for the long-term corporate sustainability, i.e. green being the colour of money" (2013: 31). Thus, building upon risk and sustainability definitions of Mitchell (1999) Costanza and Patten (1995) and Grant et al. (2013) and based upon the interview data, this study proposes the following definition of sustainability risk: "*A subjectively determined expectation of loss to supply chain continuity and viability.*"

Sustainability risk management process

At CC1, there is no formal strategy, team or department for sustainability risk management (SRM). Overall, SRM strategies are embedded in job responsibilities. At a sustainability risk identification stage, sourcing and technical teams along with a group of generalists help CC1 highlight sustainability risks. CC1 also identifies sustainability risks in partnership with suppliers, external bodies on CSR, working groups, third party auditing and on machine

basis. CC1 also use registration stage as sustainability issues identification to specifically look at where materials come from, what they are made of, are they dyed and what sort of chemicals have been used. In terms of evaluating and prioritizing sustainability risks, cost, financial gains and brand image are main considerations. However, CC1 also sees the availability of the workforce in UK and Asia; skills development and a trained workforce is a main priority of CC1. CC1 manages sustainability risks by multiple sourcing, changing management style and close working relationships with suppliers. CC1 also provides return to work incentives in foreign factories especially in Asia. CC1 seeks validation on certain chemicals and practices from external bodies and hired a lawyer in the US to specifically look at restricted materials, chemicals and legislation. CC1 also nominates suppliers for best practices and performance improvements. CC1 also has a large work study review and product review sessions.

For SRM, CC2 relies upon the technical manager or sourcing manager, the production manager (also managing director) and a member from the human resources (HR) department, mainly for planning purposes. However, SRM is largely embedded in roles and responsibilities of managers. Overall, there is no specific team or department for SRM and it is largely done on a departmental basis. Further, the ultimate responsibility lies with technical manager to guide the company from SRM perspective. Product and supply chain mapping is also practiced to identify unsustainable materials and practices. CC2 seeks guidance from multiple bodies including NGOs, working groups and universities for SRM. A few years ago CC2 conducted a sustainability report and during that process identified major sustainability risks. In order to determine priority and evaluate sustainability risks, cost, financial gains, company growth and brand image are main considerations. However, customer relationships, expectations and order volume are also important indicators. The sourcing team sets up long term contracts for supply continuity and to get advantage of average prices. Currency hedging and using already available, certified and approved supply chain partners, agencies, forums, factories and materials are also used as sustainability risk management tools. CC2 use bar-codes to identify sustainability risks and to take corrective action. CC2 has a work council, as a regular forum to deal sustainability risk issues on daily basis. CC2 developed an in-house maintenance department to manage machine and technology related issues. CC2 initiated major initiatives to reduce waste for cost savings and financial gains; copying the Toyota model.

CC3 has no formal plan, team, department or strategy for SRM. However, at complete discontinuation or at disaster level there is a formal disaster management plan which explains who will do what and explaining point of contacts. Overall, it is largely embedded in job specifications and management roles. In order to identify sustainability risks CC3 mainly relies upon sourcing manager, stock management and development team planning. These teams use product and process critical path management approach to identify risks. Development team also helps in risk identification by using vendor's briefings and communication with other factories. Retailer also provides its inputs in this process. Finally production team and HR manager also discuss issues from capacity and workforce availability perspective. CC3 evaluates and prioritizes sustainability risks on the base of final product price, cost, lead times and continuity of supply. For sustainability risk mitigation, CC3 uses a recovery action plan which is part of its disaster management plan. Technical team (sourcing team) also reviews processes for learning and to replicate knowledge for next product lines as a technique to manage sustainability risks. CC3 trying to increase control and flexibility by doing more at factory in the UK. Retailer's pressure also determines priority level. Supplier's reliability also takes consideration where vendors' KPIs are looked carefully. For continuity of supply and business, buying in bulk is also preferred.

CC4 has no specific strategy, manual, team or department for SRM; it is largely done in an entrepreneurial fashion by embedding in business strategy or by discussing in board meetings. CC4 recently hired a supply chain expert from a university who highlighted sustainability risks but only in logistics and supply chain operations. CC4 is especially concerned about its sustainability risks and, therefore, hired another researcher from a UK university as a sustainability champion. Mainly this concern was raised by finance department who realized heavy energy bills and costs, but also partly due to pressure from one of its major customers. Sustainability risks are identified by finance director and energy costs and bills are main indicators. In order to evaluate and prioritize sustainability risks, cost and financial gains are most important considerations. Retailer's pressure or customer requirements also determine priority. However, being a family business relationships with certain customers also determine priority. CC4 seeks government help in case of catastrophic events along with crisis management committee, which mainly responsible for planning but yet has no formal plan or strategy. Overall, sustainability risks are managed on departmental basis. Currency hedging is most widely used tool for sustainability risk management. Cultural initiatives to save energy are also in practice as sustainability risk management tools. Cultural improvements and internal communication initiated recently as major tools to manage sustainability risks. Finance department is further co-operating in the areas of waste reduction, recycling and reclaiming for sustainability (cost reduction and financial gains). Data is recorded and information is disseminated to all departments regarding savings and improvements.

Similarities and differences among case companies

All four companies strongly believe that sustainability and risk is the same thing. Therefore, most of their risk and sustainability management strategies are same. In all case companies, there is no specific SRM strategy which is dealt by a team or department and it is largely embedded in job duties and responsibilities. At complete discontinuation or disaster level, all companies have some sort of disaster management team, crisis committee or plan which broadly explains point of contacts rather than a formal strategy. Overall, SRM is done at departmental basis. In all companies, the technical or sourcing manager is mainly responsible to guide the company from sustainability risk perspective. However, the structure for SRM is comprised of technical, production, development, and HR managers mainly for planning purposes. Lack of skills and availability of a trained workforce is described as the biggest sustainability risk to the continuity of the business therefore the HR manager is also main part of the SRM planning process. In all the companies there is consensus on economic sustainability or green is green, i.e. the colour of money, but there is no consensus on social and eco-sustainability. As economic sustainability is key for the case companies, operational performance measures such as OTIF (on-time-in-full), reducing lead times, shortening cycle times, reducing cost, buying new technology, relationship management, supply chain cooperation, collaboration and information sharing have priority. Management structure is classic and department oriented. Overall though, there is a low level of communication, cooperation and collaboration both within the companies and their respective supply chains. Respondents from all companies highlighted an unwanted move to or introduction of fast fashion lines and described it as sustainability risk. This is mainly due to their inability to react quickly because of their business models that are designed for luxury fashion lines and a potential negative impact on brand image from their targets' market perspective; i.e. from luxury to cheap fast fashion. All companies have out-dated technology, lack of skills, less focus on R&D, and stagnant cultures. Therefore, high labour costs, unable to manage innovation, resistance to change, slow and overall very less efficient and effective. Researcher also seen some new machines and technology but surprisingly most of the new technological buying is used for fast fashion lines whereas for luxury fashion lines only upgrading of existing machines is in progress. All companies are SMEs and therefore feel no need to have a dedicated team or department for SRM. However,

most of the respondents strongly believe that having a dedicated team, department or champion can be helpful in managing sustainability risks.

LIMITATIONS AND FUTURE RESEARCH

This research is currently in-progress and thus the findings of similarities and differences reflect the within-case analysis of four companies. However, on completion of data collection and analysis from the other two companies a cross-case analysis will be performed to validate major themes. Data from two more companies should also add more rigor and findings will be more reliable and valid. Further, focus groups will be used afterwards to triangulate findings from the six companies.

CONCLUSIONS

This research found that there is no consensus on eco and social sustainability but economic sustainability is a key for all case companies. Therefore, performance measurement methods are largely designed to maximize return on investment or to maximize the money value of investment. Two points can be made on the basis of the fact that the sustainability concept is not well-understood yet at these UK fashion retailers. First, legislation will force them to ensure sustainability and internalize the externalities of their operations. Second, catastrophic events, scandals or movements will force them to ensure sustainability of their operations. However, there are huge differences in integrating sustainability risk management strategies in business strategy now and then. Doing it now will enable the sector to minimize losses to the continuity and viability of their operations on a long term basis, which is their own understanding of sustainability risk. However, this will also give them opportunity of a first-mover advantage to create entry barriers for others by setting standards in the industry, and enjoy favour with governments and multiple stakeholders.

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CORPORATE SOCIAL DISCLOSURE IN THE AUSTRALIAN RETAIL SECTOR

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ABSTRACT

This study examines corporate social responsibility (CSR) reporting practices of leading businesses in the Australian retail industry. Content analysis of corporate social disclosure shows that leading Australian retailers have diverse approaches to CSR with substantial variation in medium, extent, and content of disclosure. Only a few retailers are found to present CSR as an essential component of their business. Our research implies that the majority of leading retailers need to improve their sustainability commitment to be perceived as good corporate citizens.

Keywords: Corporate social responsibility; CSR reporting; sustainability; retailers

1.0 INTRODUCTION

The globalisation of commerce has led to a re-examination of the role, rights and responsibilities of business. Corporate social responsibility (CSR), which takes account of how businesses deal with their environmental, social and economic impacts, is a top priority for many organizations (Porter & Kramer, 2006). The growing attention on firms' CSR strategies has led to increased interest in how firms account for and report on their CSR activities (Fortanier, Kolk, & Pinkse, 2011). Recent research (Wiese, Kellner, Lietke, Toporowski, & Zielke, 2012) looking at sustainability issues in the retail industry concludes that further studies will help retailers improve their sustainability commitment. Addressing the limited research conducted on the Australian retail sector, this study examines CSR disclosure of retailers in Australia.

2.0 LITERATURE REVIEW

There is significant body of literature on the concept of CSR also referred to as 'sustainability'. Although there are various definitions of CSR, the basic principle is that in addition to the economic responsibility to undertake profitable activities for shareholders, a company also has a legal, ethical, environmental and social responsibility towards society (Whetten, et al., 2002). Essentially, business and society must be considered as interwoven rather than distinct entities (Wood, 1991). The concept of CSR is comparable to the 'triple bottom line' approach (Elkington, 1997), which is widely adopted in accounting and focuses on social (people), environmental (planet), and economic (profit) impacts of corporate activities.

Studies have found an increase in company CSR reporting practice over time demonstrating the growing importance placed on sustainability issues. According to the eighth KPMG Survey of Corporate Responsibility Reporting 2013, reporting on corporate responsibility is now a standard business practice worldwide, undertaken by almost 71 percent of the companies surveyed (KPMG, 2013). An examination of the sustainability reporting practices of the Fortune Global 250 companies finds 64% of companies report on sustainability, an increase of 29% over a 6 year period. Changes in reporting content are also noted. Whilst initially, mostly environmental reports were published, over the years social and sometimes even economic dimensions have been added (Kolk, 2008). There is significant difference in quality and extent of reporting practice among corporations globally (Fortanier, et al., 2011). Many studies examine patterns and determinants of CSR disclosure, with country of origin, company size and industry found to have a significant impact on the amount and content of disclosure (Gray et al 2001). However, the absence of universal standards or mandatory regulation has resulted in lack of uniformity in CSR disclosure. In the absence of regulatory requirements, the use of voluntary reporting guidelines is dominant. A growing number of larger companies in OECD countries are voluntarily reporting on social and environmental issues using the GRI guidelines, and in its latest report KPMG finds 82% of the 250 largest companies in the world (G250) and 78% of companies worldwide adhere to the GRI guidelines (KPMG, 2013). Government legislation and official reporting guidelines have increased reporting

practice in some countries. For example: legislation on reporting on environmental issues in the annual report in Australia and European countries including Denmark, Norway, Sweden, and France; and government support of voluntary environmental reporting initiatives in the UK, the EU and Japan, has led to improved CSR reporting practices in these countries (Kolk, 2005). However, with few exceptions CSR reporting remains largely a voluntary, company-driven initiative (Hahn & Kühnen, 2013).

Companies communicate their CSR practices through multiple mediums of disclosure that include the annual report, stand-alone sustainability reports, and web-site disclosure. Only 20% of the G250 rely solely on stand-alone CR reports, and barely 10% restrict their report either to web-only formats or annual reports alone (KPMG, 2011). Another phenomenon is the emergence of 'integrated reports', which combine the annual report and the sustainability report into one report (Kolk 2008; KPMG 2013). The number of dedicated sustainability reports produced by companies has increased markedly over the past decade from about 300 firms globally in 1996 to some 3,100 as of early 2010 (KPMG, 2011). CSR disclosures have become progressively more accessible on the internet (Wanderley, Lucian, Farache, & Filho, 2008). Recent studies show an increase in web-based social and environmental disclosure (Cormier, Aerts, Ledoux, & Magnan, 2010).

2.1 Framework of CSR Disclosure

We construct a framework for analysis of CSR disclosure of Australian retailers based on international guidelines for CSR reporting and a preliminary appraisal of retailer disclosure. CSR initiatives are grouped into the categories of: *community*, *environment*, *people*, and *sourcing*. Following, we explain categories and sub-categories of CSR initiatives of retail companies and offer a diagrammatic representation for a framework of CSR disclosure (Figure 1).

(i)Community initiatives: The CSR of an organisation with regards to the community involves the people living or working in areas that are economically, socially or environmentally impacted (positively or negatively) by the organisation's operations (GRI, 2013b). In recent times, corporate-supported social initiatives are extensive and businesses support social causes through: donations of cash or material to nongovernmental or non-profit agencies; assisting external charitable efforts; and collaboration with organizations that manage benefits derived from corporate support (Pearce & Doh, 2012). We classify CSR activities for the community into (i) programs and partnerships, and (ii) social investments.

(ii)Environmental concerns: Environmental responsibility is considered a fundamental element of CSR (Orlitzky, Siegel, & Waldman, 2011). A study of some of the world's largest multinational company's shows the majority have environmental policies and consider environment an important strategic planning function (Jose & Lee, 2007). The voluntary environmental initiatives implemented by a company generally complement mandatory compliance with national environmental regulations (Reinhardt & Stavins, 2010). In addition to national law corporations generally consider international guidelines when forming environmental policy. International organisations such as the United Nations Environment Programme focus on environmental issues that include resource efficiency, chemicals and waste, climate change and eco-system management (UNEP, 2014). For analysis of CSR disclosure we classify environment into the sub-categories: (i) energy and emissions, (ii) packaging, (iii) waste and recycling, and (iv) water management.

(iii)People in the workplace: Studies have shown CSR to be beneficial to organizations, enhancing employee attitudes, behaviours, and productivity (Tziner, 2013). Workplace policies are outlined by international organisations, for example the World Health Organisation 'Healthy Workplaces: A model for Action' (WHO, 2014) and the OECD 'OECD Employment Outlook 2013' (OECD, 2014b). For the CSR disclosure category of people in the workplace we include sub-categories of (i) training and development, (ii) occupational safety and health, and (iii) equal opportunity.

(iv) Sourcing: CSR concerns in the marketplace include local issues such as fair dealings with local suppliers and international issues such as ethical trade with foreign suppliers. When dealing with local suppliers, strategy should focus on developing positive

business relationships (Rikkonen et al., 2013). The rise of global value chains where western retailers control vast international networks of suppliers in developing countries raises concern about the social and environmental conditions in which products are manufactured (Lund-Thomsen & Lindgreen, 2013). Corporations need to be aware of addressing their social responsibility throughout the global value chain. We group CSR activities of sourcing into (i) local sourcing, and (ii) international sourcing.



Figure 1. Framework of CSR disclosure

3.0 CONTEXTUAL BACKGROUND OF THE RESEARCH

Australian companies need to be aware of challenges associated with extending CSR beyond the firm boundary and the necessity of related sustainable supply chain strategy. Supply chains in the retail sector are vast with manufacturing activities being increasingly outsourced to developing and low labour cost countries (Gereffi, Gary & Frederick 2010). Powerful corporations (retailers) holding market power and controlling key resources are being called upon to take responsibility for social and environmental impacts throughout the supply chain (Jenkins & Unies, 2001). The challenge of managing CSR in supply chains is a significant issue that needs to be addressed by Australian companies. Only 46% of the top 100 Australian companies identify social or environmental impacts across their supply chain (KPMG, 2013).

The global financial crisis has left no industry in the world untouched and is likely to have long-lasting consequences for the retail sector. Although the retail sector did not suffer rigorously in total, it is not likely to grow rapidly during the recovery (Deloitte, 2013). Australia's retail sector is worth \$265 billion and includes almost 140,000 retail businesses (ARA, 2014). The sector employs over 1.2 million people, which is 10.7 per cent of the total working population and is one of Australia's largest employers. However, despite the retail industry's significant contribution to economic output its share of GDP has been declining slightly over time reflecting slower growth than in other parts of the economy (Productivity Commission, 2013). A study of Australian and NZ retailers suggests that there are growth opportunities for retailers during times of economic downturn. Specifically large retailers consider investment in green and sustainable business practices a means to aid from recovery of the recession (Sands & Ferraro, 2010). Consumers consider the corporate social performance of a business carefully before a purchase decision (Meijer & Schuyt, 2005). Thus it is important that Australian retailers focus on appropriate CSR strategy for long-term sustainability.

Corporations in Australia are governed by the Australian Stock Exchange (ASX) listing rules and the Corporations Act, neither of which have any specific reporting requirements on the social and environmental impact of corporate activities. However, many Australian companies voluntarily report on these matters in the context of various reports or in stand-alone 'social responsibility' or like reports (CAMAC, 2006). A study of the largest 100 Australian firms listed on the ASX finds that environmental reporting is considered to be an increasingly important aspect of CSR (Rao, Tilt, & Lester, 2012). In recent years, Australian companies have increased environmental disclosures, both in the annual report and in stand-alone environmental or sustainability reports (Frost, 2007). Australian environmental regulatory obligations include the Energy Efficiency

Opportunities (EEO) Act 2006, the National Greenhouse and Energy Reporting (NGER) Act 2007, and the Australian Packaging Covenant (APC) 2010. Individual organisations publish on-line reports and action plans based on these initiatives and mention observance with environmental regulations within their CSR disclosure.

4.0 RESEARCH DESIGN AND METHODOLOGY

This study will look at CSR disclosure of leading Australian retailers and identify the scope of their CSR activities. Specifically, we examine medium and extent, and content of CSR disclosure. The research is conducted through the following steps.

Selection of retailers: To attain a broad picture of CSR issues addressed by leading Australian retailers, the top twenty-five retailers in Australia, ranked by Australian sales turnover were selected for study. The top Australian retailers are classified based on 2012 sales volume (Inside Retail, 2012). These retailers are grouped into different industrial sectors including food and liquor, department stores and speciality stores such as, electrical, hardware and auto, clothing, pharmaceuticals and others (Productivity Commission, 2011).

Web search of CSR disclosure: An internet search for publicly available CSR related information on each of the top twenty-five Australian retailers was undertaken. Selected disclosures relevant to the research include company annual reports, separately published CSR reports, and online CSR information presented on company websites.

Analysis of CSR Disclosure: Corporate social disclosure of the retailers is studied using content analysis method. Content analysis is the research method most commonly used to study social and environmental disclosure of an organisation (Parker, 2005). Content analysis is defined as a research technique for making replicable and valid inferences from data to their context (Krippendorff, 2012). Content analysis involves codifying qualitative and quantitative information into predefined categories to derive patterns in presentation and reporting of information (Guthrie & Abeysekera, 2006). Both qualitative and quantitative content analysis methodology is used in this research. Content analysis of the retailers is undertaken as follows: (i) compiling a list of retailers, (ii) collecting company web-based CSR disclosure, (iii) searching relevant CSR information from company disclosure, (iv) coding and analysing frequency of qualitative data.

As the first step towards analysis a list of top retailers was collected for study. Through internet search, company web-site and supplementary information for each retailer was found and relevant material was downloaded. To ensure uniformity and for the purpose of convenient analysis all web materials were converted into comparable documents. For each company, related web pages were converted into PDF and merged into a combined document. Company web-reports were available on-line in PDF format. For qualitative content analysis, each PDF document was read and examined carefully and relevant information grouped in tabular form. Keyword search based on categories of CSR disclosure helped form group clusters. For ease of analysis corporate activities of a similar nature were grouped into the same category of CSR disclosure. For example, in the community category 'social investments', community programs, employee programs and community projects were grouped together. For quantitative analysis the list of top retailers was copied onto an excel spread sheet. Content analysis was based on frequency count and a score of 1 (for presence) or 0 (for absence) assigned for relevant elements of disclosure. Results were verified by the co-researcher and differences adjusted in a few cases.

5.0 ANALYSIS AND DISCUSSION

Based on content analysis of the collected annual reports, stand-alone CSR reports, and web-sites of the top 25 Australian retailers for the year 2013 the study reviews: (1) medium and extent of CSR disclosure, and (2) CSR policies disclosed by retailers. Findings relevant to the research are summarised and presented below.

5.1 Medium and extent of CSR disclosure

In January 2014, a web search of CSR disclosure of the top 25 retailers in Australia was undertaken. The search revealed variations in medium of CSR disclosure of the selected retailers. The different mediums of CSR disclosure for the top retailers can be seen in

Table 3. Of the twenty-five retailers, five retailers do not provide any CSR disclosure. With the exception of these businesses, the remaining companies, which constitute the majority of retailers, present CSR activities on their websites. Nine companies, corresponding to 2 retail groups and 2 individual retailers, publish separate CSR reports. CSR information is also included in the annual report of a number of companies.

Woolworths Limited and Wesfarmers group are the two major retail conglomerates in Australia. Deloitte's 2013 Global Powers of Retailing Report of the 250 largest retailers around the world include Woolworths and Wesfarmers in their Top 20, placed 17th and 18th respectively (Deloitte, 2013). Wesfarmers group of companies include Officeworks, Target, Kmart, Bunnings and Coles. Woolworths Limited, the largest retail company in Australia includes the Woolworths and BigW divisions. Table 3 shows which companies have published separate sustainability reports. Amongst the leading retailers in Australia Woolworths Limited, Wesfarmers group, Myer, and David Jones publish stand-alone sustainability reports. Separate sustainability reports are relatively new for most retailers in Australia. Wesfarmers group is the pioneer for CSR reporting among Australian retailers, and in 2013 published its fifteenth report. In comparison the other companies are new on the scene with Woolworths publishing its sixth sustainability report, David Jones its third, and Myer its first report in 2013. Differences in report name and length can also be observed from Table 4. Out of all the retailers, David Jones is the first Australian retailer to issue an integrated report, with a sustainability report included within the annual report.

Table 3. Australia's top 25 retailers (2012) - Medium of CSR disclosure

Rank	Sales volume (\$b)	Retailer	CSR report	Annual report	Corporate website	No CSR disclosure
1	\$37.10	Woolworths	X		X	
2	\$25.55	Coles	X	X	X	
3	\$7.00	Bunnings Warehouse	X	X	X	
4	\$4.92	Harvey Norman			X	
5	\$4.15	Big W	X		X	
6	\$4.01	Kmart	X	X	X	
7	\$3.72	Target	X	X	X	
8	\$3.13	Myer	X	X	X	
9	\$2.98	JB Hi-Fi		X	X	
10	\$2.90	Aldi			X	
11	\$2.88	7 Eleven			X	
12	\$2.10	The Good Guys				X
13	\$1.89	David Jones	X	X	X	
14	\$1.86	Dick Smith			X	
15	\$1.52	Reece Plumbing			X	
16	\$1.51	Officeworks	X	X	X	
17	\$1.60	Chemist Warehouse				X
18	\$1.26	Super Retail Group		X	X	
19	\$1.10	Terry White Chemists				X
20	\$0.99	BB Retail Capital				X
21	\$0.99	Spotlight Group			X	
22	\$0.98	Repco				X
23	\$0.85	Just Group			X	
24	\$0.84	Retail Adventures			X	
25	\$0.81	Ritchies Supa IGA			X	

These top retailers have endeavoured to integrate CSR into their core business practices as evidenced by their separately available CSR reports. Wesfarmers and Woolworths Limited are the only Australian retailers to be listed in the Dow Jones Sustainability Indices (DJSI) (sustainability-indices, 2014). In 2013, Woolworths Limited was the first Australian retailer to be recognised as retail industry group leader in the DJSI. Woolworths Limited is a founding partner of the UN Global Compact Australia and CSR

reports of Woolworths Limited, Wesfarmers group and David Jones all mention conformity to GRI requirements. These companies are foremost in providing CSR disclosure, and may be considered as leading the way in assimilating sustainability issues in the retail sector in Australia. However, although they are to be lauded for incorporating CSR into business practice, each company follows its own policies and provides CSR disclosure to differing extent. Aside from these companies, the majority of the top Australian retailers do not publish separate CSR reports.

Table 4. Australian retailers with stand-alone sustainability reports in 2013

Corporation	Name of report	Page length	First issued
Woolworths Ltd	Corporate Responsibility	60	2008
Wesfarmers group	Sustainability Report	49	1998
Myer	Sustainability Report	20	2013
David Jones	Corporate Sustainability	12	2011

Our study ranks leading Australian retailers according to size (measured by sales volume). Of the four retailers and retail groups that publish separate CSR reports, Woolworths Limited and Wesfarmers group are the largest retail conglomerates in the country. Amongst the top retailers, Myer and David Jones are listed 8th and 13th respectively. We find these larger companies have the most substantial CSR disclosure. Prior empirical research shows CSR disclosure varies across companies and finds positive correlation between company size and level of disclosure (Cormier and Magnan 2003). Our research supports these findings and from our study we can assert that larger Australian retailers have a higher level of disclosure.

The retailers that include CSR information in the annual report provide differing extents of disclosure. Super Retail Group has 2 paragraphs on sustainability in its 2013 annual report within the chairman and managing director's report. JB Hi-Fi annual report 2013 contains one paragraph summarizing its CSR policy. Wesfarmers annual report 2013 addresses sustainability within the 'Chairman's message' and also in a two page 'Sustainability' section within the report. Summary of CSR activities are also included in the annual report of each company in the group. However, the 2013 annual report of Woolworths Limited, Australia's largest retailer, does not contain any CSR disclosure. Myer annual report 2013 contains a 6 page 'Sustainability' section. David Jones' integrated report presents its sustainability report within the annual report. In general, CSR information provided in the annual report can be described as a summary of the company's sustainability policy with details provided in a separate CSR report or on the corporate website.

The common medium for all retailers (excluding those with no CSR disclosure) is to disclose CSR information on the company website. However, the scope of reporting on CSR issues varies. While some retailers offer comprehensive web-based reports that present CSR as essential to their business operations, other retailers provide comparatively limited CSR disclosure on their websites.

5.2 Content of CSR disclosure

CSR disclosure of the top 25 retailers was examined according to the categories outlined in the framework for CSR disclosure: environment, community, people and sourcing. It was found that the majority of the retailers focus on environmental issues (65%). A primary focus on the environment may be expected as government legislation outlines several environmental disclosure activities. The second most common CSR category retailers address is community involvement (55%). Community related disclosures entail detailed listings of corporate philanthropic activities. In parallel with community disclosure, we find disclosures relating to employees in the workplace are given almost equal attention (50%) with many retailers supplying separate employee related policies such as 'employee diversity policy', 'equal opportunity for women in the workplace policy' and 'Aboriginal policy'. Overall, issues of sourcing in the marketplace are given the least amount (35%) of consideration by the retailers.

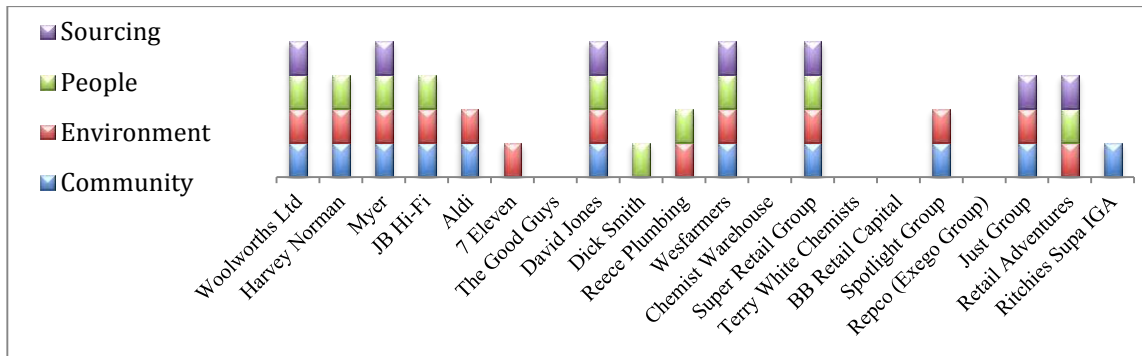


Figure 2: CSR disclosure of leading Australian retailers (by category)

Figure 2 shows separate CSR disclosure for each Australian retailer. 20% of companies provide no CSR disclosure, although the remaining retailers all report publicly on their CSR commitments. However, there is noticeable difference in reporting content. Of the top 25 retailers only 40% of companies address all categories of CSR disclosure, with varied coverage of CSR issues within each category.

6.0 CONCLUSION

Our research aims to contribute to CSR literature by examining CSR reporting practice in the Australian retail industry. We study CSR disclosure through content analysis of the annual reports, stand-alone sustainability reports and websites of the top 25 Australian retailers. We review medium and extent of CSR disclosure, and construct a framework of CSR disclosure to assess the content of leading retailers CSR initiatives.

We find that the top 25 Australian retailers have diverse approaches to CSR and analysis shows substantial variation in the medium and the extent of CSR disclosure. A number of retailers (20%) provide minimal or no CSR information suggesting limited commitment to CSR and lack of initiative in integrating CSR into core business practices. Some retailers (36%) present CSR disclosure in the annual report. However, whilst the annual report is often used as a primary medium for CSR disclosure, CSR information provided in the annual report of Australian retailers can best be described as a summary of the company's CSR policy (with full disclosure contained in a stand-alone sustainability report or on the corporate website). Just one retailer presented their CSR disclosure in an integrated report, merging the sustainability report with the annual report. This suggests that integrated reports are not yet common amongst Australian retailers. The majority of retailers (80%) specify CSR policy on their company websites, although the extent of disclosure varies from token mention of CSR to inclusion of detailed sustainability related policies. Only four of the top retail groups and retailers (representing 36% of retailers) issue comprehensive stand-alone sustainability reports presenting CSR as an essential component of the business. Our study finds that the larger retailers have the more extensive CSR disclosure.

CSR activities undertaken by top Australian retailers were examined based on categories outlined in a framework for analysis of CSR disclosure: environment, community, people and sourcing. Substantial variation was found among retailer CSR activity. The majority of retailers (65%) focus on environmental activities; almost equal consideration was given by retailers to community and employee related activities (55% and 50% respectively); whilst the least attention was placed on sourcing issues (35%). However, only 40% of the top retailers address all categories of CSR disclosure. As an illustrative example we examine the CSR activities of the retailers that issue stand-alone sustainability reports. Contents of these CSR reports were classified according to our framework of CSR disclosure. Although the reports vary in length, presentation, and degree of coverage, these companies can be identified as having successfully integrated CSR into their business practice and may be considered to be amongst the industry leaders who can help establish a model of best practice for CSR disclosure in the Australian retail sector.

From our study of leading Australian retailers, we conclude that the majority of retailers need to improve their sustainability commitment. Sustainability is important in a global

context to develop an environmentally aware, socially just, and economically responsible society (Epstein, 2008). Australian retailers need to remain competitive in the face of increased local and international competition. CSR is no longer an option; it is a normal business obligation with societies around the world expecting corporate entities to be socially responsible in whatever they do (Idowu & Leal Filho, 2009). The findings of this study may help retailers develop more effective CSR policies in line with those companies identified as having successfully integrated CSR into their business strategy. The sample set of 25 leading retailers, though adequate for the methodology employed, may be increased for future empirical study. Further related research involving cross-country comparison of international retailers and retailers in other OECD countries may also be undertaken.

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ASSESSING AND MANAGING SUPPLY CHAIN RISK THE CASE OF VIETNAM PANGASIOUS PROCESSING AND EXPORTING COMPANIES

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ABSTRACT

In the last decade, supply chain risk management has received attention of many academic researchers and practitioners. Supply chain of food in general and seafood in particular, which are fundamental requisites for human life, are no exception. The chain from "farm to fork" has to face various kinds of risks, which requires managers to look for strategic solutions in order to reduce risks and enhance performance. Based on an empirical research, authors conducted surveys and in depth interviews with Vietnam pangasious processing and exporting companies to explore the most significant risks and countermeasures to mitigate these risks. The result shows that the most dangerous risk is the vulnerable link between enterprises and farmers in benefit sharing, production planning and quality management. That resulted in the continuous fluctuations of quantity, quality and price of raw fish. The other finding is that most of companies deal with supply chain risk proactively and step by step implement the vertical integration strategies.

INTRODUCTION

As a result of worldwide population growth, the global food consumption increases constantly. The world's demand for seafood, especially pangasious, is booming (SNV-World report). The evidence is that over the last decade, export of pangasious has grown over 50 fold in Vietnam- the country is the source of more than 90 percent of world supply of pangasious (WWF report). Pangasious is the general name for 28 catfish species. The two most popular species are *Pangasious hypophthalmus* and *Pangasious bocourtiare*, which are being fed, processed and exported by Vietnam pangasious companies. Starting from very small farmers and local market, at the present, pangasious products of Vietnam are exported and consumed in 149 countries and territories. There are about 1000 pangasious hatcheries, 750 small sized pangasious farms, 150 middle sized to large sized pangasious farms and 70 processing and exporting companies. They are the main entities constituting pangasious supply chain, which is described in the following figure.

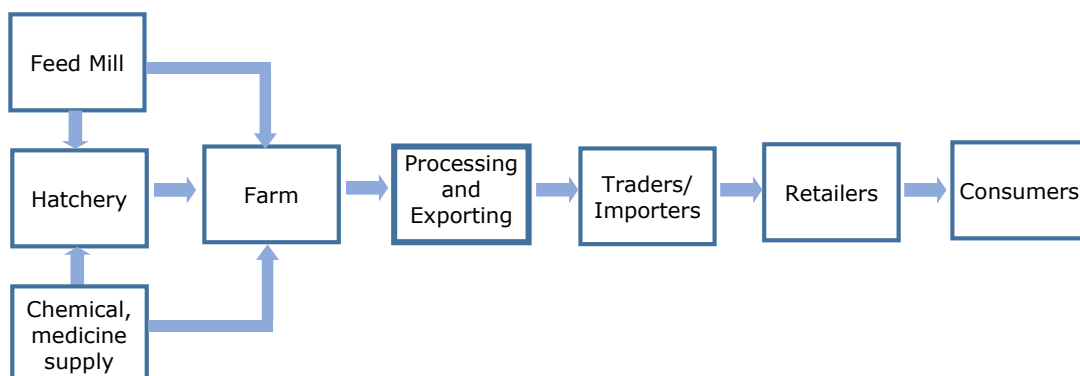


Figure 1. Pangasious supply chain

In this supply chain, the processing and exporting companies play the most important role in bringing pangasious to global markets and positively contribute to encourage farming activities, create many jobs in the Mekong Delta area. These companies always keep the active attitude in ensuring quantity and quality of

supply source as well as exploring and developing exporting markets. However, the fast growing of pangasius sector is threatened by many kinds of risks from the focal companies to supply chain members and environmental factors. According to Vietnam Association of Seafood Exporters and Producers (VASEP), there is about 30% pangasius companies facing the threat of bankruptcy due to lack of capital, management skill, material resources and severe impacts from the global economic crisis. It requires to establish an effective framework to identify, assess and manage supply chain risk.

Although risk management in seafood supply chain has gained attention in the past years in academic researchers, most of studies focused on aquaculture stage and risk analysis for farms or risks on quality of seafood product. There is lack of work on risks in whole supply chain at the point of view of processing and exporting companies. The purpose of this paper is (1) to assess level of risks in whole supply chain at stand point of view of processing and exporting companies in Mekong Delta River area and (2) investigate perception and risk management strategies of these companies towards sustainable growth.

LITERATURE REVIEW

This section will provide generic definitions about supply chain risk assessment and management. Then, it briefs previous research on supply chain risk management in seafood industry.

Supply chain risk management is the implementation of strategies to manage both every day and exceptional risks along the supply chain based on continuous risk assessment with the objective of reducing vulnerability and ensuring continuity (Wieland et al. 2012). Generally, supply chain risk management consists of three main stages: Identifying, Assessing and Managing. First, risk identification involves a comprehensive and structured determination of potential supply chain risks associated with the given problem. Second, supply chain risk assessment analyses the significant level of risks and put into a prioritizing order, basis risk mitigation strategies. Almost definitions of risk assessment in the literature includes an evaluation of the likelihood of occurrence and the possible impact in case the risk event (Vilko et al., (2002), Zsidisin et al. (2004), Ritchie et al. (2007), Manuj et al. (2008)). **Risk= Likelihood of occurrence* Possible impact.** The term risk management may vary different meaning according to the involved discipline and/or the context (Haimes, 2005). Risk management is commonly distinguished from risk assessment, however some people use this term to connote the entire of risk assessment and risk management. In the analysing part of this paper, risk management is built on the risk assessment process and looks for measure to face with the most serious risks which defined by risk assessment.

Research on assessing and managing supply chain risk has been conducted in most of economic sectors, especially the food supply chain, which provides essential conditions for human life. Liu et al. (2011) asserted that food supply chains greatly depend on environment, small delivery cycles, have closed links of material, higher requirement to storage as well as transportation device, massive uncertainty of market and strict quality requirement. They summarized and presented seven main food supply chain risks: quality, logistics and inventory, structural risk, information risk, cooperation risk, market risk and environmental risk. According to Mau (2009), complex aims, moral hazard and information asymmetry are three most serious problems in the food supply chain. Manning et al. (2013) used Probability and Consequence to assess food safety risk in supply chain in combining with HACCP system. Roth et al. (2008) and Chavez et al. (2012) developed a conceptual framework called "Six Ts" - traceability, transparency, testability, time, trust and training to manage food quality risk in global supply chain.

About risk management in seafood supply chain, there are quite a few papers research on risks. Bergfjord (2009) analysed risk perception and risk management of salmon farmers in Norwegian aquaculture and Le (2009) measured risk level and efficacy of risk management in Vietnamese catfish farming. However, most researchers investigate farming activities instead of whole supply chain. Very few studies focus on processing and exporting enterprises who are important factors in establishment and development of export product supply chain.

METHODOLOGY

Data collection

This paper collected multiple data sources by combining literature review, survey, interview and secondary data such as reports and websites of pangasius companies, associations and industry.

(1) Literature review, expert interviews with focus group of pangasius company's managers and university researchers to identify the supply chain risk profile and categories of risk response measures. After that, a questionnaire was established and pre-tested through 3 companies to improve style, supplement missing information. The final questionnaire consists two parts: Part 1 explores general information about companies (size, certification, target markets, depth of vertical integration, ability to ensure raw fish source); Part 2 use 5-point-Likert scales to assess Likelihood of occurrence (Occurrence) and Possible impact (Impact)-[1 representing very low or minor probability/impact and 5 representing very high or significant probability/ impact]- of 30 types of risk. (Table 1).

(2) Survey of pangasius-company's managers with the above questionnaire. We received 32 responses (in total 70 pangasius companies) through 3 ways: (i) Directly send and receive from managers of companies attending workshops of WWF Vietnam in project "Establish a sustainable pangasius supply chain in Vietnam" supported by European Union; (ii) Ask directly managers of 6 companies when conducting in depth interviews; (iii) through email address and online survey.

(3) Qualitative in-depth interviews with members of management board about risk awareness and risk management measures. Selecting samples to interview is an important step in qualitative research. According to Eisenhardt (1989), we need to conduct four to ten cases while more recently Yin (2002) recommended using six to ten cases is enough to provide sufficient evidence. To keep the reliable results, we decided to concentrate on six companies to do the research.

Data analysis

Data collected from survey was analysed using descriptive analyses in order to determine the most significant risks in pangasius supply chain. The correlation between companies' characteristics and level of risks are tested by R software. In this analysis, author assumed that spaces between values from 1 to 5 in 5 points Likert-scale are equal.

The method of content analysis is used to investigate output of in depth interviews with the purpose of identifying categories of supply chain risk mitigation strategy applied in Vietnam pangasius companies. Following Seuring et al. (2011), content analysis is suitable for analysing various qualitative and unstructured data such as those collected during unstructured or semi-structured interviews or web-based documentary research. The paper furthermore analysed perception, behaviour and measures in risk management of practitioners.

RESULTS AND ANALYSIS

Risk profile

Through literature review, expert interviews and pilot survey, a list of risks in pangasius supply chain was defined and presented in table 1.

Code	Type of Risk	Code	Type of Risk
R1	Quality broodstock	R16	Financial risk (interest rate, lack of capital)
R2	Quality of fingerlings is unstable	R17	Quality risk (aestheticism, size, color, packing...)
R3	Risk of food quality	R18	Control risk in cold warehouse
R4	Risk of food price, continuous increase	R19	Outbound Logistics risks (especially cold products)
R5	Farming techniques	R20	Unfair competition environment
R6	Disease on fish in the farming process	R21	Government policies: There are no strict rules and sanctions for violations of competition
R7	Farmers use medicines and chemicals of unknown origin	R22	Demand risk, market pressure from importers
R8	Antibiotic residues in raw fish exceeds the allowed limit	R23	International payment
R9	Quality of water source in fish raising	R24	Agricultural Act of 2014 of the USA on Vietnam pangasius
R10	Vulnerable links between enterprises and farmers	R25	Risk in communication, negative information about pangasius
R11	Raw fish quantity is unstable	R26	Competition in white fish sector
R12	Raw fish price always fluctuates	R27	Regulation, technical and trade barriers from importing countries
R13	Inbound logistics	R28	Antidumping duties of the USA
R14	'Bleeding' skilled labor	R29	Global economy's uncertainty
R15	Technical risk (machine, convey, electronic problem...)	R30	Risk from natural disaster

Table 1: List of risks in pangasius supply chain

Assessing supply chain risks

This research received 32 responses from pangasius processing and exporting firms which have diverse characteristics about company size, certification, target markets, depth of vertical integration, ability to supply raw fish from their own farms. The collected data was analysed in following sections.

Occurrence and Impact

Figure 2 shows the mean scores of all 30 risks in both Impact and Occurrence indicators. *First*, about Impact indicator, the top five notable significant risks are R8 -*Antibiotic residues in raw fish exceeds the allowed limit* (3.84), R19- *Outbound Logistics risks* (3.81), R10- *Vulnerable links between enterprises and farmers* (3.66), R25- *Risk in communication, negative information about pangasius* (3.53) and R18- *Control risk in cold warehouse* (3.5). The risks have lowest consequence are R30- *Risk from natural disaster* (2.13), R5 *Farming techniques* (2.19) and R14 -*'Bleeding' skilled labor* (2.22). The risk "Antibiotic residues" has the most dangerous consequence reflects the truth because when existing in the finished goods, it will affect negatively on consumer's health. Furthermore, limit of antibiotic residues is the prerequisite for shipments imported into EU, USA, Japan, Canada and some other markets. To face up to this risk, pangasius companies, in recent years, combined with farmers to control tightly antibiotic residues. The results are seen in the data on the occurrence. It is not in the alarming group.

When it comes to the Occurrence indicator, the risk has highest probability is R4-*Risk of food price, continuous increase* (3.56), standing at second position is R20-

Unfair competition environment (3.53), following by R16 Financial Risk (interest rate, capital) (3.47), R29- Global economy's uncertainty (3.44) and R26 Competition in white fish sector (3.38). The most rarely risks are R7- Farmers use medicines and chemicals of unknown origin (1.69), R14 -'Bleeding' skilled labor (1.78) and R23 - International payment (2.00). The increase of food price is the fourth critical risk and the most frequently risk because food price covers from 70% to 80% production cost of raw fish. In addition, raw fish also accounts for more than 60% production cost of processing and exporting companies.

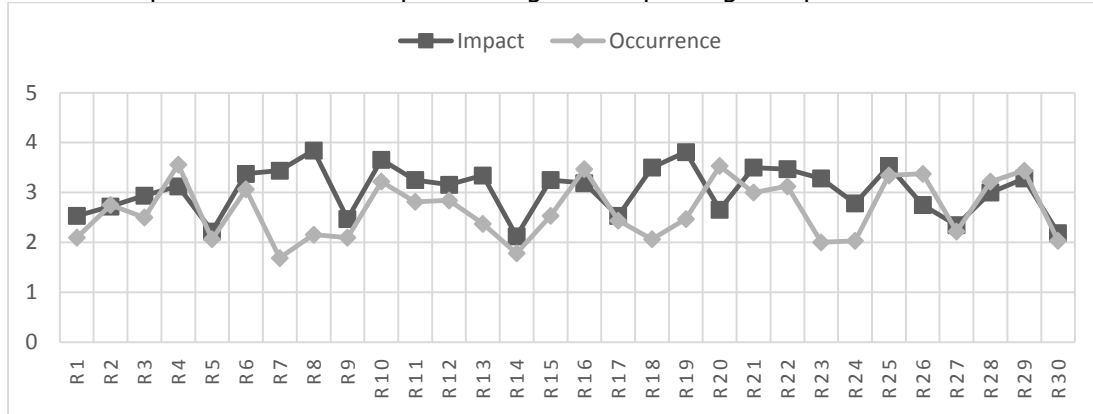


Figure 2: Pangasius supply chain risk's Occurrence and Impact average values

Level of Risk

The figure 3 illustrates that R10- *Vulnerable links between enterprises and farmers* (12.44), R29- *Global Economy's Uncertainty* (12.31), R25- *Risk in communication, negative information about pangasius* (12.03), R16- *Financial Risk (interest rate, capital)* (11.44) and R4 - *Risk of food price* (11.19) are the most significant risks in pangasius supply chain. The smallest risks are *Natural disaster* (R30), *"bleeding" skilled labour* (R14) and *Farming techniques* (R5). About R10, at present most companies invested themselves fish farms. However, their own farms could not supply 100% demand of raw fish and they still have to buy fish from farmers. The problem is that there is lack of benefit sharing and collaboration in production planning and quality management between enterprises and farmers. That caused the continuous fluctuations of quantity, quality and price of raw fish. For example, many enterprises subsidized farmer fingerling, medicine and food to rear pangasius. Nevertheless, when harvesting, many farmers break the contract and sell fish to the other companies. That is the reason why *vulnerable links between enterprises and farmers* is one of the most significant risks in pangasius supply chain. R25- *Risk in communication* stands at top three reflecting long-term and terrible consequence of negative videos and untrue information about Vietnam pangasius' image in EU in 2011. Report of Eurostat showed that in 2012 the EU imported 22% less pangasius than a year ago totalling 143200 tonnes at a value of USD 376 million, down 24% from 2011 (FAO's Globefish report,2013). Until now, the exporting value to EU still cannot recover.

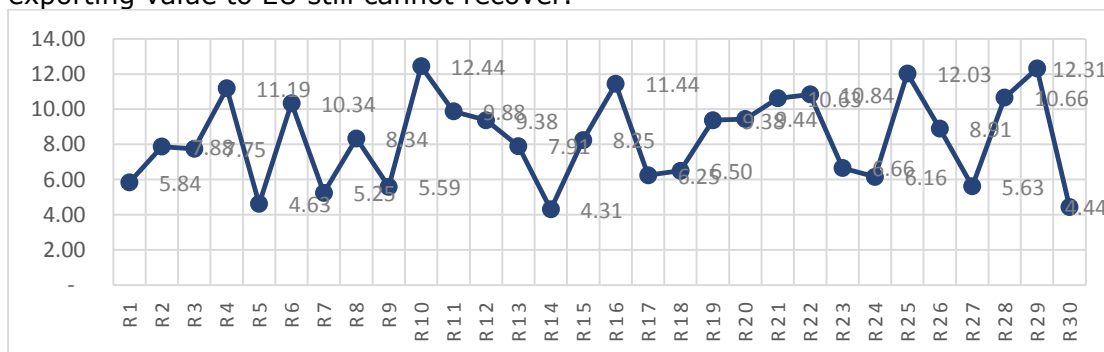


Figure 3: Pangasius supply chain risk's level

Correlation between main characteristics and level of risks

According to Lavastre (2014), size, activity sector, structure, organisation and macro-economic environment are firm's characteristics that influence risks and their impacts on supply chain management. Through exploratory study of surveyed data, authors found out relationship between levels of risks with main firm's characteristics. Two selected characteristics are:

(1) Depth of backward vertical integration - "**Depth**"- (deep level-ordinal variable) it was numerated corresponding to number of supply-tiers integrated to companies (0: no integration, 1: integrated farming activity, 2: integrated farming and feed mills or hatchery, 3: integrated feed mill, hatchery and farming).

(2) Ability to ensure raw fish source for processing - "**Supply**"- it was numerated corresponding the percentage of raw fish provided by their own farms and associated farms (1:[0-25%], 2: (25-50%], 3: (50-75%], 4: (75:100%]).

Risk type Characteristic	R2		R10		R12		R29	
	Cor.	P-value	Cor.	P-value	Cor.	P-value	Cor.	P-value
Depth (Spearman Rho r_s)	-0.70	0.00	-0.62	0.00	-0.41	0.02	-0.57	0.00
Supply (Pearson r)	-0.71	0.00	-0.79	0.00	-0.70	0.00	-0.63	0.00

Table 2. Correlation coefficient (Cor.) and P-value in correlation test

Between *ability to ensure raw fish source* and R10- *Vulnerable links between enterprises and farmers* exists the strongest relationship ($r=-0.79$). It shows that higher supply source ensuring ability, the lower risks in connection with farmers. This relationship suggests to managers to invest on their own farms to reduce risks. However, so far, there is only one company in Vietnam pangasius sector can provide 100% raw fish to its processing factories and there still has about 60% companies can supply less than 50% raw fish to their own factories. Therefore, *the vulnerable link between firms and farms* brings many serious consequences to supply chain. The test result also shows close relationship between R2- *risk about fingerling quality* with the *deep level of vertical integration* as well as *supply ensuring ability* ($r_s=-0.70$, $r=-0.71$); R12- *risk from price of raw fish* with *Supply variable* ($r=-0.7$); R29-*risk from global economy's uncertainty* with *Supply variable* ($r=-0.63$) also with *depth of chain* ($r=-0,57$).

Supply chain risk management

This section summarizes result from in-depth interviews of CEOs and managers of six pangasius processing and exporting companies. All companies asserted that risks appear at all positions of chain from supply to operation, demand and environment side. These are increasing in both number and complexity.

In supply chain risk management literature, there are four strategies to deal with risks are: avoidance, transfer/ sharing, reduction and acceptance. Through content analysis of interview's records, most of practitioners use three main strategies individually or in combination: avoidance, reduction, and acceptance. Transfer or sharing has not apply effectively in Vietnam pangasius companies due to lack of collaboration between entities.

Interviewees and their public annual reports show that all companies appropriate importance of supply chain risk management and are proactive in managing these risks. They regularly analysed internal and external environment in order to identify risks in focal firm as well as in supply and demand side.

First, supply side risk, four in six interviewed companies have invested and planned to enlarge their own farms. According to VASEP, about 30/70 enterprises archived

ASC certificate for sustainable farm. That helps them to ensure quality and quantity of supply source as well as social responsibility. More and more firms produced food and fingerlings for themselves supply chain. Hence, risk about quality of broodstock and fingerling decrease significantly. However, due to lack of capital and high risk of loan, the rest companies chose the way to strengthen links with farmers by contract conditions to reduce the shortage of raw fish.

Second, about operation risk, issues of production management, cold chain logistics, cold warehouse and product quality are always the top priority of all enterprises. They implemented seriously modern management system such as ISO 9000, ISO 22000, BRC, HACCP, and GAP.

Third, demand side risk, the processing and exporting companies are continuously looking for new markets beside penetrate more deeply into traditional markets. Last year, Vietnam pangasius exported to 9 new countries, increasing total countries consumed pangasius up to 149. Moreover, two in six interviewed companies have formed representative office in the EU and the USA, one company has bought retailer system in USA, which create favourable conditions for exporting without mediate importers.

Finally, to deal with environmental risk, forecasting and business environment analysing are performed frequently with the purpose of building flexibility and resilience for the company's operations to reduce impact and time to recover when disruptions happen.

In addition, all companies answered surveys and attended the interview worry about competitive mechanisms in internal pangasius sector and desire to improve business environment. Hence, brand name, reputation and image of Vietnam pangasius reach to higher position in customer mind.

DISCUSSION AND CONCLUSION

In this paper, authors identify and assess risks in pangasius supply chain from standpoint of view of processing and exporting companies. Risks on *links between enterprises and farmers and antibiotic residues in raw fish* have biggest consequence in supply side and supply chain. The issues of cold storage warehouse, cold chain logistics and quality management process are the most significant operational risks. Demand risks still are age-old problems and need to find out long term solutions.

Occurrence and impact of these risks depend on firm's characteristics. The companies who have deeper integration and bigger ability to supply raw fish, as well as follow high standards will avoid many kinds of risk from operation activities, customers' requirements, regulations barriers and global economy's uncertainty. Correlation test proves partly that vertical integration seems to be true strategies.

Despite having great efforts in risk management, pangasius supply chain has not yet overcome the difficulties caused by the economic crisis and media scandal in 2011. Their perception and strategies have partly solved the risk of supply and operational side but on the demand side risk is still significant threat. R22- *Demand risk, market pressure from importers* is in the top serious risk shows that pangasius companies still stand at the passive position in global supply chain and over depend on traders/importers. It requires the contributions of practitioners, researchers, associates and government.

This research overviews of the types of risks, perception and risk management strategies of pangasius companies. Findings suggest the direction of future research should focus on in-depth analysis of each type of risks and develop quantitative tools in risk management as well as find long-term solutions for *demand side risk*. Research on improving efficiency of backward vertical integration and analysing opportunity to deploying the forward vertical integration strategy with the purpose of decreasing risks, ensuring fair trade as well as sustainable

development on pangasius in particular and aquaculture products in general also is an appreciated topic.

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METHODS TO ASSESS SUPPLY CHAIN RISK: A LITERATURE REVIEW AND CLASSIFICATION FRAMEWORK

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ABSTRACT

Besides the considerable benefits of globalization, one of the main challenges is that international supply chains have to cope with substantially growing risk. This issue is addressed in an increasing number and wide variety of papers in the field of supply chain risk management. The aim of this paper is to explore the development of supply chain risk assessment research and to systematically structure it by providing an initial classification framework. We classify a diverse body of literature covering different techniques to assess supply chain risk, ranging from qualitative to semi-quantitative and quantitative models as well as mixed methods. Besides providing a systematic structure of the current state of research we also identify opportunities for future research.

INTRODUCTION

Today's corporate enterprises are confronted with growing competitive pressure. Customer requirements in terms of availability, flexibility, and reliability have significantly increased (Hammer and Kummer, 2010). Furthermore, over the last few decades, firms, especially manufacturing ones, have started to concentrate on their core competencies and have subsequently outsourced major parts of their activities. These developments were facilitated by labor cost differences and increasing political stability in the majority of the industrialized world. As a result, production activities now take place in regions where the biggest comparative cost advantage can be achieved (Jahns et al., 2006). These developments have led to the emergence of 'global supply chains' (Jahns et al., 2006), which can be identified as networks of globally dispersed actors fulfilling customer needs. Competitive advantage can often only be achieved jointly within these systems. Given their high degree of fragmentation, enterprises have to deal with increasingly complex supply network relationships leading to higher exposure to risks (cf. Christopher & Lee, 2004). Addressing and managing supply chain risks therefore have become key issues in the information systems of extended enterprises. In order to facilitate knowledge-based risk decisions, companies have to ensure that potential risks are assessed and measured in a meaningful way.

The remainder of this paper is structured as follows: The next section describes the methodology and research design. Afterwards, the concepts of supply chain risk management and risk assessment are described. The main section then discusses findings about methods to assess supply chain risk. Finally, the paper concludes with a summarized assessment and opportunities for future work.

METHODOLOGY

Aim of this paper is to provide a basic overview about existing concepts and techniques for assessing supply chain risk by conducting a concept-centric literature review. This method can combine qualitative approaches with powerful quantitative analyses and broadly enhance validity and reliability of (literature) sampling and data analysis (Duriau et al., 2007). It is favored over an author-centric approach since it provides a better basis for synthesizing prior research (Webster and Watson, 2002). Figure 1 outlines the four-phase research approach for this specific study. The general procedure is adapted from Mayring (2000), Levy and Ellis (2006), and Seuring and Gold (2012).

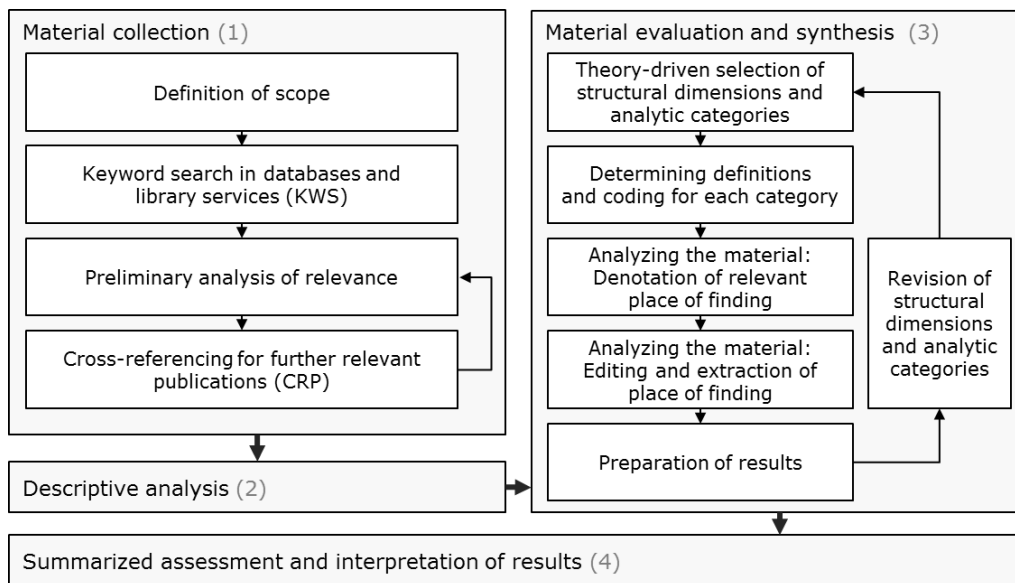


Figure 1: Research approach

In the material collection phase (1), structured keyword search (KWS) in databases and library services is performed. In addition, cross-referenced publications (CRP) are used as a complementary source. The analysis focuses on research articles written in the period between 2004 and 2014 with an emphasis on more recent publications. No a priori limit is defined concerning the number of papers to be examined. It has to be acknowledged that the research field of supply chain risk management is comprised of diverse, interdisciplinary work. Therefore, technical as well as business-oriented work is considered as relevant input. In order to identify major contributions and to ensure a high level of quality, research articles published in peer-reviewed scholarly journals are regarded as the most important source of information. For each article, a preliminary relevance assessment is conducted in order to identify its suitability for further analyses. This study primarily investigates articles explicitly dealing with assessment methods. More general supply chain risk management articles or cases are only included if the employed risk assessment technique is comprehensively described. Papers dealing with highly unique industry risks (e.g. specific risks exclusive to food supply chains) are not considered unless there is a certain degree of generalizability. Articles which mostly analyze the effects of supply chain risks without assessing the risks themselves are also excluded. A descriptive analysis of all considered papers (2) then gives an overview of the main characteristics of the body of literature. Here, the sources as well as the distribution of publications over time are evaluated. Afterwards (3), the research papers are classified based on their content (Seuring and Gold, 2012). De-contextualization and theory-led abstraction shall then allow claiming a certain degree of generalization for the findings (Seuring and Gold, 2012). This phase is considered to follow an iterative procedure. This critical synthesis of the reviewed literature serves as the basis for developing research propositions. This is done in phase (4), where the results are interpreted and discussed. In order to increase the reliability of the research, the collection phase (1) is performed independently by a second researcher before merging the results (adapted from Seuring and Müller, 2008). For the same reason, phases (3) and (4) are conducted jointly.

SUPPLY CHAIN RISK MANAGEMENT (SCRM) AND RISK ASSESSMENT

In general, following the definition by Harland et al. (2003), risks can be understood as possibilities of danger, loss, injury, damage, and other unwanted consequences. The more specific concept of supply chain risk management (SCRM) is further defined as any risks for the information, material, and product

flows from the original supplier to the delivery of the final product for the end user (adapted from Jüttner et al., 2003). It is concerned with strategies to manage both every day and exceptional risks along the supply chain based on continuous risk assessment with the objective of reducing vulnerability and ensuring continuity (Wieland and Wallenburg, 2012). Christopher and Lee (2004) stress that SCRM is becoming an integral part of a holistic supply chain design. The relevance of this topic is evidenced by an increasing number of published research articles addressing SCRM.

SCRM can be understood as an iterative, multi-step process. On this basis, a four-step view consisting of (I) identification, (II) assessment, (III) decision making and (IV) implementation is adopted for this study (cf. Figure 2). As a fundamental component of SCRM, risk assessment is primarily concerned with measuring risks by applying quantitative and / or qualitative techniques. It is an instrument for analyzing the specific vulnerability to potential threats and therefore represents a cornerstone for formulating knowledge-based risk decisions. This paper focuses on this very specific element by critically examining the current state of research concerning risk assessment methods in the field of supply chain management.

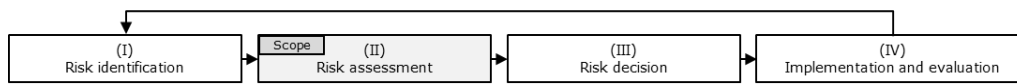


Figure 2: SCRM, Adapted from Van Mieghem (2010)

FINDINGS

KWS and CRP yield a large set of articles. Conducting a relevance assessment and applying the criteria outlined above results in 56 articles to be further analyzed. The distribution of the publications over time is depicted by Figure 3 (dark bars). A general comparison search for "Supply Chain AND ("Risk Assessment" OR "Risk Calculation" OR "Risk Measurement")" in the Web of Science (Thomson Reuters, 2014) reveals (Figure 3, light bars) that the distribution of articles selected for the review is sufficiently correlated to this general measure. Both graphs show an increasing number of publications in this area which can be interpreted as an approximate measure of importance.

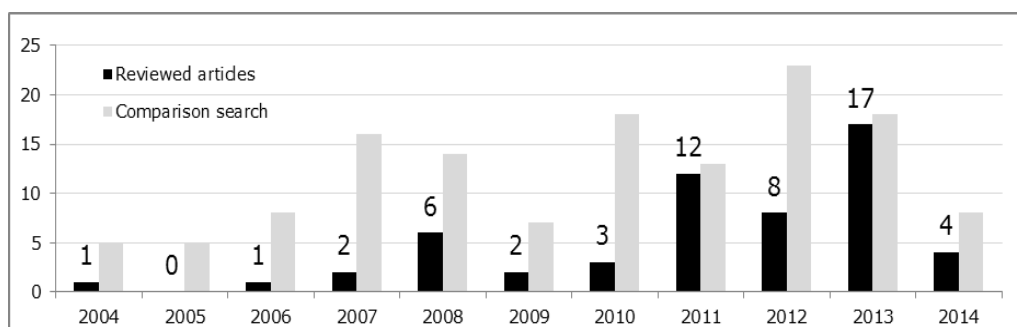


Figure 3: Distribution of publications over time

Multiple contributions stem from the following Journals: International Journal of Production Economics (9 articles), Benchmarking (3), International Journal of Physical Distribution & Logistics Management (3), Computers in Industry (2), European Journal of Operational Research (2), International Journal of Production Research (2), International Journal of Risk Assessment and Management (2), Supply Chain Management: An International Journal (2), and Transportation Journal (2). In addition, single contributions of another 29 academic journals are included. A significant share is represented by scholarly journals with a quantitative orientation (e.g. economics or operations research). However, it can also be noticed that, in general, a diverse spectrum of journals (38) defines the body of literature. This heterogeneity is also reflected in the articles themselves.

Hence, formulating a single unifying framework which is sufficiently simple without compromising valuable details is exceedingly difficult. Figure 4 provides an abstract overview by categorizing the articles along three dimensions: general method of assessment, type of risk, and supply chain scope. Four broad assessment approaches can be identified: quantitative, semi-quantitative, qualitative and mixed methods as depicted in Figure 4. Quantitative assessment is defined as the application of mathematical methods to numerical data. Semi-quantitative techniques often also use mathematical concepts but mostly base the assessment on more qualitative data. Qualitative techniques are predominantly applying qualitative research methods. In this paper, mixed methods are concerned with analyzing data in quantitative and qualitative ways. If articles fit into multiple categories, the most suitable classification is chosen. Texts that cannot be categorized (e.g. literature reviews) are not represented in Figure 4.

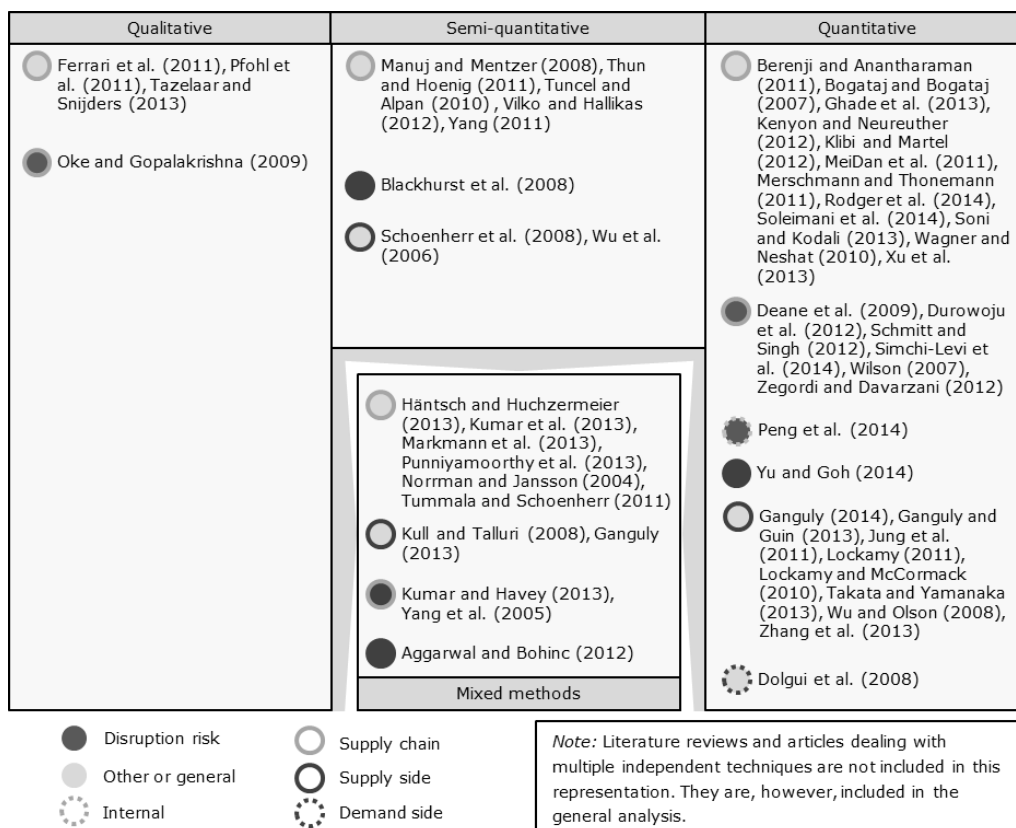


Figure 4: Classification of selected references

On the one hand, the majority of supply chain assessment literature is quantitative in nature which is (as mentioned above) also reflected in the set of journals dominant in this field. Qualitative techniques are, on the other hand, underrepresented. One might infer that measuring risk only in a qualitative fashion is not sufficient as a basis for decision making. At this point, it has to be stressed that general SCRM literature heavily uses qualitative techniques during the risk identification phase (cf. Figure 2). For both, mainly qualitative and mainly quantitative work, a strong emphasis on the assessment method itself can be identified. By contrast, mixed method research is often more applied (e.g. case studies). Here, the integration of qualitative and quantitative components is not only used to improve the quality but also to enhance practicability and feasibility of the instruments in real-world business environments. However, there is little research analyzing mixed methods on a more methodological or conceptual level.

It can also be concluded that a significant number of articles exclusively focuses on measuring inbound supply risk. Prior work deals with semi-quantitative,

quantitative and mixed method approaches. Ganguly (2013) conducts case study research and assesses how six distinctive purchasing organizations define, discover, assess, and manage supply risk. It is found out that only two of these companies use formal and proactive risk assessment methods while the other four firms see it as a by-product of using other supply management tools or realize risks only after they materialize (Ganguly, 2013). For work published before 2004 one can refer to Zsidisin et al. (2004) who comprehensively investigates supply risk assessment techniques.

In many cases, risk assessment is based on historic data in order to compute the likelihood of occurrence. As stressed by Simchi-Levi et al. (2014) or Chopra and Sodhi (2014), this approach is generally not feasible for low-probability, high-impact events since data is often rare or nonexistent. Taking these limitations into account, the authors propose a quantitative assessment technique employing a time to recovery (TTR)-based exposure measure and performance impact evaluations where risks can be analyzed without having to know or estimate likelihoods of infrequent, high-impact events (Simchi-Levi et al., 2014).

CONCLUSION AND OUTLOOK

This preliminary analysis of the current state of research shows that risk assessment is indeed an interdisciplinary and diverse area of research where some streams are already quite advanced (quantitative risk assessment techniques), while others (mostly qualitative and mixed method designs) are still underrepresented or nascent. More applied work already emphasizes the need for using multiple techniques in order to enhance quality and ensure practicability. However, there exists a lack of conceptual and methodological contributions in this subject area. Another research gap is identified concerning closed-loop supply chains (cf. Soleimani et al., 2014). Current work in this field is predominantly concerned with design aspects. A next wave of research should proactively analyze the risk dimension of closed-loop designs by studying if (and to what extent) traditional assessment techniques can be applied here and should also adapt existing or develop entirely new methods to better meet changing requirements and expectations of contemporary supply chains.

Considering the breadth and depth of the underlying topic, in this paper only a limited, preliminary overview about risk assessment techniques could be given. Several aspects which are only briefly discussed in this text (e.g. mixed methods assessment) should be covered by more focused literature analyses. The fact that only a simplified classification framework was introduced must be considered a major limitation. Classifying previous research in a more standardized way would have been able to serve as a basis for a more structured and subsequently a more easily comprehensible assessment. At this point it has to be mentioned that classifying such a diverse set of literature using a limited number of distinguishing characteristics is hardly possible. As a result, multiple frameworks would have to be worked out in order to present a more practical solution. Yet, for this preliminary work, such an approach was not feasible. Future and more focused research must be conducted in this field.

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THE RESEARCH OF THE ONSET AND PREVENTION FACTOR OF SPORTS INJURIES BY THE BASKETBALL

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ABSTRACT

Purpose of this paper

Basketball is a competition of non-contact with the mating on the rules. In basketball rules, it is prohibited to contact to the mating. But, in fact, fairly strong contact occurs and it leads to onset of sports injury. From the characteristics of the competition, many disorders or trauma to the lower extremities onset by repeating the dash or jump.^{1,2}

For each of injury site, injury of hand portion (including list and finger) and forearm are many in upper limbs and injury of ankle is many in the lower limbs. At the top level, injury of foot, ankle, knee joint, back and lumbar region are many.¹

Prevention of sports injuries is one of the most important problems on sports. So, the coaches or players have to keep in mind about onset factor of sports injuries. However, there is a little research for onset and prevention factor of sports injuries.

Purpose of this research is to alert the coaches or players by revealing the factors leading to onset and prevention of sports injuries and proposing the preventive measure.

Design/methodology/approach

We have used logistic regression analysis and poisson regression analysis, typical analysis of count data. From these analysis, we have revealed the onset factor of sports injuries of muscle and joint and we showed the preventive measure.

It is generally to use odds ratio for consideration to logistic regression analysis. However, this method has following two problems.

1. It is possible to read whether changes in the explanatory variables affect to increase or decrease in the incidence from odds ratio but it is difficult to read specific values how much it increase or decrease incidence.
2. About event whose incidence is high to the same extent, it is difficult to judge cause of increasing incidence is "Explanatory variables of a certain one is a significant impact" or "Explanatory variables of multiple mutually influence little by little and the incidence increase by its technology together".

In order to solve these two problems, we use the method by Takada³ in this research. We will described in detail of analysis on full paper.

In addition, we use regression coefficient for consideration to poisson regression analysis.

Findings

We revealed following two results.

1) We revealed practice time has greatly affection by onset of sports injuries of muscle and other factors have less. Keeping from excessive training is the most simplest and effective method of preventing sports injuries of muscle.

2) Run training is effective in preventing of sports injuries of joint. But, it varies to onset factor of sports injuries by doing at the same time it and training of different purpose. So when doing run training, you have to do only it and you

must not do it along with training of different purpose.

In future work is following.

Considering why the difference came out in these high school only by sports injuries of joint. Revealing more specific preventive measure by analyzing in consideration of mechanism of injury.

What is original/value of paper

Prevention of sports injuries is one of the most important problems on sports. In recent years, we make effort to detect the risk factors and to take precautions in advance for reducing incidence of sports injuries. However, the criterion for determining priority of prevention factors is unclear.

So, we reveal the factors leading to onset and prevention of sports injuries. We thought we can set this criterion by using these.

Keywords

sports injury, logistic regression analysis, poisson regression analysis, basketball

INTRODUCTION

Background

There are two kinds of injuries in sports. First is traumatic injury. Collisions with the ground, objects, and other players are common, and unexpected dynamic forces can cause injury. For example, fracture, dislocation, ligament injury, etc. Second is overuse and repetitive stress injury. For example, backache, stress fracture, jumper's knee, etc.

Prevention of sports injuries is one of the most important problems on sports. In recent years, we make effort to detect the risk factors and to take precautions in advance for reducing incidence of sports injuries. However, the criterion for determining priority of prevention factors is unclear. The purpose of this research is to alert the coaches or players by revealing the factors leading to onset and prevention of sports injuries and proposing the preventive measure.

Feature of sports injury by the basketball

Basketball is a competition of non-contact with the mating on the rules. In basketball rules, it is prohibited to contact to the mating. But, in fact, fairly strong contact occurs and it leads to onset of sports injury. From the characteristics of the competition, many disorders or trauma to the lower extremities onset by repeating the dash or jump.^{1,2}

For each of injury site, injury of hand portion (including list and finger) and forearm are many in upper limbs and injury of ankle is many in the lower limbs. At the top level, injury of foot, ankle, knee joint, back and lumbar region are many.¹

PREMISE OF ANALYSIS

Investigation object

Investigation object is men's basketball club in high school A and B in Shizuoka, Japan. Because same sports trainers belong this two schools and he proposes practice menu, these schools are doing about the same practice menu. In addition, we considered the competition level of the players of each club is comparable from results of the tournament. And player numbers for each club is 23 players in A school, 19 players in B school and total is 42 players.

We analysed the daily data which managers of these schools fill out on a regular basis. Investigation period is 12 months from June 2011 to May 2012. Matters of daily data is date, player's name, method of treatment, site of onset of sports injuries, practice content and practice time.

Injury site

We show the incident number of injury per site in Figure 1. Horizontal axis represents injury site, and vertical axis represents incident number. Incidence number of the total is 317. As shown in Figure 1, sum of femur, knee, cruris and ankle is 218 and accounts for 69% of the total. As above, it is characterized of sports injury of basketball that incidence of sports injuries of lower limb (four sites of the particular) is high. So, we analysed and deliberate about above sports injuries of the above four site in this research.

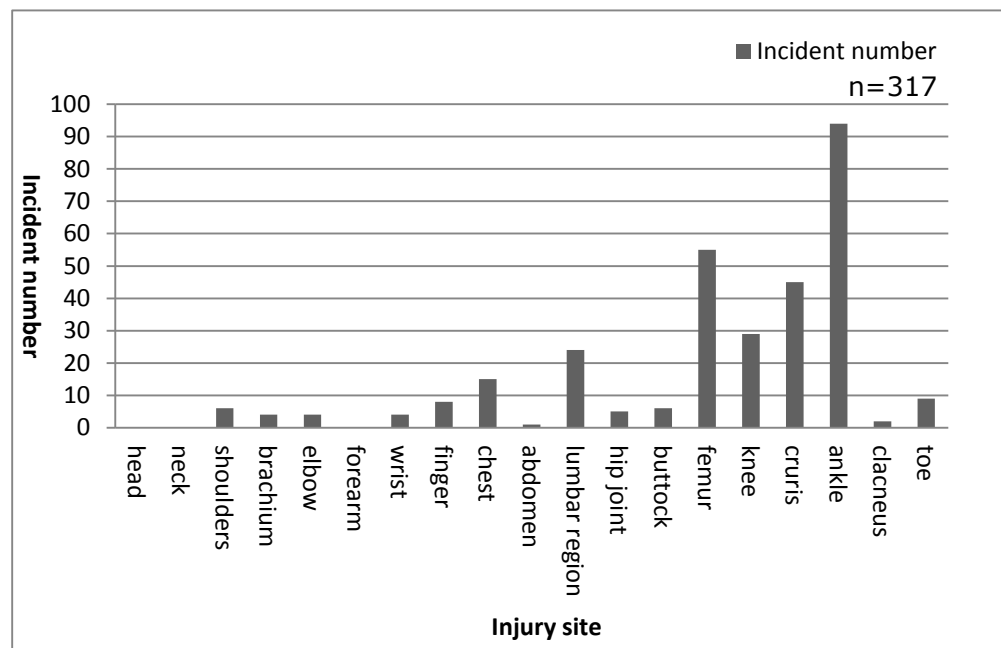
Practice content

In this research, we call practice which you use ball playing characteristics. And we call practice which you don't use ball common training.

In addition, we classify playing characteristics into three types. These are game format (BG), run training (BR) and skill up (BS). And we also classify common training into three types. These are run training (CR), making behaviour (CP) and core training (CT). (Words in parentheses are abbreviations.)

In addition, we set intensity in consideration of the load on the body under the cooperation of above sports trainer. In other words, this intensity is "A measure indicating how much hard of practice".

Figure 1. incident number of injury per site



Preanalysis

As preanalysis using multiple regression analysis, result of "Common training has a strong influence on the onset and prevention of sports injuries" and "About onset of sports injuries of muscle, practice time has a great influence, but influence of the other factors is small." has been revealed.³ And according to Kuzuhara², it has been reported numerically that practice or game in the overcrowded schedule increase the risk of sports injury. So, in order to explore what training lead to onset and prevention of sports injury, in this research, we using logistic regression analysis and poisson regression that are a typical technique of count data analysis. We will described in detail of analysis later.

METHODS

Logistic regression analysis

Calculated logistic regression equation

In this research, we used the statistical processing software SPSS21.0 to calculate logistic regression equation. The objective variable is incident number of sports injuries and the candidates for the explanatory variables are training intensity, average temperature in practice time, temperature change during practice, temperature difference between the day and the day before, practice time and dummy variable of high school. (It is expected to be related to onset of sports injuries.) And we selected by forward selection method and calculated regression equation.

Consideration method

It is generally to use odds ratio for consideration to logistic regression analysis. However, this method has following two problems.

1. It is possible to read whether changes in the explanatory variables affect to increase or decrease in the incidence from odds ratio but it is difficult to read specific values how much it increase or decrease incidence.
2. About event whose incidence is high to the same extent, it is difficult to judge cause of increasing incidence is "Explanatory variables of a certain one is a significant impact" or "Explanatory variables of multiple mutually influence little by little and the incidence increase by its technology together".

In order to solve these two problems, we use the method by Takada⁴ in this research. We will describe in detail of analysis later.

About problem 1, we did following variation of logistic regression equation.

$$\begin{aligned} P(z) &= P(x_1, x_2, \dots, x_n) \\ &= \frac{1}{1 + \exp\{-(\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n)\}} \\ &\doteq P(0) + \frac{dP}{dz} \Big|_{z=0} \cdot z \end{aligned}$$

$$\text{Here, } P(0) = \frac{1}{2}$$

In addition,

$$\text{from } \frac{dP}{dz} = \frac{1}{\{1 + \exp(z)\}^2}$$

$$\frac{dP}{dz} \Big|_{z=0} = \frac{1}{4}$$

$$\text{So, } P(z) \doteq \frac{1}{2} + \frac{1}{4} \cdot a + \frac{1}{4} \cdot \beta_1 \cdot x_1 + \frac{1}{4} \cdot \beta_2 \cdot x_2 + \dots + \frac{1}{4} \cdot \beta_n \cdot x_n \quad (1)$$

Only, $(x_1, x_2, \dots, x_n) = (x_1, x_2, \dots, x_n | z=0)$

(β_i is regression coefficient)

Formula (1) corresponds to equation which is done Taylor expansion in the neighborhood of $z=0$ and take the first-order approximation.

As a result, it can be seen that the probability P is changed of the value of the 1/4 times the regression coefficient if explanatory variable increase 1 unit.

About problem 2, we did following variation of logistic regression equation.

$$P(z) = P(x_1, x_2, \dots, x_n) \\ \doteq \frac{1}{2} + \frac{1}{4} \cdot \beta_1 \cdot x_1' + \frac{1}{4} \cdot \beta_2 \cdot x_2' + \dots + \frac{1}{4} \cdot \beta_n \cdot x_n' \quad (2)$$

Only, $x_i' = x_i - x_{i0} \doteq x_i - \bar{x}_i$
 (β_i is regression coefficient)

After that, if the cases whose incidence is top three in each injury site, we calculate $\frac{1}{4} \cdot \beta_i \cdot x_i'$ for each explanatory variable of these. And we consider visually by radar charts we made out based on the value.

Poisson regression analysis

Calculated logistic regression equation

In this research, we used the statistical processing software SPSS21.0 to calculate poisson regression equation. Similar to logistic regression analysis, the objective variable is incident number of sports injuries and the candidates for the explanatory variables are training intensity, average temperature in practice time, temperature change during practice, temperature difference between the day and the day before, practice time and dummy variable of high school. (It is expected to be related to onset of sports injuries.) And we selected by Newton-Raphson method and calculated regression equation.

Consideration method

About poisson regression, we considerate from regression coefficient. And in order to show the result of logistic regression isn't unique, we compared the result of poisson regression with the result of logistic regression.

RESULT OF ANALYSIS

Result of logistic regression analysis

We show the result of logistic regression analysis on table 1, table2, table3 and table4. And we show radar charts on Figure2, Figure3, Figure4 and Figure5.

Table 1. The value of regression coefficient and odds ratio (femur)

femur	BG	BS	CR	temperature	temperature change during practice	temperature difference between the day and the day before	practice time	constant term
β	-0.066	0.194	0.079	0.109	-0.353	-0.175	0.532	-4.429
$\beta/4$	-0.016	0.049	0.020	0.027	-0.088	-0.044	0.133	-1.107
odds ratio	0.936	1.214	1.082	1.116	0.703	0.840	1.702	0.012

Table 2. The value of regression coefficient and odds ratio (knee)

knee	high school (A:0, B:1)	BG	CR	CP	CT	temperature difference between the day and the day before	constant term
β	1.192	0.055	-0.119	0.043	-0.029	-0.296	-0.865
$\beta/4$	0.298	0.014	-0.030	0.011	-0.007	-0.074	-0.216
odds ratio	3.295	1.057	0.888	1.044	0.972	0.744	0.421

Table 3. The value of regression coefficient and odds ratio (cruris)

cruris	temperature	temperature difference between the day and the day before	practice time	constant term
β	-0.099	-0.165	0.348	0.033
$\beta/4$	-0.025	-0.041	0.087	0.008
odds ratio	0.906	0.848	1.416	1.034

Table 4. The value of regression coefficient and odds ratio (ankle)

ankle	high school (A:0, B:1)	BG	BR	CR	CT	temperature difference between the day and the day before	constant term
β	-2.989	-0.065	-0.187	-0.116	0.062	0.217	3.154
$\beta/4$	-0.747	-0.016	-0.047	-0.029	0.015	0.054	0.789
odds ratio	0.050	0.937	0.829	0.891	1.064	1.242	23.434

Figure 2. Rader chart (femur)

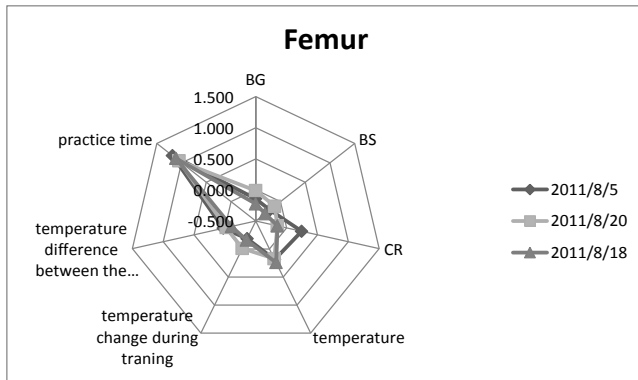


Figure 3. Rader chart (knee)

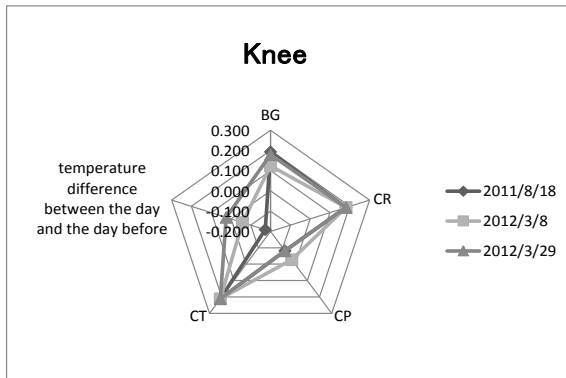


Figure 4. Rader chart (cruris)

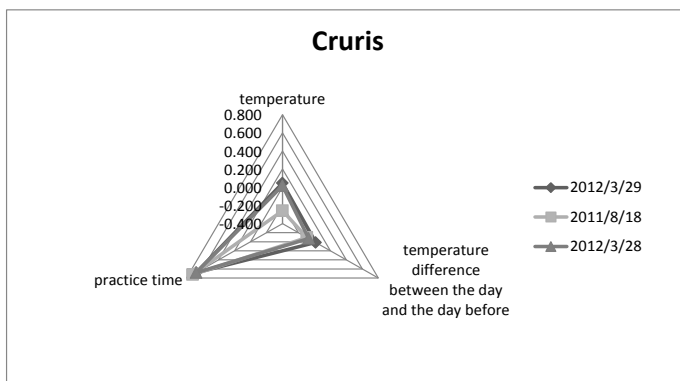
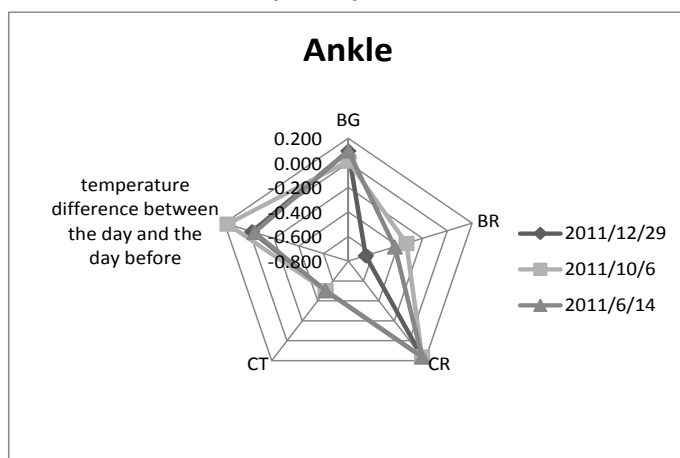


Figure 5. Rader chart(ankle)



Result of logistic regression analysis

We show the result of poisson regression analysis on table 5, table6, table7 and table8.

Table 5. The value of regression coefficient (femur)

femur	constant term	BS	CR	temperature	temperature change during practice	practice time
β	-3.356	0.116	0.046	0.084	-0.231	0.214

Table 6. The value of regression coefficient (knee)

knee	constant term	high school (A:0, B:1)	CR	CP	CT	temperature difference between the day and the day before
β	-0.332	-0.442	-0.080	0.020	-0.015	-0.169

Table 7. The value of regression coefficient (cruris)

cruris	constant term	temperature	temperature difference between the day and the day before	practice time
β	-0.509	-0.069	-0.134	0.205

Table 8. The value of regression coefficient (ankle)

ankle	constant term	high school (A:0, B:1)	BG	BR	CR	CT
β	0.160	0.387	-0.013	-0.049	-0.033	0.010

CONSIDERATION

Consideration of logistic regression analysis

Sports injuries of muscle (femur and cruris)

From Table 1 and Table 3, we revealed practice time has greatly affection by onset of sports injuries of muscle and other factors have less. From Figure 2 and Figure 4, we can find same thing because only practice time is plotted on the outside and other factors are plotted in the vicinity of 0. Further, as above, the same result is found by multiple regression analysis. In addition, we can find the

dummy variable of high school (it was one of the candidates of explanatory) isn't selected as the explanatory variable. So, the difference isn't seen between this two high schools. We consider they are cause that players in these high schools train almost same menu and there is little difference to the competition level.

Sports injuries of joint (knee and ankle)

From Table 2 and Table 4, we can find the dummy variable of high school is selected as the explanatory variable. So, the difference is seen between this two high schools. However, as above, players in these high schools train almost same menu and there is little difference to the competition level. Therefore, it is considered the difference of onset of sports injuries of joint cause by external factors such as the climate of each region. Also, we revealed run training (BR, CR) effects on prevention of sports injuries from Table 2 and table 4. However, looking at Figure3 and Figure 5, both common to high incidence case, effect of run training (CR) is big. In other words, we can read run training (CR) is increasing factor of incidence. But, looking carefully, this is not single factor and game format (BG) and core training (CT) on Figure 3 or game format (BG) and temperature difference between the day and the day before have big effects.

From the above, it is effective in the prevention of sports injuries that you perform run training only, but if you combine with practice of game format, it varies to the factor of increasing incidence of sports injuries.

Consideration of poisson regression analysis

Sports injuries of muscle (femur and cruris)

From Tables 5 and 7, we can find length of practice time is greatly affected by the onset of sports injuries of muscle and the influence of other factors is small. This is similar results of logistic regression and multiple regression. In addition, we can find the dummy variable of high school isn't selected as the explanatory variable in poisson regression, too. So, the difference isn't also seen between this two high schools.

Sports injuries of joint (knee and ankle)

From Table 6 and Table 8, we can find run training (BR, CR) effects on prevention of sports injuries. This is the same result of logistic regression.

From the above, we can revealed same results from logistic regression and poisson regression.

CONCLUTION

The purpose of this research is to alert the coaches or players by revealing the factors leading to onset and prevention of sports injuries and proposing the preventive measure. So, we used logistic regression analysis and poisson regression analysis and revealed following two results.

1 Keeping from excessive training is the most simplest and effective method of preventing sports injuries of muscle.

2 Run training is effective in preventing of sports injuries of joint. But, it varies to onset factor of sports injuries by doing at the same time it and training of

different purpose. So when doing run training, you have to do only it and you must not do it along with training of different purpose.

In future work is following.

Considering why the difference came out in these high school only by sports injuries of joint.

Revealing more specific preventive measure by analyzing in consideration of mechanism of injury.

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DECISION-SUPPORT FOR RESPONSIBLE RISK HANDLING IN LOGISTICS AGGLOMERATIONS

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ABSTRACT

Due to the fact that risks are part of every business operation and can never be avoided completely, the responsible design of supply chains requires the examination of safety aspects and the risk-sensitivity of all partners within the supply chain. Additionally, supply chains experience further risk exposure for their business activities owing to the fact that changes in the business environment emerge more rapidly (Schneck 2010).

The handling of negative impacts arising from unforeseen risk events poses an especially great challenge for supply chains. Such negative impacts may disrupt supply chains or can even lead to their complete destruction.

Therefore, our research is focused on rapidly coping with arising risk impacts through decision-support in the case of unforeseen risk events.

INTRODUCTION

The increasingly dynamic and unpredictable environment of supply chains have led to disruptions of the material and information flows in numerous supply chains. Various examples prove that the survival of supply chains can be endangered by the occurrence of unforeseen events in the supply chain (Ziegenbein 2007). Therefore, it becomes apparent that not only catastrophic events lead to serious threats for supply chains. In fact, these situations can also arise from minor problems in a supply chain like a machine failure or a supplier's planning error (Waters 2011, Ziegenbein 2007). In order to manage the resulting negative impacts and to ensure the value added activities, decisions have to be made under great time pressure and under consideration of many uncertain influences, leading to a requirement for effective decision-support. Decision support aims at enhancing the decision-making process by accelerating reaction times, thus allowing to rapidly cope with risks and their impacts.

In this paper, a responsible risk-related design of supply chains is presented by focusing on the enhancement of the supply chain resilience. To this end, the conceptual design of a decision-support model is presented which aims at accelerated decision-making in case of unforeseen events. In this context, decision-making in regard to risk-related coping strategies requires the comprehension of (i) the process of decision-making, (ii) the decision situation and (iii) the knowledge about different possible action strategies.

The conceptual design of the decision-support model has a modular structure. Based on the specified formulation of the pursued objectives, the different modules are illustrated in the paper and consolidated into a composite methodology.

Freight villages as a special kind of logistics agglomeration, are in the centre of our attention. These represent infrastructural linking points of transport in logistics networks and provide resources for the execution of cross-company value added processes (Sucky 2008).

LITERATURE REVIEW

As mentioned above, the requirement for decision-support in the case of unforeseen events is justified by the potential consequences of supply chain disruptions. In general, decision-support is defined as the execution of measures for the improvement of the decision efficiency (Pfohl 1977), which includes the enhancement of the decision quality as well as the reduction of the effort required in reaching a decision (Lassmann 2006). Therefore both the supply of decision-makers with information as well as the information processing is of great importance (Klesse et al. 2003). To achieve differentiated and careful decision-making, actual and reliable information is essential, as these contribute to taking the right measures and avoiding incorrect decisions in such situations of rapidly coping with risks impacts while reducing economic losses. By rapidly coping with risks, decision-support also aims at a resilient design of supply chains. In this context, resilient refers to the ability of a system to return to an original state or a new, more desirable state after the occurrence of an unforeseen event (Pfohl et al. 2010, Christopher and Peck 2004).

In order to provide concrete support of accelerated decision-making in the context of performing the correct measures for risk response, an understanding of the basic decision-making process is required. Based on Heinen (1992), this process consists of the elementary stages will-formation and decision-implementation. The will-formation stage comprises the phases planning and decision. The planning and decision process can be further subdivided into the activities problem recognition, detection of action alternatives and evaluation of action alternatives as well as the choice of an alternative action and in fact the decision-making (Domschke and Scholl 2005). The decision-implementation stage comprises the realisation and control phase with the realisation and application of a decision as well as monitoring the accomplished results and the adaptation of measures if necessary (Lassmann 2006). The context is shown in Figure 1.

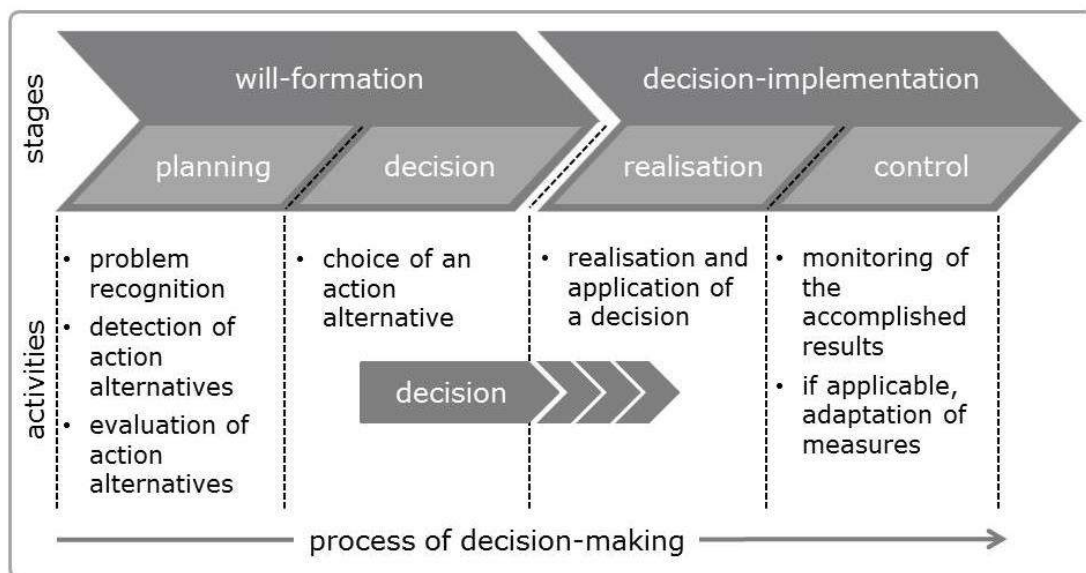


Figure 1: Process of decision-making

The decision-making process's strength mainly lies in acting as a guideline for structuring the arising activities, rather than simply sequentially transferring the individual phases and activities. It also serves as a base for the development of decision comprehension.

Is there a need for information and hence an informational deficit in a decision situation, the decision itself can only be made under great risk. The improvement

of the decision situation is then possible, when an early convergence of informational supply, demand and need exists (Gluchowski et al. 2008).

This is the point, at which decision-support can assist: if actual and crucial information is available and pre-processed in a problem-specific fashion during the stage of decision preparation and therefore during the phase of will-formation, this information can directly be of use. Furthermore this information may be conducive for an established decision base, which in turn accelerates decision-making and allows for faster reactions.

Thus, in the context of unforeseen events in supply chains and the subsequently arising risk situations, decision-support requires decision-makers to be supplied with actual, reliable and risk-relevant information and to be in a position of processing this information. These activities lie within the scope of supply chain risk management.

In literature, a manifold of definitions regarding the term supply chain risk management exist. To avoid dwelling on different definitions, in this paper, we follow the definition of this term as described by Diederichs (2012) and Gleißner (2011) in which supply chain risk management is defined as a systematic, cross-company and collaborative handling of supply chain risks and includes all strategies, measures and processes, which deal with the identification, the assessment, the handling and the control of supply chain risks. Supply chain risk management aims at the avoidance of undesirable consequences resulting from supply chain risks, through the establishment of transparency over a risk situation as well as the realisation of adequate measures for the avoidance or the limitation of the supply chain vulnerability against risks.

At the decision-level, a subdivision into strategic and operational supply chain risk management is carried out (Servatius 2006). In principle, strategic risk management aims at the increase of the company or the supply chain value (Gleißner 2011), while operational risk management addresses business processes and focuses on the capture of risk sources, causes of damage and the resulting impacts (Romeike 2003). The systematic handling of risks within the scope of operational risk management is supported through the risk management process, which comprises the already named phases of risk identification, risk assessment, risk handling and risk control (c. f. Diederichs 2012, Romeike 2003). However, a systematic handling of risks is not equivalent to a responsible handling of risks. In the following, responsible supply chain risk handling is referred to as the conscious knowledge about supply chain risks and the perception of responsibility in terms of an active configuration of a supply chain in order to maintain the value of a supply chain and to ensure the long-term survival of a supply chain. While the awareness of risks implies that a decision-maker considers risks in his actions and knows that risks can arise through his actions (Falkinger 2007), responsible risk handling takes a further step and includes the anticipation of decision consequences, target-oriented actions and the execution of appropriate risk-related measures. The accuracy of consequences can be estimated more accurately, when a larger amount of risk-relevant information is available. This can be achieved by decision-support. The scope of application in regard to the responsible handling of risks comprises all phases of the supply chain risk management process. While the awareness of risks is definitely available, the actual state of the realisation and establishment of risk-related measures allows a margin for further improvements (c. f. Löffler et al. 2011, Kersten et al. 2008).

Furthermore, it is remarkable, that in literature in the context of supply chain risk management, the handling of risk impacts is rarely considered and most of the discussed measures for risk management refer mainly to the phase of risk identification with the issues of problem definition and classification of supply chain risks. Literature also often focuses on the transfer of general risk management knowledge in the context of supply chains. Comprehensive concepts covering practical applications are only available in an early development phase

(Pfohl et al. 2010). Besides this, Wagner and Bode (2007) determine that the handling of risk impacts rarely attracts interest in literature and most of the discussed measures lie in the scope of risk handling, usually specifically referring to risk avoidance and risk reduction within this scope. Publications, which examine interruptions in supply chains, are generic and abstract and present little information on how to handle these interruptions, either in the short-term or the long-term (Blackhurst et al. 2005).

Besides this, also dynamic aspects of risk factors and their variation in time are rarely regarded (Winkler and Kaluza 2007). However, in the context of supply chains, a dynamic examination is necessary, because risk impacts continue over the supply chain partners and increase economic losses (Jüttner et al. 2003).

The attention of our research is focused on a responsible risk-related design of supply chains, which is achieved by examining the potential negative risk impacts and aims at coping with risks within the scope of operational supply chain risk management. For that purpose, the conceptual design of a decision-support model is presented. This model aims at accelerated decision-making in the case of unforeseen events occurring. To this end, freight villages, which are a special kind of logistics agglomeration, are regarded. Freight villages are especially suited for this, due to the fact that they are integrated in multiple supply chains. If an unforeseen event arises within a freight village, the efficiency and the success of many supply chains are affected, because these depend on the weakest link within the supply chain (Poluha 2010).

CONCEPTUAL FRAMEWORK

The conceptual framework aims at the support of decision-making in order to efficiently cope with risks in freight villages after the occurrence of unforeseen events. Through accelerated decisions and therefore accelerated reactions, the extent of loss should be kept as low as possible and the value adding processes should be ensured.

As already explicated, an early convergence of informational supply and demand, caused by a lack of information, is important for decision-support. Referring to the occurrence of unforeseen events, detailed information on the decision situation is necessary. On the one hand, uncertainties in the context of future events, activities and decisions arise, which make a decision situation complex. On the other hand, developing dynamics that arise from unforeseen events have to be controlled, which means that the effects of negative variations must be mitigated.

To reduce complexity, actual, risk-relevant and problem-specific information must be provided (Eisenführ and Weber 2003). A further reduction of complexity can be achieved by structuring the decision situation (Grünig and Kühn 2013).

Dynamics are comprised of variations of the decision elements. These are: objectives, preferences, action alternatives, states of nature and consequences (Eisenführ and Weber 2003), as well as interdependencies between them. Furthermore, dynamics can arise through variations in time. In this context, the possibility of flexible adaptations of measures, the possibility of taking further measures and the development of an action strategy as reaction to arising variations has to be given.

Altogether, through (1) the availability of risk-relevant information as well as (2) the structuring of a decision situation under consideration of (3) interdependencies and (4) of variations in time, a rapid functionality of processes and infrastructure, as well as the reduction of negative consequences in freight villages can be ensured in case of unforeseen events. Simultaneously, incalculable and great costs can be avoided or at least kept as low as possible. Thus, four modules have to be considered by describing and analysing the decision situation.

The subsequent insights, resulting by applying the four methodological modules, build the base for the generation of action alternatives in case of the occurrence of unforeseen events.

In a nutshell, the aim of coping with risks lies in the scope of supply chain risk management and within this in the phase of risk handling. Supply chain management builds on decision theory, which describes the decision-making process and the executing steps within this process. Within the scope of risk management, the modular methodology for decision-support determines the individual steps required to achieve an accelerated risk response resulting from the generated action alternatives. As a result, decisions regarding measures to be taken for eliminating or reducing risks can be obtained. The general context is shown in Figure 2.

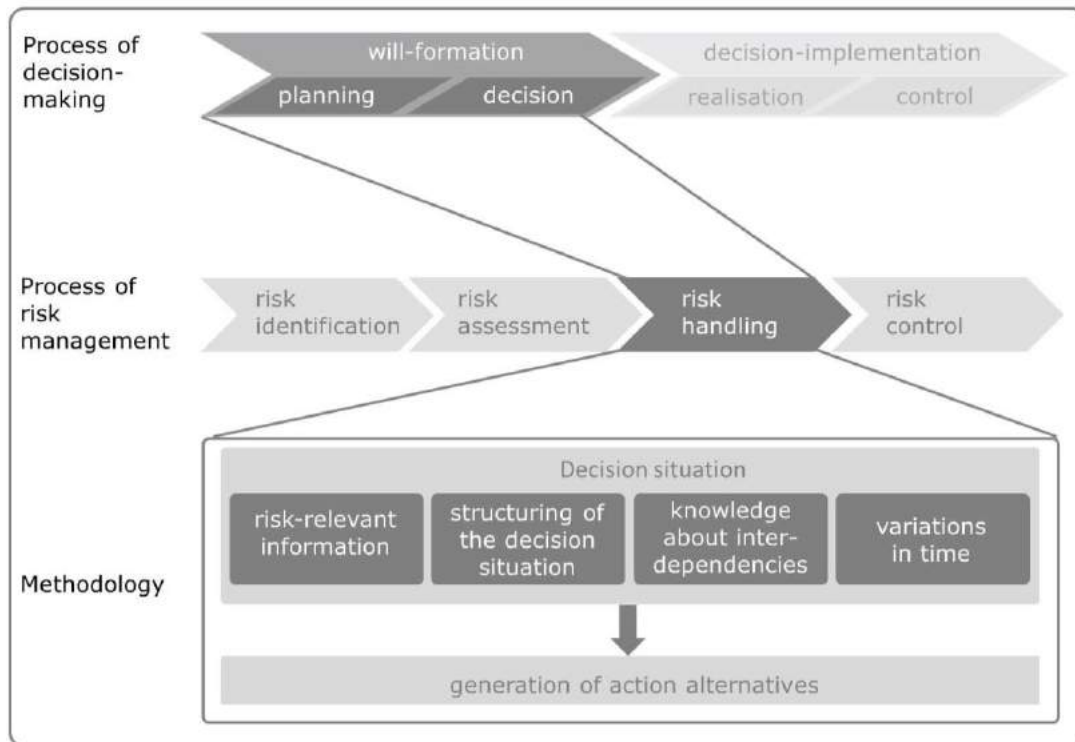


Figure 2: Conceptual framework supporting decision-making for risk response

Regarding the four modules, information has to refer to different aspects. By taking a static view as a basis, aspects of the relational structure like organisational structure, capacities, performance and functionalities are in the foreground. By considering variations in time, the process structure lies in the foreground and dynamic aspects like the operational structure and the flow of goods, which describe the way in which goods travel through a system, are reflected.

Referring to freight villages, information about actors located within the freight village, the resources and infrastructures as elements of the relational structure as well as information regarding logistics processes and information about the goods themselves as elements of the process structure are risk-relevant. All elements provide different risk-relevant attributes. The operational structure supplies information about the interdependencies between the elements of the relational structure and also allows statements in regard to temporal aspects. For gathering, preparing and providing information, two freight villages and multiple involved companies are available for analysis within our research.

CONCLUSION

The purpose of our research is the support of decision-making in freight villages thus improving their resilience towards unforeseen events and the resilience of complete supply chains using integrated freight villages for their value adding activities.

Hence, in this paper, the focus lies on a conceptual framework for risk response. The conceptual framework aims at the support of decision-making to efficiently cope with risks in freight villages after the occurrence of unforeseen events. Through accelerated decisions and therefore accelerated reactions, the extent of loss should be kept as low as possible and the adding value should be ensured. By allowing for accelerated decisions, which in turn lead to accelerated reactions, the extent of loss can be minimized while ensuring that value adding processes can continue to take place.

The aims can be achieved within the scope of supply chain management by applying different modules on the basis of decision theory and especially through the process of decision-making. In doing so, the modules refer (1) to the availability of risk-relevant information, (2) to the structuring of decision situations, (3) to the consideration of interdependencies and (4) to the variations in time. The subsequent insights, build the base for the generation of action alternatives that can be used in case of the occurrence of unforeseen events.

In a next step, the choice of methods for implementing the different steps for risk response, described by the methodology modules, will be performed.

Thus, special emphasis lies on developing of the decision-support model, which has to represent the operational and organisational structure of freight villages. This will be done with the help of simulation methods. It will subsequently be possible to evaluate and assess different uncertain developments in freight villages after the occurrence of unforeseen events as well as apply different action strategies as reactions to these events. Also, interdependencies between different risks and domino effects can be elaborated and considered in the simulation.

The subsequent insights build the base for the generation of action alternatives. To allow for flexible adaptations of a decision strategy, the action alternatives will be incorporated into interactive standard operating procedures, which can be used by a responsible person in a freight village. That person will be guided to an appropriate course of action and as such will be able to accelerate the necessary decision-making processes by following a path of yes/no questions about the unforeseen event that has occurred.

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Section 5: Inventory and Warehouse Management

PRICE SETTING STRATEGIES FOR PERISHABLE PRODUCT AT THE FARMER'S MARKET

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ABSTRACT

This paper concerns with price strategies of Small-scale trader for perishable product under price control of Large-scale trader. If Small-scale trader follows Large-scale trader's lower price strategy, total sales will decrease. On the other hand, if Small-scale trader choice high price strategy against Large-scale farmer, consumer will show unfavourable and unacceptable attitude. In this paper, we present the price setting problem of Small-scale farmer in Farmers' Market and present mathematical model to analyse the problem. We present some numerical examples representing potential consumers and numerical experiment on a certain consumer-product matching process.

Keywords: Fresh Foods, Supply Chain Management, Inventory Theory

INTRODUCTION

Recently, Farmer's Market has obtained much attention in Japan, where fresh agricultural products are traded between farmers and consumers. At the market, decision making on management, e.g. production, sales and inventory, is primarily responsible of farmers. However, these have been executed according to their experience and leaders opinion without theoretical background.

Takeno et al. (2013b) carried out a questionnaire investigation and showed some analysis on farmers' decision making process. Through the investigation, they have clarified that farmers can be categorized into three groups according to their production size. Price setting of Medium-scale farmers is almost same with average price of the market. Those of Large-scale farmers and Small-scale farmers are lower than average and higher than average respectively. The reason is explained as Large-scale farmers prevent themselves from holding dead stock of perishable products. We have focused on the strategy of Small-scale farmers. As number of their products on hand is limited little, they have to set higher unit price to achieve higher income. On the other hand, expensive unit price is unfavourable and unacceptable by consumers. Therefore, it is important to seek highest unit price favoured and accepted by consumers as the market strategy for Small-scale farmers.

The problem is apparently same with Newsboy problem. However, Newsboy problem model cannot directly apply to the problem because expected demand distribution is different. In general, random variable of demand distribution is described as number of demand where price becomes the random variable in the problem. Therefore, Newsboy problem cannot be apply to the problem.

Purpose of this paper is to present rationality of small-size farmer's decision and strategies. First of all, we build a mathematical model characterized with introducing stochastic process in consumers purchasing price. We present some numerical examples representing potential consumers and numerical experiment on a certain consumer-product matching process.

FARMERS' MARKET

Farmers' markets have become an important distribution channel for fresh agricultural products in Japan during the last two decades. Farmers sell their products directly to consumers at a store. Because the person who produced the product might be readily

known or identifiable, the products satisfy consumer demands related to food safety. In Japan, such stores are called Sanchoku, which means direct sales at production areas. Farmers' markets require the participation of customers, farmers and a manager who is a representative of farmers and the shop. Shelves inside the shop are assigned to farmers. Farmers prepare and manage their products on these shelves. Customers come to the shop and select products from these shelves. They make payments to a cashier, as in a supermarket, while farmers are able to work and spend time performing farming tasks. Occasionally, farmers visit the store to confirm the inventory. If the stock level dips below a certain level, farmers can replenish the products. After closing the store, the manager calculates the total sales for the day and informs each farmer of the total sales. Farmers must determine their own production, shipment, sales and other operation parameters. However, the core competency of farmers is agricultural production, especially for Medium-scale and Small-scale farmers. Hence, they have insufficient knowledge and methods to manage their businesses in farmers' markets. A certain amount of support for their store business is necessary to manage and run the store. Utilization of an information system can be a beneficial solution.

SMALL-SIZE FARMER'S PRICE MODEL

Suppose a farmers' market in which customers buy product A. There are two farmers belongs to the market. One farmer is Farmer F_1 who is a Large-scale farmer. And the other is Farmer F_2 who is a small scale farmer. Consumer C_i , $i = 1, 2, \dots, n$, has upper limit U_i on the price to buy product A. U_i is a random variables and has normal distribution with parameter μ_c and σ_c . Let P_1 and P_2 be a price of A produced by large scale famer F_1 and F_2 respectively. According to Takeno et al. (2013b), Large-scale farmer has tendency to set price lower than the other. Therefore we have $P_1 \leq \mu_c < P_2$. Let S_1 and S_2 be shipping volume of product by farmers F_1 and F_2 respectively. From the definition, S_2 is much smaller than S_1 , $S_2 \ll S_1$. Let ρ be a ratio of production amount of F_2 to that of F_1 , $\rho = F_1/F_2$. We have $0 < \rho < 1$. In actual farmers' market, ρ is expected to about 0.01.

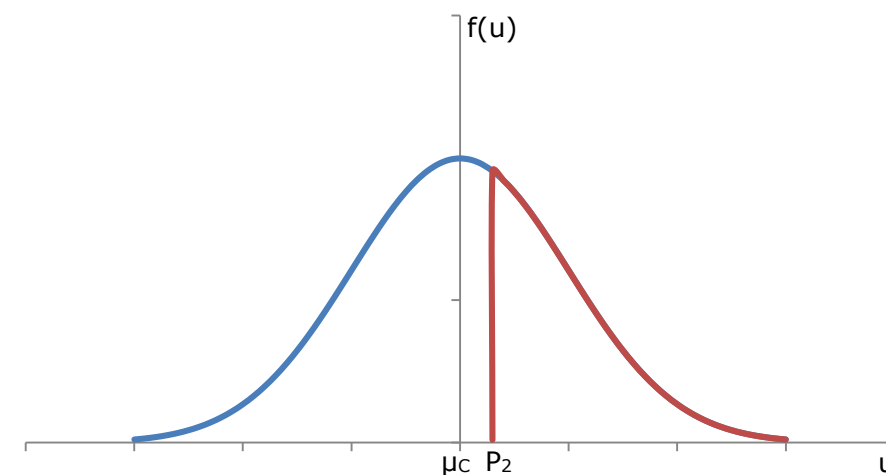


Figure 1 Relationship among P_1 , μ_c and P_2

Figure 1 shows relationship among P_1 , μ_c and P_2 . Horizontal axis and vertical axis show price and probability density of $P(U_i < u)$, respectively. Upper limit price U_i distributes as blue line, partially covered with red line. As P_2 , price of product a by farmer F_2 , is larger than μ_c , probabilities of sales on F_2 is limited to the area enclosed by red lines. In other words, probability indicated with the enclosed area corresponds to the opportunity to sell for farmer F_2 .

The model presents relationship between U_i and P_2 . If P_2 gets large, then price of each product get higher. However, number of sold product get smaller as the area enclosed

with red line gets smaller. On the other hands, if P_2 gets smaller, then price of each product get lower. And number of sold will increases. The problem is to seek suitable price P_2 to obtain the highest sales for farmer F_2 . As ρ is set to be a small value, the P_2 will not affect sales of farmer F_1 . The problem seems to be a Newsboy problem, see for example Hiller and Lieberman (2010). However, price of the product A is given as random variable in the problem though number of demand is given in the Newsboy problem.

NUMERICAL EXAMPLES ON POTENTIAL CONSUMERS

We set $\mu_c = 1000$ and varies σ_c from 25 to 150. Table 1 shows relationship between σ_c and P_2 . Each lines and column corresponds to price P_2 and σ_c respectively. Figure 2 shows this relation. As price P_2 increases, the probabilities to sell decreases. Note that expectation number of sold is product of the probability and inventory at the market, i.e. (S_1+S_2) . Therefore, product of farmer F_2 can be sold out if ρ is small enough. In fact, the probability becomes more than 0.02 under condition of $P_2 = 1200$ and $\sigma_c = 100$. The value 0.02 means that two times of S_2 will be sold if $\rho = 0.01$.

Table 1 Probabilities of demands according to sales price P_2 ($\mu_c = 1000$)

p_2	σ_c					
	25	50	75	100	125	150
1000	0.500000	0.500000	0.500000	0.500000	0.500000	0.500000
1050	0.022750	0.158655	0.252493	0.308538	0.344578	0.369441
1100	0.000032	0.022750	0.091211	0.158655	0.211855	0.252493
1150	0.000000	0.001350	0.022750	0.066807	0.115070	0.158655
1200	0.000000	0.000032	0.003830	0.022750	0.054799	0.091211
1250	0.000000	0.000000	0.000429	0.006210	0.022750	0.047790
1300	0.000000	0.000000	0.000032	0.001350	0.008198	0.022750
1350	0.000000	0.000000	0.000002	0.000233	0.002555	0.009815
1400	0.000000	0.000000	0.000000	0.000032	0.000687	0.003830

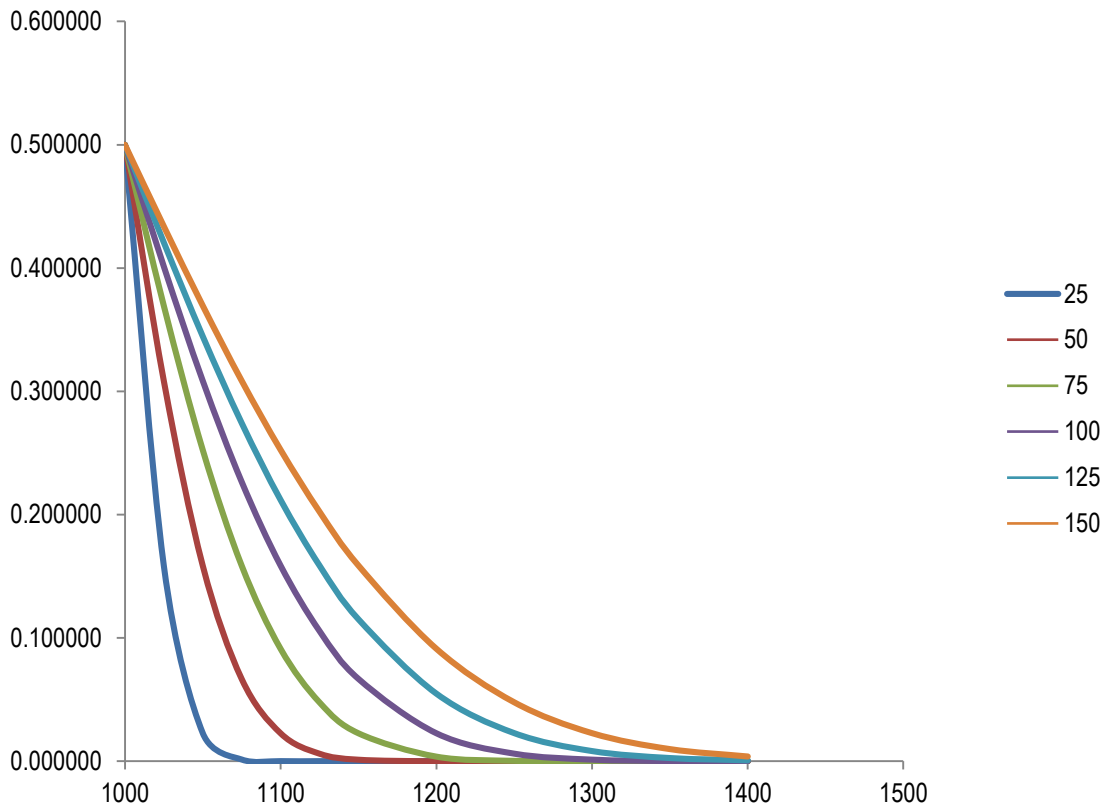


Figure 2 Setting price and probabilities to sell

Ignoring consumer's detailed purchasing process, e.g. choice of products at the shelf, product of F_2 can be sold out according to conditions of parameter ρ and σ_c . Table 2 and 3 shows relationship between the potential and parameters ρ and σ_c where $P_2 = 1200$ and $P_2 = 1150$. Rows and columns correspond to parameter ρ and σ_c respectively. Each cell presents a ratio of the probability, shown in Table 1, to production ratio ρ . If the value is larger than 1, corresponds to yellow colored cell, expected number of sold product A is greater than S_2 . We can see there is opportunity to sell the product at higher price for Small-scale farmer F_2 according to the condition of high variance or smaller ρ .

Table 2 Range of potentially sold out on F_2 ($P_2=1200$)

ρ	σ_c					
	25	50	75	100	125	150
0.01	0.000000	0.003167	0.383038	2.275013	5.479929	9.121122
0.02	0.000000	0.001584	0.191519	1.137507	2.739965	4.560561
0.03	0.000000	0.001056	0.127679	0.758338	1.826643	3.040374
0.04	0.000000	0.000792	0.095760	0.568753	1.369982	2.280280
0.05	0.000000	0.000633	0.076608	0.455003	1.095986	1.824224
0.06	0.000000	0.000528	0.063840	0.379169	0.913322	1.520187
0.07	0.000000	0.000452	0.054720	0.325002	0.782847	1.303017
0.08	0.000000	0.000396	0.047880	0.284377	0.684991	1.140140
0.09	0.000000	0.000352	0.042560	0.252779	0.608881	1.013458
0.10	0.000000	0.000317	0.038304	0.227501	0.547993	0.912112

Table 6 Number of sold products and effects of ρ and σ_c ($P_2=1150$)

ρ	σ_c					
	25	50	75	100	125	150
0.01	9 (9%)	11 (11%)	4 (4%)	7 (7%)	7 (7%)	7 (7%)
0.02	9 (5%)	10 (5%)	14 (7%)	13 (7%)	14 (7%)	18 (9%)
0.03	15 (5%)	20 (7%)	25 (8%)	8 (3%)	28 (7%)	26 (9%)
0.04	29 (7%)	25 (6%)	33 (8%)	19 (5%)	28 (9%)	32 (8%)
0.05	25 (5%)	31 (6%)	41 (8%)	32 (6%)	42 (7%)	29 (6%)
0.06	40 (7%)	38 (6%)	47 (8%)	38 (6%)	48 (8%)	34 (6%)
0.07	31 (4%)	45 (6%)	43 (6%)	42 (6%)	56 (8%)	54 (8%)
0.08	59 (7%)	54 (7%)	42 (5%)	52 (7%)	58 (7%)	50 (6%)
0.09	71 (8%)	58 (6%)	55 (6%)	60 (7%)	62 (7%)	60 (7%)
0.10	72 (7%)	67 (7%)	75 (8%)	53 (5%)	67 (7%)	69 (7%)

Table 5 and 6 shows the outcome of numerical experiment of $P_2 = 1200$ and $P_2 = 1150$ respectively. Each number and percentages noted in brackets correspond to number of sold product A by F_2 and ratio of sold products to holding products of the farmer F_2 . In the case of $P_2 = 1200$, percentages of sold products have distributed from 0% to 4% and the percentages seems to ignore effects of parameters ρ and σ_c . From the outcome, the effect of matching process much larger than it of parameters. We have to rearrange the matching process to see the effect of parameters. Unless it has low percentages, we can see that products of farmer F_2 have potential to be sold in higher price setting. In the case of $P_2 = 1150$, we have rather practical numbers of sold products. The percentages have distributed from 4% to 11%. We also have strong effect of matching process.

CONCLUSION

In this paper, we have focused on the price setting problem of Small-scale farmer. And we have proposed a mathematical model in which the upper limit price of each consumer is random variables. We have showed characteristics of the model and possibility to set higher price for Small-scale farmer. We have also carried out a numerical experiment. Through the experiment, we have showed that the possibility is much depends on consumer's behaviour and, therefore, expected sales of small-scale farmer is not enough high. Further considerations are necessary especially for consumer-product matching process. Model in this paper could not explain effects of parameters of distribution enough.

We are planning to extend the model of numerical experiment especially for consumer and product matching. With this modification, our future work is to estimate the most profitable price setting for Small-scale farmer. Matching process should be improved and varied. We have to consider farther situation and matching process between consumer and products. Furthermore, the price setting methodologies treating in this paper can be utilized on price setting problem another niche product. Investigation about such product is also our future work.

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CHARACTERISTIC ANALYSIS OF PRODUCTION AND INVENTORY PLANNING SYSTEM FOR MARINE FROZEN PRODUCTS: A CASE OF BLUE FINS

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ABSTRACT

The purpose of this paper is a characteristic analysis of current production and inventory planning system for frozen products of blue fins under the instability of the fishery caused by the warming of the earth and an indiscriminate fishing. For the analysis, a simulation is performed quoted by Vassian's production management theory. The result of the analysis is that the current system is aimed at minimizing a variation of the inventory at the end of the period.

INTRODUCTION

Simon proposed one inventory management models by a servomechanisms theory. One of them is illustrated from Figure 1 (Simon 1952). It is a feedback control system by the block system. The optimum inventory θ_I is input data, the actual inventory θ_o is output data and the difference between two data $\varepsilon (= \theta_I - \theta_o)$ is an error. An order θ_L is a disturbance of warehouse K_1 as a controlled object. An inventory controller K_2 determines a manipulated variable μ to minimize the difference ε and supplies to warehouse K_1 .

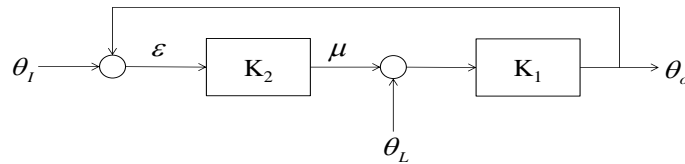


Figure 1: Inventory Management System (Simon 1952)

There have been researches about the production and inventory planning based on the model. He himself introduced a fixed interval ordering system in which production lead time was adopted to a manipulated variable μ of the model (Simon 1952). Vassian (1954) proposed a fixed interval ordering system quoted by a control theory too. In the model, an demand at period t is input and an inventory at the end of the period t is output. By the two assumptions, a block diagram can express the manufacturing flow which is an order, a production and an inventory in order. Equation (1) and Equation (2) are a mathematical model of the diagram. Equation (1) has four items such as a) accumulated demands predicated within next production lead time, b) production orders delivered for the future, c) inventories at the end of the period and d) safety inventories. The output is a production order of each period to minimize the variation of the inventory at the end of the period.

$$P_t = \sum_{i=1}^L \widehat{D}_{t,t+i} + \sum_{i=1}^{L-1} P_{t-i} - I_t + S \quad (1)$$

$$I_t = I_{t-1} + P_{t-L} - D_t \quad (2)$$

<Notation>

D_t : Demand at the period t

I_t : Inventory at the end of the period t

P_t : Production order indicated at the period t . It is delivered at the period $t+L$.

$\widehat{D}_{t,t+i}$: Future demand at the period $t+i$ predicated at the end of the period t

L : Production lead time+1

S : Safety inventory

Furthermore various studies have been performed based on Simon's model. For example, Katayama (1986, 1998) and Nishijima (1999) developed sub-models of the model, i.e. methodologies of a demand forecasting or a production ordering. Hirakawa (2003) extended the model to a multistep system. These outputs are mainly applied to manufacturing industry. And then, in recent years, an application range of the studies has been spread. For example, Chiyoma (2013) utilized Vassian's model to a supply chain on agriculture industry.

In this paper, the challenge is accepted and Vassian's model is tried to apply to marine frozen production industry. In particular, blue fins are focused. The reason is that Japan has the largest fishing and consumptions of it in the world. On the other hand, they have one urgent problem which is a lack of stability of the resources caused by the warming of the earth and the reckless fishing. Based on the background, an analysis of the current system of a marine frozen production and inventory is tackled in the following chapters.

PREVIOUS STUDY

Pall (1988) is recognized as one of the previous studies of our research. Focusing on a procurement activity of a processing factory under the influence of daily variation of fish catches in north Europe, it proposes a formularization of a production scheduling problem under the condition of the effect by linear programming. However, studies of a marine frozen production by the approach from a production management are not found except it.

RESRACH PROCEDURE

Research procedure of this paper consists of the four steps.

STEP1: Investigation of statistical data

From the annual report of statistical data on a distribution of aquatic products (Ministry of Agriculture, Forestry and Fisheries 2007, 2008, 2009, 2010 and 2012), three statistical data on a frozen production of blue fins, as the object of our research, are surveyed such as 1) a monthly amount of materials to plants, 2) a monthly amount of products from plants and 3) an inventory of products at the end of the month. The report is the result of the survey on a distribution of frozen aquatic products in the survey on a distribution of aquatic products. It is carried out by Ministry of Agriculture, Forestry and Fisheries in Japan. The object data of this paper are data from 2005 to 2009 before not only a modification of how to survey from 2010 but also the 2011 earthquake off the Pacific coast of Tohoku. A definition of blue fins is followed by the annual report. Namely, the category of blue fins consists of four kinds such as a long-finned tuna, a big eye tuna, a yellow fin tuna and others.

In order to analyze surveyed data, not only basic statistics but also a link relative is calculated to a monthly amount of materials to plants and a monthly amount of products from plants. Values of a link relative are given in the utilization process of a method of a link relative (Persons 1919). It is the ratio of each item at the period t of the series to the preceding item, which is item at the period $t-1$. A quantification of a change of an annual series' shape of the two surveyed data will be expected by the indicator.

STEP2: Construction of constructed models

Two constructed models are formularized to grasp the current of the object system. Previously, a performance of a production and inventory planning system is measured by a stability of input and/or output of the system. A representative indicator of the former is a variation of an indicated production order and that of the latter is a variation of an inventory at the end of the period (Nishijima 1999). Watanabe (2013) focuses on the facts and proposes a method to analyze the characteristic of the current system through the comparison among the current system, the model to minimize a variation of an indicated production order and

the model to minimize a variation of an inventory at the end of the period. This paper applies to the simple and essential analysis method too.

STEP3: Simulation of production and inventory system

In the simulation, a monthly amount of materials to plants investigated in Step 1 is considered as input data of two models constructed in Step 2. And an average and a standard deviation of an indicated production order and an inventory at the end of the period are calculated in the simulations by every model. Through the comparisons among current values and the results, a characteristic of the current system is analyzed.

STEP4: Discussion

Based on the result in the previous steps, the future direction of a production and inventory planning system of frozen blue fins products is discussed.

STEP1: INVESTIGATION OF STATISTICAL DATA

A monthly amount of materials to plants

Figure 2 shows time series of a monthly amount of materials to plants from 2005 to 2009. It is found that the time series go down year by year. In particularly, the minimum amount is reduced every year. An average of the monthly amounts is 31,545 ton in 2009 which is 88% of 38,322 ton in 2005.

There are some months which have large variation of the monthly amounts among five years. In particularly, the amounts on April and August in 2009 drop to a lower position but the amounts in 2005 are the most of amounts in five years. From the results, the variation of the monthly amount on each month is very large as shown in Figure 3.

Furthermore, Table 1 indicates link relatives every month among five years. It is found that a change of increase or decrease of the amount at a month against the amount at next month occurs during the investigated years.

Instability of the amount is confirmed based on the above analysis. A realization of maintenance of a capacity of a frozen processing line to overcome the burden will be needed.

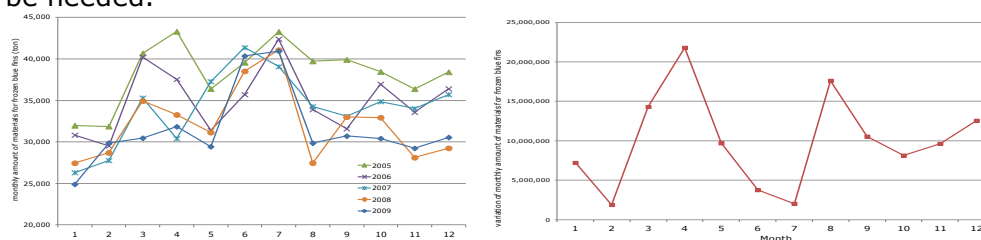


Figure 2: Time series of monthly amount of materials for frozen blue fins from 2005 to 2009 (Right side)

Figure 3: Time series of variation of monthly amount of materials for frozen blue fins among five years from 2005 to 2009 (Left side)

Table 1: Link relatives of monthly amount of materials for frozen blue fins from 2005 to 2009

Month	2005	2006	2007	2008	2009
1	-	0.80	0.72	0.77	0.85
2	1.00	0.96*	1.06**	1.05	1.20
3	1.28	1.36	1.27	1.22	1.02
4	1.06	0.93*	0.86	0.95	1.05**
5	0.84	0.84	1.23**	0.94*	0.92
6	1.09	1.14	1.11	1.24	1.37
7	1.09	1.19	0.94*	1.07**	1.01
8	0.92	0.80	0.88	0.67	0.73
9	1.00	0.93*	0.97	1.20**	1.03
10	0.96	1.17**	1.05	1.00	0.99*
11	0.95	0.91	0.98	0.85	0.96
12	1.06	1.08	1.05	1.04	1.04

* : A link relative is less than 1.00 at a year but it is 1.00 and over at the preceding year.

** : A link relative is 1.00 and over at a year but it is less than 1.00 at the preceding year.

A monthly amount of frozen products from plants

Figure 4 show time series of a monthly amount of products from plants from 2005 to 2009. It is found that the time series go down year by year like a monthly amount of materials to plants. An average of the monthly amounts is 38,224 ton in 2009 which is 85% of 32,365 ton in 2005. On the other hand, in comparison with the time series among five years, there is little disturbance of the shape of the time series. From Table 2, it indicates to realize steady supply to the market every year. However, in case of July, a change of increase or decrease of the amount at a month against the amount at next month occurs during the investigated years.

In the tendency of quantitative reduction mentioned above, a ratio of a setup time to total processing time will be increased. It is necessary to maintain a productivity of a production system which is equal to the conventional system.

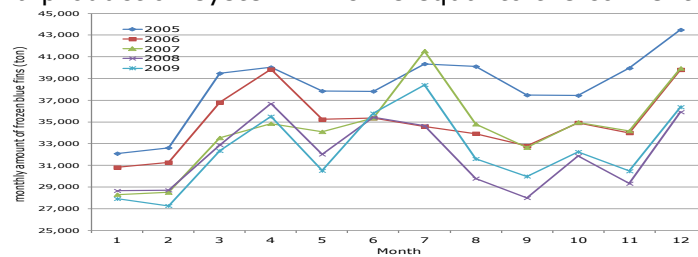


Figure 4: Time series of monthly amount of frozen blue fins from 2005 to 2009

Table 1: Link relatives of monthly amount of frozen blue fins from 2005 to 2009

Month	2005	2006	2007	2008	2009
1	-	0.71	0.71	0.72	0.78
2	1.02	1.01	1.01	1.00	0.98*
3	1.21	1.18	1.18	1.15	1.19
4	1.01	1.08	1.04	1.12	1.10
5	0.95	0.88	0.98	0.87	0.86
6	1.00	1.00	1.04	1.11	1.17
7	1.07	0.98*	1.18**	0.98*	1.07**
8	0.99	0.98	0.84	0.86	0.82
9	0.93	0.97	0.94	0.94	0.95
10	1.00	1.07	1.07	1.14	1.08
11	1.07	0.97*	0.98	0.92	0.94
12	1.09	1.17	1.17	1.22	1.19

* : A link relative is less than 1.00 at a year but it is 1.00 and over at the preceding year.

** : A link relative is 1.00 and over at a year but it is less than 1.00 at the preceding year.

An inventory of products at the end of the month

Figure 5 shows time series of an inventory of products at the end of the month from 2005 to 2009. It is found that the time series go down year by year like two kinds of the amounts mentioned above. Days of an inventory are illustrated from Figure 3. It is given a monthly amount of the products from plants divided by an inventory of the products at the end of the month. An average of the indicator increases from 1.77 in 2005 to 1.95 in 2009. It seems that a suitable reduction of an inventory of the products has not been performed. Furthermore a variance of the indicator increases from 0.22 in 2005 to 0.05 in 2009. It indicates the instability of the inventory of the products.

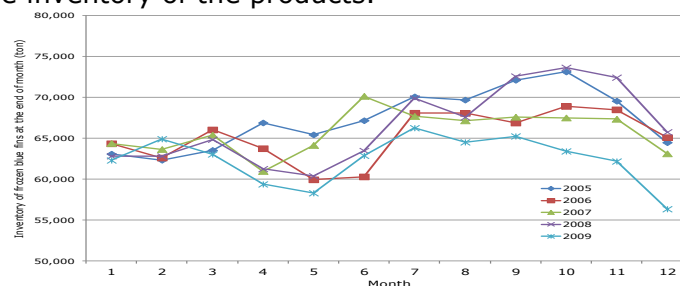


Figure 5: Time series of inventory of frozen blue fins at the end of month from 2005 to 2009

Table 3: Days of an inventory of frozen blue fins from 2005 to 2009 (Month)

Month	2005	2006	2007	2008	2009
1	1.97	2.09	2.27	2.19	2.23
2	1.91	2.00	2.23	2.19	2.38
3	1.61	1.80	1.95	1.97	1.95
4	1.67	1.60	1.75	1.67	1.67
5	1.73	1.70	1.88	1.89	1.91
6	1.78	1.71	1.98	1.79	1.76
7	1.74	1.97	1.63	2.02	1.73
8	1.74	2.01	1.93	2.27	2.04
9	1.92	2.04	2.07	2.59	2.18
10	1.95	1.97	1.93	2.31	1.97
11	1.74	2.02	1.97	2.47	2.04
12	1.48	1.64	1.58	1.83	1.55
Average	1.77	1.88	1.93	2.10	1.95
Variance	0.020	0.029	0.040	0.074	0.055

STEP2: CONSTRUCTION OF CONSTRUCTED MODELS

On the assumption that production lead time is one period, Equation (1) and Equation (2) become Equation (3) and Equation (4). Two models are proposed based on the two equations. In addition, followed by the situation of the object case, P_t means a monthly amount of materials to plants and D_t means regarded as a monthly amount of products from plants.

$$P_t = \hat{D}_{t;t+1} + \hat{D}_{t;t+2} - P_{t-1} - I_t + S \quad (3)$$

$$I_t = I_{t-1} + P_{t-2} - D_t \quad (4)$$

- 1) In case of a minimization of a variation of an inventory at the end of the period

The assumption that a monthly amount of products of term i ahead are given at the end of the period t is installed to Equation (3).

$$\hat{D}_{t;t+1} = D_{t+1} \quad (5)$$

$$\hat{D}_{t;t+2} = D_{t+2} \quad (6)$$

- 2) In case of a minimization of a variation of an indicated production order

The assumption that a monthly amount of products of each period is constant is installed to Equation (3).

$$P_t = C \quad (7)$$

STEP3: SIMULATION OF PRODUCTION AND INVENTORY SYSTEM

Precondition

In this step, the simulation is performed by the two proposed models. An outline of the simulation is as follows.

<Outline of the simulation>

- Input data: Actual data of the monthly amount of materials to plants
- Output data 1:
Average and standard deviation of monthly amounts of materials
- Output data 2:
Average and standard deviation of inventories at the end of month
- A number of simulation: Five times (from 2005 to 2009)
- Others
 - An inventory at the end of December in the preceding year:
Actual data (In case of 2005, 2004's value is utilized.)
 - A monthly amount of materials to plants at November and December in the preceding year: Actual data (In case of 2005, 2004's value is utilized.)
 - A monthly amount of frozen products from plants in January and February of the next year: Actual data (In case of 2009, the following equation is utilized.)
*The amount at January in 2010 = The amount at January in 2009 × (The amount at January in 2009 - The amount at January in 2005) ÷ 5

*The amount at February in 2010=The amount at February in 2009× (The amount at February in 2009- The amount at February in 2005)÷5

- Safety inventory: Two month's average of actual monthly amount of products from plants during simulation term
- In case of minimization of a variance of a monthly amount of materials to plants, a monthly amount of materials to plants: Average of actual monthly amount of materials to plants during simulation term

Results

The results of the simulation are illustrated from Table 4, Table 5, Figure 6 and Figure 7. It is found that the current system is nearly a system to minimize a variance of an inventory at the end of the period. However it is considered that the system had a margin for a reduction of an inventory at the end of the period.

Table 4: Results of the simulation (Materials to plants)

Year	Minimization of a variance of an inventory at the end of the period		Current system		Minimization of a variance of an amount of materials to plants	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
2005	37,166	1,211	38,322	1,021	38,224	0
2006	33,892	1,044	35,002	1,086	34,940	0
2007	33,647	1,324	34,119	1,202	34,390	0
2008	30,850	1,236	32,147	1,214	31,990	0
2009	31,940	1,060	31,545	1,263	32,365	0

Table 5: Results of the simulation (Inventory at the end of the period)

Year	Minimization of a variance of an inventory at the end of the period		Current system		Minimization of a variance of an amount of materials to plants	
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation
2005	76,966	885	67,293	1,001	81,314	1,132
2006	70,505	583	65,212	859	72,036	710
2007	69,703	756	65,757	712	73,889	1,223
2008	65,313	954	66,456	1,292	69,692	945
2009	65,098	265	62,397	826	62,787	1,079

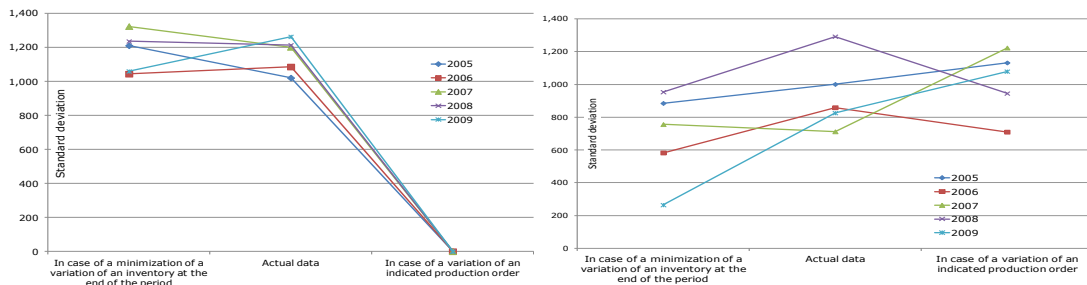


Figure 6: Standard divisions of materials of conventional model and two proposed models (Right side)

Figure 6: Standard divisions of inventories at the end of the period of conventional model and two proposed models (Left side)

STEP4: DISCUSSION

From the both results of the survey described in Step 2 and the simulation performed in Step 3, the following four future works are considered.

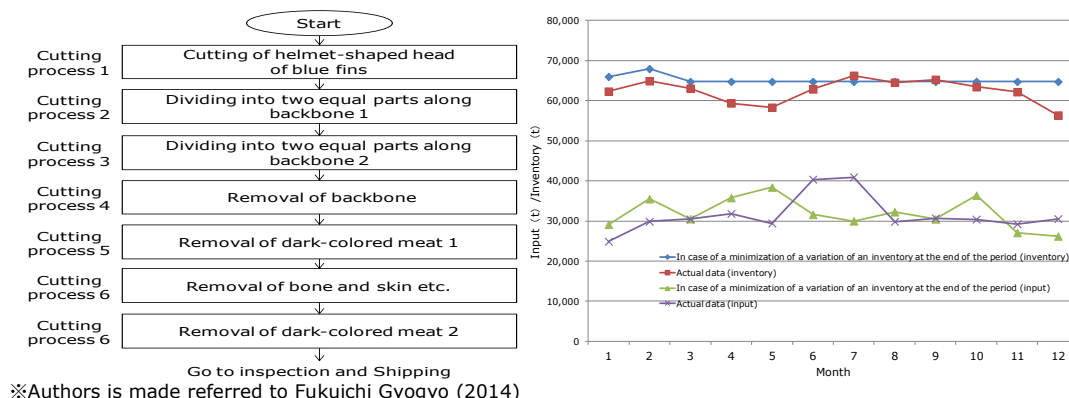
- Future work 1: Construction of the production system that absorbs an instability of amounts of materials to plants
- Future work 2: Improvement of a flexibility of the production line that corresponds to a reduction of amount of products from plants
- Future work 3: Compression of an inventory that corresponds to a reduction of amount of products from plants
- Future work 4 : Equalization of two variances of amount of materials to plants and an inventory at the end of the period

For the first work, the amount of materials to plants is reduced and the expected amount will not be guaranteed on the basis of a stable fish catch. It is related to an excess and a deficiency of production capacity and become factors in an occurrence of opportunity loss and surplus cost. A shift of planned procurement of materials will be needed corresponding to market requirements.

For the second work, as a production scale become down, a ratio of setup time to total processing time will become up. Based on the internet survey about a frozen processing process of blue fins, in order to fillet one big blue fins to a shape of rectangles, several cutting process which are from a cutting of helmet-shaped head of blue fins to a removal of dark-colored meat is passed as shown in Figure 8 (Fukuichi Gyogyo 2014). An exchange time of a cutting tool is a stop time of production. It is important to shorten set up time in the process.

For the third work, in the survey of Step 2, a reduction ratio of an inventory at the end of the period is low against a reduction ratio of amount of materials/product to/from plants. Also, it is found that a variance of an inventory at the end of the period is increasing. In general, a surplus of an inventory becomes an increase factor of cost. Accordingly effective management of an inventory in the object system will seem needed.

For the fourth work, Figure 9 shows time series of the monthly amount of materials to plants and an inventory at the end of the period provided from the simulation results described in Step 3. In case of a minimization of a variance of an inventory at the end of the period, a stationary state is kept in an inventory at the end of the period from March to December however transient characteristics are confirmed at January and February. Compared the simulated data with actual data, actual data is equal to or lower than the simulated data. On the other hand, as stated above, a variance of an inventory at the end of the period is increasing year by year. When an amount of materials to plants is checked, equalization of simulation results is better than that of actual data. Based on the results, a control of a variance of materials to plants is needed as one direction of the object system improvement. And a production and inventory system is more stabilized without becoming worse of current level of a variance of an inventory at the end of the period.



※Authors is made referred to Fukuichi Gyogyo (2014)

Figure 8: Cutting Process in blue fins processing (Right side)

Figure 9: Time series of an amount of materials to plants and inventories at the end of the period (In case of 2009) (Left side)

CONCLUDING REMARKS

In this paper, a characteristic analysis of current production and inventory planning system for frozen products of blue fins is performed under the instability of the fishery caused by the warming of the earth and an indiscriminate fishing. For the results, it is found that the current system is aimed at minimizing a variation of the inventory at the end of the period. Also, in order to correspond to the instability of a material procurement, the future works are discussed. For example, it is necessary to control a variance of amount of materials to plants and to reduce setup time, in particular an exchange of cutting tool, in total

processing time without becoming worse of current level of a variance of an inventory at the end of the period.

ACKNOWLEDGEMENT

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AN INFLUENCE DIAGRAM MODEL FOR THE ASSESSMENT OF GLOBAL SUPPLY CHAIN CONFIGURATIONS

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ABSTRACT

Because manufacturers are increasingly seeking to distribute their supply chain functions from domestic to overseas, applying suitable global supply chain configurations in managing resources is crucial for the satisfaction of growing demands from the customers worldwide. To provide an assessment tool for manufacturers who face the decision problem of selecting a suitable global supply chain configuration for a new manufacturing plant, we adopted the approach of influence diagram to develop a decision support model with the objective of maximum payoff, which considers the trade-offs among qualitative factors, costs and sales. This study also emphasizes the consideration of free trade zone, where tariffs, taxes and quotas can be exempted under certain conditions. In addition, utility theory is applied to depict decision makers' preferences with regard to uncertain outcomes. We also illustrate a case study to discuss the applicability of the proposed approach.

INTRODUCTION

To exploit global resource to lower production cost, manufacturers are increasingly seeking to distribute their supply chain functions such as production, value-added processing, physical distribution and inventory from domestic to other countries or regions. However, the increasing diversification towards supply chain also imposes new challenges to existing supply chain management because there are more uncertain factors to deal with in the global economic and business environment (Sheu, 2004). Hence, it's important for manufacturers to apply suitable global supply chain configurations in managing resources for the satisfaction of growing demands from the customers worldwide (Meiwell and Gargeya, 2005). The simplest configurations of global supply chain can have the entire process of manufacturing controlled and completed domestically, whereas more complicated configurations have more supply chain functions and facilities outsourced overseas. Because configuring global supply chain involves with complicating factors such as duties, taxes, trade barriers, labour quality, and infrastructure quality, numerous studies have proposed different approaches to address the related issues. For example, Vidal and Goetschalckx (2001) proposed an optimization model for a global supply chain that maximizes the after tax profits of a multinational corporation with the consideration of transfer prices and the allocation of transportation costs. Nagurney, Cruz and Matsypura (2003) modelled the behaviour of the decision-makers under global supply chain and derived the optimality conditions as well as governing equilibrium conditions which were formulated as a variational inequality problem. Feng and Wu (2009) developed a tax saving model for maximizing after-tax profit in the emerging global manufacturing network. However, most of the studies developed decision support models through the approach of optimization programming, which may be difficult to apply in dynamic business environment because their objective functions are based on specific combination of strategies. In addition, the optimization-based studies may not be suitable in investigating the issues of uncertainties and complexities of global supply chain strategic planning which generally involves with the evaluation of qualitative factors such as foreign regulation and political stability (Sheu, 2008).

To overcome the limitations of the optimization approach, this study aims to develop an influence diagram model for manufacturers who face the decision problem of global supply chain configurations. Using influence diagram for problem modelling has several advantages. For example, uncertain variables are represented with a conditional probability table and associated with random nodes in influence diagram, where the probability distributions of random nodes can be described by related data or subjective measurements from decision makers. This characteristic is important for business practices because decision makers usually encounter indeterminate events during the evaluation processes. In addition, the value node is associated with von Neumann-Morgenstern utility, which is used to depict decision makers' preferences with regard to uncertain outcomes (Anand, 1993). Hence, the selection of the most suitable global supply chain configuration in this study is based on the alternative with the maximum expected utility, which describes the objectives of maximizing profits and qualitative factors. Moreover, this study also emphasizes the consideration of free trade zone (FTZ), where tariffs and quotas can be exempted under certain conditions and administrative constraints are reduced in order to attract domestic and foreign investments (Sullivan and Sheffrin, 2003). Manufacturers can establish their plants in FTZ with the incentives of tax breaks to import raw materials/components, make primary assembling and export the final products to foreign customers. With the consideration of FTZ factor, possible alternatives of global supply chain configurations are proposed in this study. Each alternative distinguishes itself from the others mainly in the degree of resource sharing and integration with foreign companies. In the next section, we start with the description of the decision problem that is addressed in this study. Then we discuss how to develop a decision model through an influence diagram approach in Section 3. A case study is presented in Section 4 to evaluate the applicability of the proposed model. Finally, conclusion and future directions are discussed in Section 5.

PROBLEM STATEMENT

Suppose that a manufacturer faces a decision problem of choosing a suitable global supply chain configuration for a new manufacturing plant, which will produce a new product line in large-scale. The new plant will be located in domestic FTZ or foreign FTZ, which provides incentives on "duty-free privileges; concessionary tax rates, breaks, and exemptions; preferential fees for land or facility use; favourable arrangements with project duration, size, sector invested, location, and the type of ownership; flexible treatments regarding business management, employment, and wage schemes" (Ge, 1999). According to the studies of Sheu (2004 & 2008), a total of six decision alternatives are under evaluation: full production in home country (d_1), further processing in home country (d_2), further processing in foreign country A (d_3), full production in foreign country A (d_4), further processing in foreign country B (d_5), and full production in foreign country B (d_6). Under the configuration alternative d_1 , modular components supplied by vendors will be transformed domestically into finished products by the new plant located in FTZ. To exempt from domestic taxes, the finished products will be transported directly to the final market without entering the home market. If the manufacturer decides to adopt configuration alternative d_2 , the new plant will carry out processing on the semi-products instead of modular components under d_1 . Meanwhile, decision alternatives d_3 to d_6 are similar to alternatives d_1 and d_2 , except these alternatives are based on foreign countries A or B. The new plant is either for full production on modular components or for further processing on semi-products. Because companies will be levied tariffs if the goods are transferring from domestic to foreign countries, as well as from FTZ to tax areas, the finished products produced by the new plant in FTZ will be shipped overseas to the final market to exempt tariffs.

As each alternative would have its evaluation on sales, qualitative factors, taxes, procurement costs, inventory costs, transportation costs and processing costs, decision makers of the manufacturer wish to choose the global supply chain configuration that maximizes the payoff with the trade-offs among sales, qualitative factors and costs. According to Sethi et al. (2002) and Lu and Yang (2007), qualitative factors considered in this study include market size (X_1), labour quality (X_2), infrastructure quality (X_3), political stability (X_4), openness of government policy (X_5), efficiency of government administration (X_6), and culture distance (X_7). These factors are especially important to the decisions related to the investments on foreign countries. In addition, we need to evaluate the net present values of the costs for each configuration alternative. According to the studies of Lu and Yang (2007) and Feng and Wu (2009), these costs include import duties, value-added taxes, procurement costs, manufacturing costs, transportation costs, fixed costs, wages, rental costs of land, overhead costs, maintenance costs, insurance costs, investment costs, and operation costs, which are based on. The uncertainties related to these costs are the cost of modular components per unit (CM), the cost of semi-products per unit (CS), the processing cost of modular component per unit (CMP), the processing cost of semi-products per unit (CSP), the transportation cost per unit (CT), the land rental cost per month (CL), the annual average salary per employee (CE), insurance rate (RI), the overhead cost rate (RO), and the maintenance rate (RM). Other uncertainties considered in this study include unit price of finished goods (P), annual average sales volume (V), interest rate (I), and market growth rate (G).

MODEL CONSTRUCTION

To cope with the uncertainties in the aforementioned decision problem, we adopt the approach of influence diagram to construct a decision model of global supply chain configurations with the objective of maximum payoff, which is the utility function of qualitative factors, costs and sales. An influence diagram is a directed acyclic graph with chance nodes, decision nodes, and payoff nodes. Directed arcs between nodes are used to show the conditional relationships between variables. Accordingly, Figure 1 demonstrates the influence diagram model of this study, where the oval rectangles represent the calculation nodes, the node D represents the decision node with 6 alternatives of global supply chain configurations, and the oval nodes represent the uncertain variables described in problem statement. Because the cost of each global supply chain configuration is based on the corresponding decision alternative and uncertain variables, the calculation node $Cost$ has directed arcs from the decision node and the chance nodes CM , CS , CMP , CSP , CT , CL , CE , RI , RO , and RM . Meanwhile, the calculation node $Sales$ is related to the unit price of finished goods and the annual average sales volume. The node NPV is used to calculate the net present value of $Cost$ and $Sales$ for each decision alternative. As shown in Figure 1, the payoff node has directed arcs from NPV and X_1, X_2, \dots, X_7 . It implies that payoff of each global supply chain configuration is determined by the qualitative factors and the net present value of cost and sales. In addition, from the quantitative perspective of an influence diagram, each chance node has a probability distribution and each directed arc has a conditional probability distribution. Suppose that each uncertain variable follows normal distribution. Questionnaire can be distributed to the decision makers to collect their subjective assessments on these probability distributions. Then we can apply extended Pearson-Tukey method to transform these assessments into discrete probability distributions for efficient calculations of the calculation nodes and the payoff node.

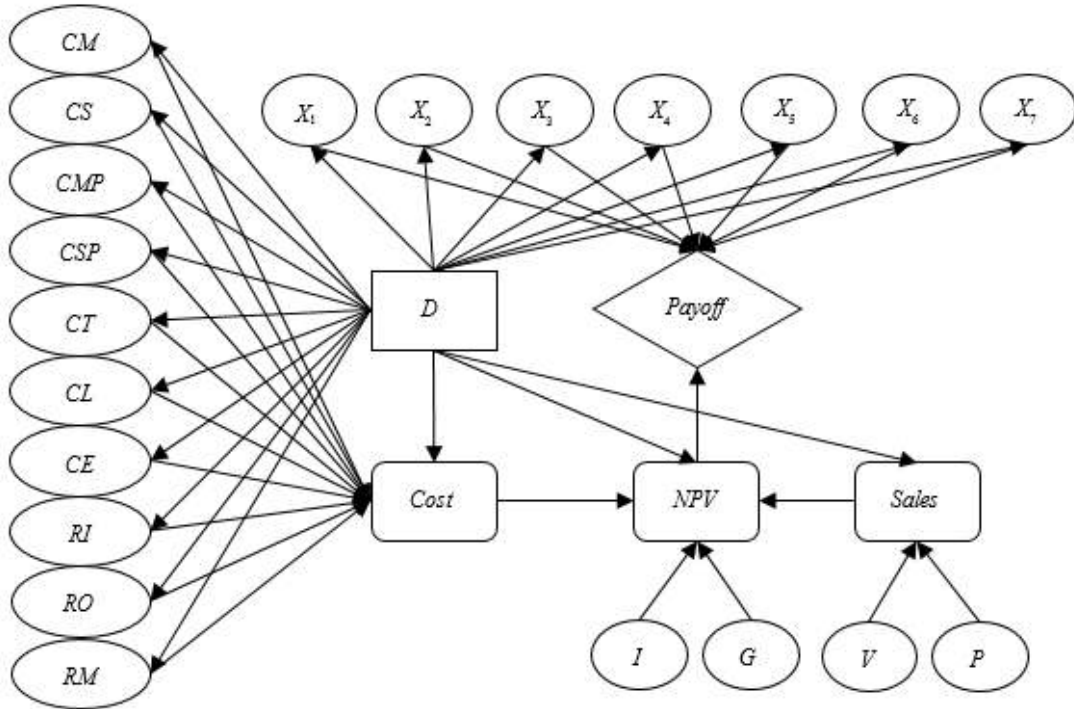


Figure 1: Influence diagram model of the decision problem regarding global supply chain configurations

Because the qualitative factors and NPV have different measure units, their values will be further transformed into utility values based on Equation (1) and (2), where NPV_i is the net present value of the configuration i , and R_{1j} and R_2 represent the risk tolerance of decision makers on the qualitative factor j and NPV , respectively. The utility functions $U_j(X_j)$ and $U(NPV)$ are based on the assumption that the decision makers are risk-neutral.

$$U_j(X_j | D = d_i) = 1 - e^{-E[X_j|D=d_i]/R_{1j}}, i = 1, 2, \dots, 6; j = 1, 2, \dots, 7. \quad (1)$$

$$U(NPV | D = d_i) = 1 - e^{-NPV_i/R_2}, i = 1, 2, \dots, 6. \quad (2)$$

To compute the payoff variable, we first evaluate the weights (k_j) of each qualitative factor by the approach of analytic hierarchy process (AHP). Suppose that the decision makers also have different preference on the qualitative construct and NPV . AHP can be also applied to evaluate the weight of qualitative construct (W_1) and the weight of NPV (W_2). Then the payoff of decision alternative d_i can be calculated by

$$Payoff(d_i) = W_1 \sum_j k_j \times U_j(X_j | D = d_i) + W_2 \times U(NPV | D = d_i). \quad (3)$$

Hence, the alternative d_i with the highest payoff value is the most suitable global supply chain configuration for the manufacturer.

CASE STUDY

To illustrate the applicability of the proposed approach, a case study was conducted on a leading provider of semiconductor manufacturing services and advance IC packaging in Taiwan. This manufacturer faced the similar decision problem described above: choosing a suitable global supply chain configuration for a new manufacturing plant. A total of six decision alternatives were under evaluation: full production in Taiwan (d_1), further processing in Taiwan (d_2), further processing in China (d_3), full production in China (d_4), further processing

in Vietnam (d_5), and full production in Vietnam (d_6). After several in-depth interviews with the decision makers of the manufacturer, we acquired the necessary data for the evaluation of conditional probability distributions, weights, risk tolerances, and the calculation variables. Table 1 shows the results of weight evaluation based on the AHP approach. The ratio of W_1 and W_2 is almost 2 to 1, which implies that the decision makers concerned much more on the net present value of sales and costs than the qualitative construct. In addition, political stability, openness of government policy, and effectiveness of government administration are the most important qualitative factors because they had the highest weights than the others.

Qualitative Construct vs. <i>NPV</i>	W_1	0.366		
	W_2	0.634		
Preference among qualitative factors	K_1	0.126	K_5	0.180
	K_2	0.105	K_6	0.179
	K_3	0.129	K_7	0.095
	K_4	0.185		

Table 1: Results of weight evaluation

Meanwhile, Table 2 shows the payoff of each configuration alternative, which is based on the calculation of Equation (3). Results indicate that d_1 had the highest payoff value (0.9233) than other alternatives. Hence, full production in Taiwan's FTZ is the most suitable supply chain configuration for this manufacturer. The reason why d_1 was selected is because it had the best performance on qualitative construct and its performance gap to the best alternative on *NPV* was small. Although d_6 had the highest utility value on *NPV*, it had the lowest utility value on qualitative construct. It implies that the overall performance of market size, labour quality, infrastructure quality, political stability, openness of government policy, efficiency of government administration, and culture distance was not good in Vietnam. Meanwhile, the alternatives d_4 and d_3 were ranked second and third respectively. This finding indicates that the investment in China was worth considering.

Alternative	<i>NPV</i>	Qualitative Construct	Payoff	Ranking
d_1	0.6264	0.2968	0.9233	1
d_2	0.6168	0.2968	0.9137	4
d_3	0.6210	0.2930	0.9141	3
d_4	0.6286	0.2930	0.9217	2
d_5	0.6260	0.2675	0.8936	6
d_6	0.6312	0.2675	0.8988	5

Table 2: The payoff of each decision alternative

According to the tornado diagram analysis, the cost of modular components per unit and the unit price of finished goods are the most influential uncertain variables affecting the final payoff. Thus, sensitivity analyses on these two variables were conducted also. Figure 2 depicts the impact to payoff in each alternative when the cost of modular components per unit varies, where the X-axis represents the variation of the cost of modular components per unit, and the Y-axis represents the payoff of each alternative. Our results indicate that the payoffs of d_2 , d_3 , and d_5 are unvaried because manufacturer in these

configurations only imports semi-products from vendors. On the contrary, the payoffs of others, including d_1 , d_4 , and d_6 , will be altered if variable CM changes. When variable CM varies from 68 to 72, the payoff of d_1 will be between 0.9288 and 0.9276, the payoff of d_4 will be between 0.9257 and 0.9249, and the payoff of d_6 will be varied from 0.9011 to 0.9008. Despite the changes in the cost of modular components per unit, the rank of position in each alternative is still the same. In other words, d_1 is still the best configuration alternative with the highest payoff among others.

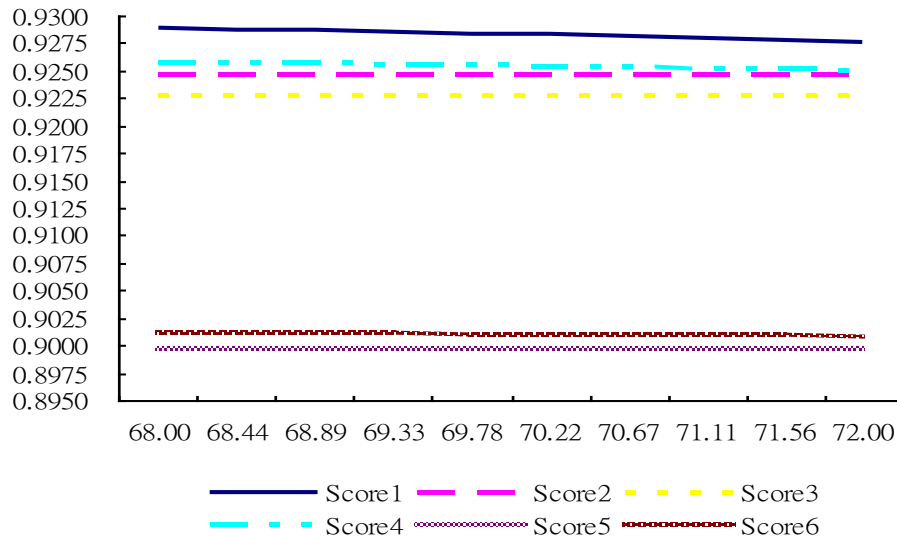


Figure 2: Sensitivity analysis on cost of modular components per unit (CM)

The impacts to payoffs when the unit price of finished goods (P) varies are shown in Figure 3. The ranking of alternatives d_1 to d_6 by payoff does not change generally. However, d_4 becomes the best alternative when the unit price of finished goods is less than 187.22 USD. These findings indicate that the risk of making inappropriate choice is small, because the possible values of P range from 185 to 205.

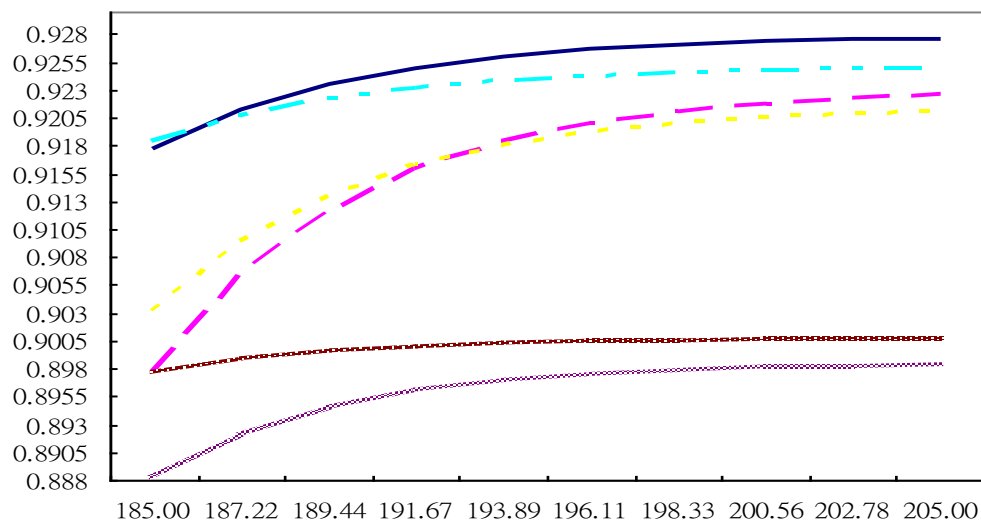


Figure 3: Sensitivity analysis on the unit price of finished goods (P)

CONCLUSION

Making choice of suitable global supply chain framework is practically important for business operations. However, previous related studies usually discuss the conceptual frameworks, which may not be useful for the evaluation of decision alternatives. Although optimization models have been applied for global supply chain configurations, these models only focus on the allocation of resources among competing supply chain activities to optimize measurable objectives, not on the decision-making of supply chain framework alternatives. Besides, most of the related studies ignore the consideration of FTZ, where normal trade barriers are removed and bureaucratic necessities are narrowed. Although over 116 countries have tax-exempt areas like FTZ, there is still lack of studies addressing the decision problem of choosing a suitable global supply chain configuration with the consideration of FTZ. This study tried to bridge the gap by proposing a decision support model based on the approach of influence diagram. The proposed approach not only overcomes the limitations of optimization approaches, but also provides methods to evaluate the uncertainties of the decision problem. In addition, all of the six configuration alternatives proposed in this study are based on the assumption that the new manufacturing plant will be built in FTZ, no matter its purpose is for full production on modular components or further processing on semi-products. We also use a case study to illustrate how to apply our approach in practice. The proposed model can be easily modified if the decision environment changes. In short, our proposed approach is not only practical for wide industry-wise adoption, but also applicable for team decision analysis, because it allows incomplete sharing of information among team members to be modelled and solved explicitly.

ACKNOWLEDGEMENTS

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THE LINKS BETWEEN BUSINESS PROCESS MANAGEMENT AND SUPPLY CHAIN COLLABORATION: A LITERATURE REVIEW

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ABSTRACT

The link between a firm and Supply Chain (SC) members has been recognised as one of the key issues for ensuring business success and achieving competitive advantage. Indeed, working across organisational boundaries is required to accomplish effective responses to customers' needs. Supply Chain Collaboration (SCC) is viewed as an important vehicle for improving performance (Cao and Zhang, 2011). However, previous SCC research has not adequately addressed the role of Business Process Management (BPM), which is considered crucial for leveraged performance. This review aims to suggest avenues for the development of further understanding in relation to how SCC and BPM interrelate to drive collaborative advantage and organisational performance. A taxonomy was developed to classify diverse types of relationships. The results of this review provide research gaps and opportunities that could be valuable for research on intra-inter organisational relationships.

INTRODUCTION

Supply Chain Management (SCM) requires both internal and external business process integration across the Supply Chain (SC). Being reliable and responsive by delivering the right product at the right time at a low cost can create value throughout the SC. Collaboration is known as a "silver bullet" in many areas of SCM (Kampstra *et al.*, 2006, p. 314), which illustrates the importance placed on it by many firms. The Print Media Indicator (PMI) of key terms (see Figure 1) indicates that the terms of BPM, SCC and intra-inter organisational relationships have become popular fields of study, with increasing numbers of publications.

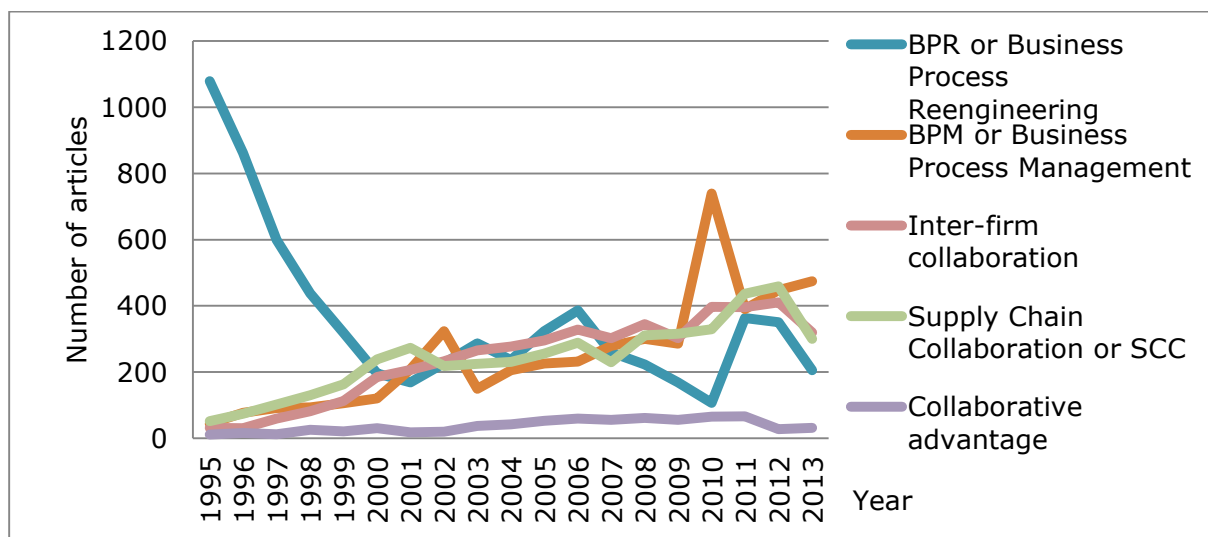


Figure 1: Print Media Indicator of key terms trend

Working across organisational boundaries is required to achieve effective responses to customers' needs (Davis and Spekman, 2004). Various researchers have been recognised that the link between a firm and its SC members is one of the key issues to ensure business success and a competitive advantage (e.g., Rosenzweig, 2009; Hsu *et al.*,

2009). A firm and its SC members working collaboratively, by opening communication and the sharing of resources, risks and rewards should result in mutual benefits. Despite the previous studies, there is still a need for a comprehensive study of other aspects that link the SC partners, to gain a competitive advantage and improve organisational performance. The purpose of this paper is to review the relevant literature in order to investigate the link between BPM and SCC, and how this relationship could lead to intra-inter organisational outcomes, in terms of collaborative advantage and organisational performance. Based on the relevant literature review, a framework was developed to explain these relationships. Additionally, a taxonomy was developed to identify four different types of internal and external developments, BPM and SCC. Subsequently, research gaps and opportunities, in the form of research agenda are revealed.

DESIGN/METHODOLOGY/APPROACH

This research aims to conduct a literature review to identify the role of BPM in SCC and their benefits in terms of collaborative advantage and organisational performance. Relevant terms such as *business process management*, *supply chain management*, *supply chain collaboration*, *collaborative advantage*, *organisational performance* and *intra-inter organisation* were used for identifying relevant key words in research papers. The literature was collected using a multitude of sources, including books and academic journals. Online databases, such as ABI/INFORMS Global, Business Source Primer (EBSCO) and Science Direct assisted in the initial collection of relevant academic papers. Academic journals focusing on the fields under investigation were also sought, such as *Journal of Operations Management*, *Supply Chain Management: An international Journal*, *International Journal of Logistics Management* and *Business Process Management Journal*.

LITERATURE REVIEW

Business Process Management

BPM has been explained by various authors (e.g., Van der Aalst *et al.*, 2003; Chang, 2006). According to Lindsay *et al.* (2003), BPM strives to better understand the key mechanisms of a business to improve, and in some cases to radically change the business performance by identifying opportunities for new business, outsourcing, improving business efficiency and areas within the business where technology can be used to support business processes. Van der Aalst *et al.* (2003) suggested that BPM was a field of knowledge that covered the use of various methods, techniques and technologies to support business process changes, encouraging employees to become more involved. More recently, Chang (2006) defined BPM as a process-oriented organisational approach, used to design, analyse and improve business processes to effectively manage and improve organisational performance. In summary, BPM utilises both incremental and radical methodologies, focusing on process-centric, technology and the involvement of people to ensure that customer satisfaction is achieved in an effective way.

To capture the main elements of BPM, we define BPM by covering the four main elements as highlighted in previous research (e.g., Chang, 2006; Smart *et al.*, 2009). These are *strategic alignment*, *Information Technology (IT)*, *process orientation and improvement* and *people involvement*. *Strategic alignment* refers to long-term goals, the consideration of customer requirements and the internal characteristics of organisations, and it involves developing specific strategies and plans that can be implemented to maximise the value from process redesign and improvement (Smart *et al.*, 2009). Additionally, joint decision making with SC partners is necessary for intra-organisational operations and the development of long-term plans. For instance, a firm and its SC partners could make joint decisions about demand forecasting and jointly establish and share common goals along an SC. *IT* is not only developed to use only within organisational boundaries but can also involve external IT interface and SC engagements. *Process orientation* is central to BPM and includes key elements such as process view/documentation, value stream mapping, process ownership, and process measurement. BPM represents a

convergence of previous *process improvement* approaches as it provides information and a process management infrastructure for improvement (Chang, 2006; Smart *et al.*, 2009). Both *top management and employee empowerment* need to be involved in BPM practices. Top management needs to be committed and communicate effectively, setting organisational values and developing a suitable management style to improve organisational performance (Chen and Paulraj, 2004). Additionally, the empowerment of employees allows them to participate actively and creatively with their work.

Organisational performance refers to how well an organisation fulfills both financial, as well as its market-oriented goals (Qrunfleh and Tarafdar, 2012). Some prior studies have measured organisational performance through sales growth, profit margin on sales, return on investment, overall product quality, overall competitive position, overall customer service levels, and core competencies and capabilities (e.g., Flynn *et al.*, 2010; Cao and Zhang, 2011). Several studies have revealed that BPM has a positive impact on organisational performance (e.g., Maddern *et al.*, 2007; McCormack *et al.*, 2008). However, there is limited research on the link between some attributes of BPM on organisational performance. A number of studies (e.g., Maddern *et al.*, 2007; Smart *et al.*, 2009) focused on the '*process*' concepts of BPM, its attributes and establishing the links between attributes and benefits such as organisational performance and customer satisfaction. Smart *et al.* (2009) empirically validated a BPM framework by considering the context of processes to characterise BPM. They identified five main dimensions of BPM namely, process strategy, process architecture, process measurement, process ownership and process improvement. Research by Maddern *et al.* (2007) performed a longitudinal case study to examine the impact of BPM on service quality and customer satisfaction and highlighted that BPM is a critical factor in driving customer satisfaction. The relationship between process orientation and organisational performance was studied by (Skirinjar *et al.*, 2008). Their results showed that business process orientation leads to an improvement in both financial and non-financial performance. In summary, prior studies on BPM has mostly focused on some specific attributes of BPM. Hence, there is a lack of BPM research that includes all the main attributes covering the entire scope of BPM. Most studies of BPM have typically been narrowly defined and have focused on aspects within the organisational boundaries rather than investigating the link BPM to the inter-organisational relationship.

Supply Chain Collaboration

Several researchers have indicated an increasing interest in SCC (e.g., Wiengarten *et al.*, 2010) and this is also supported by the PMI results in Figure 1. SCC occurs when two or more firms in SC work closely together in planning and delivering products to end customers, to optimise profits for the SC members and gain mutual benefits (Cao and Zhang 2011). It is necessary to develop closer relationships, integrating processes and sharing information with customers and suppliers. According to Barratt (2004, p. 33) "*Internal collaboration must be married with external collaboration*". Thus, firms need to collaborate in order to gain access to combinations of resources or improved capabilities that allow them to achieve collaborative advantage and gain a higher performance. *Collaborative Advantage* refers to strategic benefits achieved over competitors in the market place, which could not have been achieved without working through the SC partnership (Malhatra *et al.*, 2005; Cao and Zhang, 2011). Therefore, these benefits achieved should be more than those achievable by a firm working in isolation.

Synthesizing the literature, the important elements of SCC that have been commonly used in previous research are *information sharing and communication, sharing common goals, joint activities* and *incentive alignment* (e.g., Nyaga *et al.*, 2010; Cao and Zhang, 2011). *Information sharing and communication* are described as important for effective collaboration to achieve a greater shared understanding within the SC partnership, an environment of innovative thinking will be encouraged and supported (Barratt, 2004). *Joint activities* refer to joint decision-making and the sharing of resources between SC partners. A firm and its SC partners joint doing activities could result in the development

of deeper understanding between partners, leading to more efficient communication in a virtuous cycle. *Sharing common goals* are important aspect of good relationships between firms, as they need to share common goals and work for mutual benefits. *Incentive alignment* refers to the degree to which participating SC members share costs, risks and benefits (Simatupang and Sridharan, 2008). It provides a system for repositioning the benefits and problems that are encountered when process changes occur within the SC.

A positive association between SC performance and organisational performance has been supported by previous studies (e.g., Li *et al.*, 2006; Qrunfleh and Tarafdar, 2012). Therefore, achieving SC performance is critical to improving firm performance. Additionally, prior studies have reported that SCC is vital for improving organisational performance (e.g., Nyga *et al.*, 2010; Cao and Zhang, 2011) by reducing ambiguity and identifying priorities which can speed up business operations, save time and ensure that the business runs smoothly. Research by Vereecke and Muylle (2006) indicated that SCC had an impact on performance improvement (in terms of delivery, cost, quality, flexibility, lead time and time to market). Thus, SC members who provide higher levels of collaboration practices (e.g., information sharing, joint activities and decision making) were able to achieve better operational performance and innovative activities (Simatupang and Sridharan, 2005). Also, SCC can be utilised for transferring knowledge and new technological skills across the firms, which should result in better opportunities for enhancing their objectives (Cao and Zhang, 2011), and it can result in improved performance and competitive advantage over time.

LITERATURE REVIEW OUTCOMES

Unlike previous research, which has tended to focus on BPM and SCC separately (e.g., Hsu *et al.*, 2009; Zacharia *et al.*, 2009), this study summarises the link between BPM and SCC, as presented in Figure 2. A framework has been developed based on a review of the relevant literature to identify the link between intra-inter firm collaboration. In terms of internal collaboration, as represented by BPM, this ultimately incorporates four main attributes: strategic alignment, IT, process orientation and improvement, and people involvement.

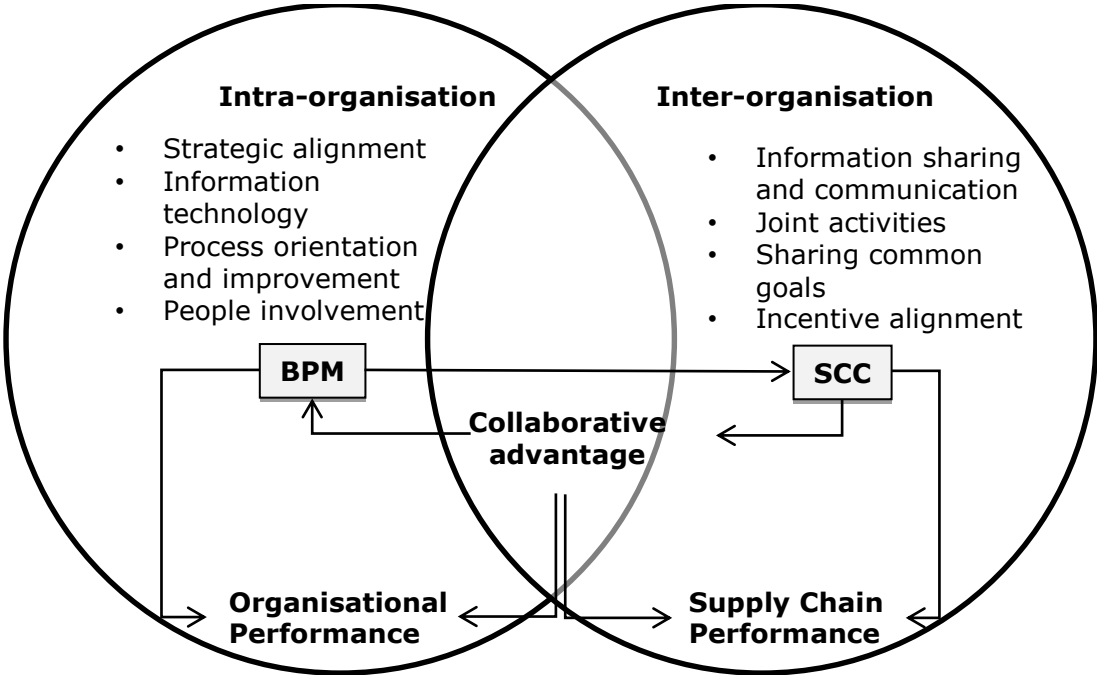


Figure 2: The relationship between BPM, SCC and the performance outcomes

SCC emphasises external collaboration and this incorporates four main attributes, namely information sharing and communication, joint activities, sharing common goals and incentive alignment. Effective internal development and working collaboratively with SC partners should result in superior performance, at both firm and SC levels. Firms that practice BPM and also collaborate with SC partners develop collaborative advantage, which cannot be achieved when they work individually. Collaborative advantage, in turn, leads to improve internal capabilities and organisational performance. Therefore, the presence of a virtuous cycle is suggested.

Consequently, a taxonomy was developed (see Figure 3) to map the possible links between BPM and SCC and benefits achieved in terms of SC performance, which can lead to organisational performance improvement. A taxonomy divided along two dimensions: the level of internal development, represented by BPM and the level of external development, as influenced by SCC. A combination of these two dimensions classifies four types of relationships and this interaction results in different levels of performance outcomes.

The 'Star Performance' quadrant A represents the state where all firms within a SC emphasise high internal development (high BPM), as well as high level of collaboration with their SC partners (high SCC). This state is achieved, typically, in an effort to effectively differentiate themselves from their rivals and/or reduce costs along the SC. High internal and external development can be achieved by integrating processes and sharing information with customers and suppliers. Companies collectively achieve higher levels of SC performance by instigating holistic SCM. Therefore, firms in this quadrant need to closely monitor the effectiveness of internal and external development in order to justify relevant efforts and maintain their relative competitive positions (Barratt, 2004; Simatupang and Sridharan, 2008).

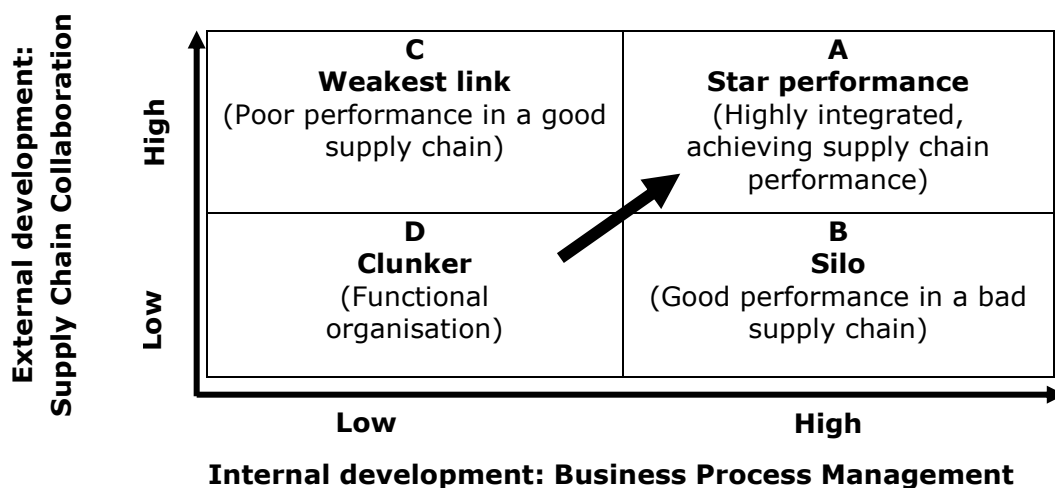


Figure 3: Different styles of Internal and External Collaboration

The 'Silo' situation B represents the state of high BPM & low SCC. A high level of internal development is achieved when a firm completes integrated tasks across various internal boundaries, such as purchasing, manufacturing, logistics and marketing. This position can be achieved by using advanced technology and/or by using process improvement programmes such as Total Quality Management (TQM), Just-in-Time (JIT) and Enterprise Resource Planning (ERP) to optimise the *silo* (i.e. the individual company) rather than optimising the whole SC. Nowadays, a narrow view that only focuses within an organisation is not considered adequate (Paiva *et al.*, 2008). A firm that pays little attention to work collaboratively with SC partners and does not align its business strategy to the SC strategy may lead to a loss of opportunity to improve its performance

(Slone *et al.*, 2007). Therefore, a firm in this position needs to collaborate with their SC members to achieve effective responses to customers' needs (Davis and Spekman, 2004), by jointly forecast and planning, otherwise they may lose their relative competitive positions and fail to achieve the star performance.

The '*weakest link*' quadrant C represents the state of low BPM & high SCC. In many cases, close relationships between a firm and its SC partners exist, but often the firm is resistant to open information sharing (Fawcett *et al.*, 2007). Incomplete or insufficient information sharing to support collaboration will probably reduce the opportunity for a high level of collaboration between a firm and its SC partners (Fawcett *et al.*, 2007). Additionally, this position can occur when a firm perceives some costs in contending with their partners' threats (Simatupang and Sridharan, 2005). Firms in this position need to improve its internal capabilities such as technology and innovation development and the use of process improvement techniques in order to collaborate with SC members effectively and to achieve better performance. Otherwise, their future membership in the SC may be in jeopardy.

The '*clunker*' quadrant D represents a state of low BPM & low SCC. Here we find low levels of internal and external integration which are typical of a supply chain containing many *functional organisations*. It can be presented as a "traditional supply chain" (Holweg *et al.*, 2005, p. 172), whereby each level in the SC issues production orders and replaces stock without considering the situations of suppliers and customers in the SC. Therefore, the SC exhibits low formal collaboration between firms. Overall, firms in this position may lack a common SC perspective in terms of internal and external development.

RESEARCH AGENDA

After the review of relevant literature, it becomes evident that there is relatively little understanding of the relationship between BPM and SCC. Therefore, research gaps and research opportunities have been identified. Firstly, most studies of BPM are typically narrowly defined, focusing on aspects within the organisational boundaries. Additionally, studies of BPM have mainly focused on identifying its attributes and benefits as explained above. There is no published study covering the main BPM attributes in a holistic manner to fully explain the scope of BPM in the context of SCM. BPM should be treated as a multi-dimensional construct, incorporating various variables to cover the entire scope of BPM along the SC. Secondly, BPM and SCC are vital for improving collaborative advantage and organisational performance. Prior studies have treated them as individual components and they have tended to be studied separately. Therefore, there is a research opportunity to identify the relationship between BPM and SCC by considering both BPM and SCC as hierarchical constructs that reflect important domains of each approach rather focusing on individual attributes of each approach separately. Additionally, future research should empirically investigate how BPM and SCC might interrelate and drive benefits in terms of collaborative advantage and organisational performance.

RELEVANCE/CONTRIBUTION

Considering its theoretical contribution, this paper provides an overview of the current knowledge on BPM, SCC and the associated benefits in terms of collaborative advantage and organisational performance. Furthermore, by means of a literature review, our paper proposes a matrix that captures the different situations exhibited within SCs, considering internal and external development, and different types of relationships between BPM and SCC are identified within the configurations being distinguished. This review proposes research avenues for further developing understanding in relation to how BPM and SCC interrelate and drive collaborative advantage and organisational performance. Specifically, we highlight that there is relatively little published empirical evidence available on the interrelationships identified. The results of the literature review can also

assist practitioners in mapping the portfolio of the various SCs in which they are embedded.

CONCLUSIONS

There is an increase in the amount of literature that emphasises intra-inter organisational relationships. This study reviews relevant literature associated with the links between BPM, SCC and the outcomes in terms of collaborative advantage and organisational performance. Hawse have aimed to provide a better understanding of the competitive and performance linkages between internal and external developments of BPM and SCC by offering a framework developed to identify the link between BPM and SCC. It can be seen that both BPM and SCC are important for improving performance and competitiveness. Additionally, the different scenarios of the link between BPM and SCC were identified in a taxonomy presented as a 2x2 matrix. Finally, we provide an outline of promising directions, which are open for investigation, which could be valuable for future research on intra-inter organisational relationships.

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THE ADOPTION OF VMI IN HOSPITAL PHARMACEUTICAL SUPPLY CHAINS

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ABSTRACT

Vendor Managed Inventory (VMI) is frequently viewed as being beneficial in many supply contexts. However, it may be challenging to implement a VMI approach in a specific context. This case-study based research investigates VMI approaches in hospital pharmaceutical supply chains to identify factors that affect its feasibility and adoption. Four factors have been identified that affect the adoption of VMI approaches - supplier characteristics, hospital characteristics, supply chain characteristics and product characteristics. The results show that differences in these characteristics can either accelerate or raise barriers to VMI adoption.

1. INTRODUCTION

The number of supply chain initiatives introduced to improve inventory and demand management have increased (Mustaffa and Potter, 2009). One such initiative is Vendor Managed Inventory (VMI). In contrast to traditional inventory management, VMI seeks to shift responsibility for replenishment decision making from the customer to the supplier (who may or may not be a producer). The customer is required to share demand information with the supplier to support the process (Kauremaa et al., 2009).

The claimed benefits of VMI include performance improvement, cost reduction and improvements in customer satisfaction. Due to these benefits the approach has come to the attention of the healthcare industry - pharmaceutical companies, distributors and healthcare providers including hospitals (Danese, 2006; Mustaffa and Potter, 2009). However, VMI has not become a standard mode of operation in supply chain networks (Kaipia et al., 2002). There are challenges in VMI adoption that may reduce the benefits or lead to failure in implementation. These include lack of trust, inaccurate information sharing, information transmission delays, and inefficient co-ordination (Sari, 2008; Niranjan et al., 2012).

The main purpose of this research is to investigate whether VMI is feasible and beneficial for pharmaceutical supply chains, specifically in a hospital context, so that healthcare organizations can make better decisions about VMI adoption. The paper is structured as follows. Literatures related to VMI adoption and specifically VMI in healthcare are considered next. The study methodology is then described. The subsequent sections present the analysis and findings, followed by the study conclusions.

2. LITERATURE REVIEW

VMI originated in the retail industry in the late 1980s (Niranjan et al., 2012). The potential benefits have been clear since the adoption of this approach in the early cases. Several empirical research studies have been conducted in order to analyze VMI, its adoption and implementation. A number of studies have investigated the value of VMI adoption and factors that impact on VMI success (Kaipia et al., 2002; Classen et al., 2008; Kauremaa et al., 2009). Classen et al., (2008) examined the buyer's perspective on how VMI success related to firms' performance outcomes. The study revealed VMI impacts significantly on customer service, supply chain control and cost reduction. Kaipia et al. (2002) suggests that VMI provides time benefits to suppliers to operate stock management effectively. Kauremaa et al., (2009) proposed five inhibitors in VMI adoption - brand offering, buyer professionalism, and supplier's large delivery package size relative to customer's demand, supplier's small share of total business and long product life cycles. However, fewer studies have focused on how VMI should be implemented. Elvander et al., (2007) proposed a framework with four dimensions for

characterising VMI systems: inventory-related dimensions, information-related dimensions, decision-making related dimensions and system integration level dimensions. Niranjana et al., (2012) raise an interesting question of "Are you ready for VMI implementation?" and propose an assessment for VMI readiness, which focuses on three features: product-related, company-related, and supplier-related features.

With regard to VMI in healthcare, some studies have focused on supply chain integration aspects. Mustafa and Potter (2009) focus on healthcare supply chains in Malaysia. In comparing VMI with two other collaborative approaches, JIT and a stockless approach, they propose that VMI is an appropriate solution for the current situation of healthcare industry owing to transportation constraints in developing countries. Turhan and Vayvay (2009) use a service-oriented architecture to model VMI implementation in a hospital. The system shows how information sharing and business reengineering affect cost reductions realized from VMI. Watson et al., (2012) suggest that VMI adoption in the public sector can bring similar benefits to those achieved in the private sector. Bhakoo et al. (2012) explore VMI adoption in an Australian hospital supply chain and identify product characteristic as a contingent factor affecting the development of collaborative relationships. Some studies explore VMI implementation in hospitals for a particular product. Matopoulos and Michailidou (2013) investigate VMI adoption for five medical devices whereas Stanger (2013) has a particular focus on the blood supply chain.

Although some relevant previous work has been conducted in the health care sector, research specifically related to VMI implementation for pharmaceutical supplies in hospitals is still limited. The main question this study aims to answer is whether VMI implementation is feasible for pharmaceutical supplies in hospital supply chains. The study identifies four aspects from a detailed literature review - hospital characteristics, supplier characteristics, supply chain integration characteristics and product characteristics – and considers how they affect the feasibility and adoption of VMI.

3. METHODOLOGY

The research objective is to investigate whether VMI is feasible and beneficial specifically for pharmaceutical supply chains in a hospital context. A multiple-case study approach has been employed to explore the rich picture of the pharmaceutical supply chains in hospitals and the factors affecting VMI adoption in this context. Case studies allow the researcher to 'investigate a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident' (Yin, 2003, pp.13). Multiple case studies can augment external research validity and create more testable theory than single cases (Voss et al., 2002; Yin, 2003).

The study explores VMI implementation within four Dyads, which consists of 3 hospitals, one private distributor (D) and one public manufacturer (M), as shown in Table 1.

Dyad	Supplier	Buyer	VMI status	Products
1	Private distributor (D)	Public hospital (H _A)	Designed but discontinued	Stable demand medicines
2	Public manufacturer (M)	Public hospital (H _A)	Continued	Antiretroviral products
3	Public manufacturer (M)	Public hospital (H _B)	Continued	Antiretroviral products
4	Public manufacturer (M)	Private hospital (H _C)	Continued	Antiretroviral products

Table 1: Four VMI Dyads

All these hospitals and suppliers are located in Thailand. One VMI supplier is a private distributor (D) and one is a government owned public manufacturer (P). Three hospitals were included - H_A (university hospital), H_B (provincial hospital) and H_C (private hospital). The cases differed in terms of ownership, size of hospital and location. Hospital H_A is a

large size hospital (1,200 beds) while hospital H_B and H_C are medium-sized (400 beds). H_A and H_B are state-owned hospitals while H_C is part of a private hospital group. Both H_A and H_C are located in the capital city while H_B is located in a rural area. In Dyad 1, VMI is a private project between the private distributor and the public hospital H_A . For the other Dyads (2, 3 and 4), VMI is a public sector project in which all hospitals collaborate with one public manufacturer. They all had considered VMI adoption and some had continued (Dyads 2, 3 and 4). Also, it presents different characteristics of VMI approach as one is operated by the private sector and the other operated as a public project. This allowed the researcher to compare the similarities and differences among these VMI projects.

Semi-structured interviews were used as the primary data collection approach, while observation and documentation were also gathered for triangulation purposes. Interview guides were developed before conducting case studies. The questionnaires in the interviews were created based on previous VMI studies and supply chain management in healthcare arena. These covered four main aspects relating to the research question: (1) hospital characteristics; (2) supplier or distributor characteristics; (3) supply chain integration strategies and measures; and (4) product characteristics. The interviewees were managers and pharmacists responsible for setting policies at the case sites. The VMI questionnaires were designed to understand how VMI had been/was conducted. The flow of material and information was discussed and demand information, which is shared between both parties was discussed. After collecting data, the researcher employed two steps in case study analysis - internal analysis and cross-case analysis. For the internal analysis, information from each Dyad was analysed individually in order to identify relevant factors, relationships and causalities. Then, a cross-case analysis was performed in which the findings from each Dyad were compared and contrasted.

4. ANALYSIS AND DISCUSSION

4.1 Supplier characteristics

4.1.1 Type of supplier

Two types of supplier are identified – a private distributor and a public sector manufacturer. The analysis shows that type of supplier influences VMI adoption. In Dyad 1, it is possible to adopt VMI between the private distributor and the hospital, if the hospital decides to initiate the approach. The hospital selected this distributor because the company is a large organisation that provides many products and high volumes of pharmaceutical supplies directly to the hospital and has the potential to engage in VMI adoption. For the other three Dyads that operate under the national health scheme, the public manufacturer is responsible for distributing antiretroviral products. Hospitals that enrol in the national health scheme receive free products based on the number of registered patients. This attracts the public hospitals to engage in VMI projects with the public manufacturer. Thus, VMI has been adopted in Dyads 2 and 3. In the meantime, it allows the private hospital to engage in this national health scheme project as well. This expands the distribution channel of the products to the patients while the private hospital receives free products and reimbursement for other relevant services. Hence, the private hospital H_C adopts a VMI project with the public manufacturer.

In conclusion, from this study, the type of supplier affects the feasibility of the VMI approach in a hospital setting. For the public manufacturer, it is possible to implement VMI as the program operates under a national health scheme project, which persuades the various types of hospital to engage with this program. However, it is difficult for private suppliers to initiate VMI adoption as the hospital itself typically decides whether the project should be implemented.

4.1.2 Supplier performance

Supplier performance is another factor enabling the feasibility of VMI. It needs to be evident that the supplier is capable of handling the flow of information and physical stock in order to facilitate the smooth implementation of VMI (Vigtil, 2008). For the distributor,

the company owns one of the largest warehouse in Thailand and has five cross-docking distribution centres across country to facilitate and enhance timely distribution. IT applications and warehouse management systems are employed to enhance information visibility and improve stock management. This enables the company to deliver products at the right place, at the right time and in the right quantity. So, hospitals tend to be satisfied with the company's performance. For Dyad 1, the hospital was willing to collaborate with the distributor as it is a key supplier and has the capacity to manage a VMI project. For the manufacturer, as a publicly-owned organisation, it has the capability to invest in the logistic system to ensure product availability and accessibility to the hospital. Hospitals that enrol in public VMI projects do not bear the cost of products or service as the manufacturer receives funds from the government to facilitate the distribution channel. In terms of supplier performance, it is found that both companies have a capability to ensure product availability and are ready to engage with VMI projects. These enhance the likelihood of VMI adoption with the hospital.

4.1.3 Willingness to undertake a VMI project

For all 4 Dyads, the distributor and the manufacturer are willing to be involved in VMI projects, even though the goals and purposes of VMI are different due to the characteristics of the organisations involved and the context. In the Dyad 1, the university hospital H_A is a key customer from which the distributor gains a high percentage of sales. The distributor considers engaging in a collaborative approach to help it to provide better service, improve resource utilization and importantly, secure customer retention in a highly competitive market situation. Hence, the company decided to respond to the request from the hospital and proposed that it would be responsible for developing information systems in order to facilitate the information management. VMI adoption was considered based on strategic and financial goals. For the Dyads 2, 3 and 4, the manufacturer is responsible to ensure product availability and accessibility to all HIV patients in the country. Implementing a VMI approach can ensure customer service improvement and product accessibility. As the manufacturer considers the benefit to be gained from this approach, it is willing to invest time and resource by providing the training and IT infrastructure to attract both public and private hospitals to enrol in the public VMI project. In conclusion, these suppliers have a willingness to undertake VMI projects but for different reasons. The distributor is concerned more on strengthening the relationship with a key customer while the public supplier considers to enhance product availability and welfare benefits to adopt VMI approach.

4.2 Hospital characteristics

4.2.1 Type of hospital

For the public VMI project implemented in Dyads 2, 3 and 4, the characteristics of the hospitals are different with respect to ownership, size, and hospital location. However, it was not evident in this study that the type of hospital affected VMI adoption for the public VMI project as the objective of the government project is to enhance medicine accessibility for HIV patients and hence size or location of the hospital are not relevant.

In Dyad 1 hospital H_A implements VMI with the private distributor. The difference between this hospital and the other two hospitals is that it is large with more than 1000 beds. As such, the hospital is a key customer to the private distributor and it has bargaining power to negotiate with the distributor to engage in this collaborative approach. Moreover, hospital H_A also has the capability to invest in high quality medical equipment and technology systems to enhance high quality medical services. However, when asked, neither of the other hospitals had considered implementation of VMI with other suppliers. For the provincial hospital H_B , the pharmacist pointed out that, owing to the success of VMI project with the public sector, it would be interesting to engage in a VMI project with a private supplier. However, given the size of the hospital it would not be attractive for the private suppliers to invest and enrol in a VMI project. The private hospital state clearly that they are not interested in implementing VMI agreements with other suppliers except the current public VMI project. In conclusion, given the need for

medicine accessibility, the type of hospital does not matter for the public VMI project. However, when VMI is implemented as a private project hospital size does matter as the large hospital has financial, systems and labour resources to invest in its adoption and also has the bargaining power to negotiate with the private supplier. Thus, it appears that large hospitals may be more likely to engage in VMI adoption than smaller hospitals.

4.2.2 Top management commitment

From the four Dyads, it is clear that top management commitment can affect the adoption and continuation of a VMI approach. The decision to engage in a VMI project depends on the hospital's management board. Without this decision, it is impossible for VMI projects to be initiated. In Dyads 2, 3 and 4, top management has considered the benefits gained from VMI approach with public manufacturer where the hospital bears less risk. The VMI project is used to monitor the stock for antiretroviral products. As noted, the initiation of a private VMI program is typically from the hospital side. Due to the need for top management approval, several meetings were needed as VMI adoption requires involvement from different parties, including representatives from the supplier's side, pharmacists, IT staff, and third-party logistics experts. These meetings were held to discuss the issues related to collaboration including internal and external IT integration, the contract, and product characteristics. However, it was decided that VMI should be implemented only for the least complicated products. Thus, the designed VMI project was implemented with normal saline solution instead of pharmaceutical products. Hence it is apparent that top management can affect the likelihood of VMI adoption.

4.2.3 Willingness to share information

For the public VMI project, the hospitals and the manufacturer have developed trust with each other and the hospitals are willing to share information with the manufacturer. For the Dyads 2 and 3, all operate as state-owned organisations. So, they are comfortable in sharing this sensitive information with the manufacturer. For Dyad 4, even though the hospital is a private hospital, it also shares information with the manufacturer because it is aware that the manufacturer will not take advantage from this sensitive information as the project is for non-profit purposes. So, the hospital is prepared to engage in VMI with the manufacturer. On the other hand, none of the hospitals are currently employing VMI projects with the distributors. For Dyad 1, it is possible that the hospital does not want to lose control over the management of pharmaceutical stock and may perceive risks in sharing information with the private sector. Even though the purpose of VMI project with the public hospital aims to enhance strategic collaboration and enable benefits to both parties, the hospital is not willing to share this sensitive information with the private sector. All other hospitals are also reluctant to share information and engage in VMI collaboration with the private distributors. This is similar to the study of Stanger (2013) who notes that the willingness of the customer to share sensitive information with the supplier is critical for VMI adoption in the blood supply chain.

4.3 Supply chain characteristics

4.3.1 Current supply chain integration

For this study two types of VMI adoption can be identified - private projects and public projects. Dyad 1 is a private VMI project that was initiated individually between hospital H_A and the distributor. It aimed to replace the traditional replenishment approach with a VMI approach. The VMI project was designed and it was planned to facilitate information sharing between the hospital and the distributor electronically. The hospital originally considered to implement this with the top-ten high volume products with smooth volumes that the hospital obtains from the distributor. In this Dyad, the distributor was willing to bear the cost for the information system while the hospital was responsible for the cost of purchased products. However, the program for pharmaceutical products has been discontinued, while it is now piloted with the normal saline solution only, which is operated by another supplier. The other Dyads can be categorised as public VMI projects. The project was launched as part of a National health project. It was initiated by the manufacturer and the contracted hospitals, including hospitals H_A , H_B and H_C . It is less

complicated than the project between H_A and the distributor. The issues discussed between the VMI implementers are the communication channels, information issues and the authorized representatives. This project has discarded the purchasing and document creation processes, which motivates the hospitals to be involved in the project. In this case, the manufacturer bears the cost for setting up the information system. The costs of the products are reimbursed by the national health authority. In conclusion, the differences between these two VMI projects is that the hospital bears less risk under the public project as the hospitals do not have to bear the cost for products or information systems. So, when the VMI project is operated as a public project, it appears to be more sustainable than the private project.

4.3.2 Flow of information

The case studies reveal two aspects to be considered, including the medium for sharing information and the type of information shared. Firstly, electronic information systems are considered to facilitate information sharing within all Dyads. The similarity between these VMI adoptions is that the suppliers are responsible for investing and developing web-based portals as a medium to share information with customers as the manufacturer and distributor gain advantage from this demand data. Such IT applications have to be easy to use and to access to persuade the hospital to share information with suppliers. Secondly, for Dyad 1, it was considered that the IT system would allow the distributor to see the actual stock level for VMI products. The Dyad was planned to set up an agreed minimum and maximum level for each VMI product so that the distributor was able to calculate the replenishment quantities. However, the distributor only proposed the replenishment quantities, allowing the hospital to make a final decision for the replenishment. For the other Dyad, the hospital has to specify the total number of registered patients with the manufacturer. In addition, each week the responsible pharmacist keys in the stock levels on the web-portal and the manufacturer uses this data to decide the replenishment quantities. In conclusion, the flow of information is a key factor to encourage VMI adoption. For all VMI Dyads, the supplier is responsible for investing in information systems that enable information sharing. The ease-of-use and accessibility of IT systems may persuade hospitals to share necessary data with suppliers. Interestingly, even though the hospital agrees to share the information, it still wants to be involved in the replenishment decisions in some cases.

4.3.3 Flow of material

The VMI supplier is responsible for delivering products directly to the hospital's central warehouse. The products are stocked at the central warehouse and then distributed internally by hospital staff to the storeroom. To ensure an efficient flow of material, performance measurement is needed. Under the public VMI project, checks are carried out of on-time delivery, delivery accuracy, document accuracy and the product quality. Even though hospitals still experience delivery delays, overall the hospitals are satisfied with the public manufacturer's performance in managing and operating VMI. For the private VMI project, the key performance indicators were set to assess the distributor's performance in terms of the delivery and the stock fulfilment. For delivery performance, it is similar to the public VMI project that the hospital checks the percentage of inaccurate documents, inaccurate amounts of product, and the delivery lead time. Stock fulfilment performance focuses on the percentage of stock outs, inaccurate advance shipping notice (ASN) documents, the justification for proposed replenishment quantities, inaccurate delivery documents, inconsistent with the ASN document. In conclusion, key performance indicators are used to assess the efficient of flow of material operated by the suppliers and the performance outcomes of the suppliers affect the feasibility of this collaborative approach.

4.3.4 Relationship between supplier and hospital

With regards to Dyad 1, the collaboration between the supplier and hospital depends on the product type. For some particular products, if it can be supplied by various suppliers and also be substituted by other products in the same therapeutic category, the hospital

may not be interested in developing a long term relationship with one particular supplier. Vigorous competition promotes high delivery performance and lower prices of medicine as benefits to the hospital. Also suppliers and hospitals seem in some cases to have adversarial objectives. A supplier aims at enhancing revenue by pushing products to hospital while the hospital considers cost-effectiveness before selecting the product. Thus, the relationship between hospital and supplier is more likely to be developed based on the contractual agreements. However, when comparing the bargaining power across Dyad 1, it shows that the hospital is more powerful. The hospital was dominant in the VMI adoption as this project was initiated by the hospital but later discontinued. On the other hand, the public VMI project does not have a dominant actor because both hospitals and the public manufacturer have the same goal to promote drug accessibility. Moreover, under the public project, the national health organisation is responsible for selecting appropriate suppliers and the public manufacturer operates the logistic system to the hospital. According to this, some types of antiretroviral products may be supplied by the public manufacturer and some of them may be purchased from other pharmaceutical companies that offer a competitive deal. Hence, the cost-effective purpose is achieved as well. In conclusion, the feasibility of private VMI project depends on the decisions of the hospital, which tend to be the dominant actor in such projects. On the other hand, the mutual agreement under the public sector enables the public project to persuade more parties and appears more sustainable than the private project.

4.4 Product characteristics

Pharmaceutical products often have several brands and substitute products in the same therapeutic groups. So, the hospital does not want to adopt the collaborative approach with a particular supplier as it gains advantage from the market competition. Also, cost-effectiveness is critical for the hospital. Hence, the hospital prefers to gain advantage by protecting its bargaining power with various substitutes available in the market. This is consistent with the finding of Stanger (2013) that hospitals may accept dependence when there is one supplier. According to the case studies, if VMI adoption is under consideration, hospitals may possibly agree to implement it with smooth rather than fluctuating demand products because the former are predictable and the hospital is able to estimate the stock level that should be prepared. This also allows the hospital to assess whether the suppliers makes a justified decision for the replenishment quantities. Moreover, it is feasible that the public sector implement VMI to control stocks for vital products. In this study, HIV disease is a serious problem in the country and the government wishes to ensure product accessibility to all patients. So, antiretroviral products are selected to operate under VMI approach. In addition, the national healthcare scheme reimburses the cost for these products, which means the hospital does not bear the costs for the product or for VMI implementation. From the hospital's side, it is attractive for them to enrol in the public VMI project.

5. CONCLUSIONS

This study has investigated the feasibility of a VMI approach in hospital pharmaceutical supply chains with regard to four aspects - hospital, supplier, supply chain integration, and product characteristics. The work was based on a number of case studies conducted in Thailand. The study examined two types of VMI adoption - public sector and private sector. The type has affected the feasibility of VMI adoption and its continuation. The public project was launched under a national healthcare project which was concerned with enhancing product accessibility to patients regardless of the type or location of the hospital. The private project was operated between a large hospital and a private distributor in order to enhance collaboration and enable benefits to both parties. The size of hospital appears to be a factor in a private sector VMI project. A large hospital is attracted to engage in VMI adoption with a distributor as it has more bargaining power to negotiate the implementation of a new approach compared with a smaller hospital. For both types of VMI project, the size and the capability of the supplier affects the hospital's willingness to implement a VMI approach.

To enhance collaboration, the supplier needs to invest and develop easy-to-use IT systems to encourage the hospital to share information and facilitate effective information flow. The hospital prefers to adopt the approach with smooth demand products as they are predictable and easier to manage than products with fluctuating demand. In addition, VMI is feasible for vital products such as antiretroviral medicines in which it is necessary to ensure product availability and accessibility to all patients and where governments exercise control. Other product characteristics also affect the feasibility of VMI adoption. If there are various suppliers in the market for a particular product, and various substitutes are available in the same therapeutic groups, hospitals may not be interested in adopting a VMI approach with a particular supplier as it may not allow the hospital to achieve cost efficiencies. Implementing a VMI approach may mean the hospital will lose its bargaining power to negotiate on price and thus fail to gain benefits from competition in the marketplace. In addition, pharmaceutical supplies are critical products for hospitals. Hospitals perceive risks and lack of control in giving up stock management and transferring the responsibility to the supplier. This affected the private VMI project, which was ultimately discontinued with the distributor but a VMI implementation was continued with another supplier on a relatively simple product.

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THE IMPLICATIONS OF JUDGEMENTAL INTERVENTIONS INTO AN INVENTORY SYSTEM

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ABSTRACT

Purpose of this paper:

Physical inventories constitute a considerable proportion of companies' investments in today's competitive environment. The trade-off between customer service levels and inventory investments is addressed in practice by formal quantitative inventory management (stock control) solutions. Given the tremendous number of Stock Keeping Units (SKUs) that contemporary organisations deal with, such solutions need to be fully automated. However, managers very often judgementally adjust the output of statistical software (such as the demand forecasts and/or the replenishment decisions) to reflect qualitative information that they possess. In this research we are concerned with the value being added (or not) when such statistical/quantitative output is judgementally adjusted by managers.

Design/methodology/approach:

Our work aims to investigate the effects of incorporating human judgement into inventory related decisions and it is the first study to do so empirically. First, a set of relevant research questions is developed based on a critical review of the literature. Then, an extended database of approximately 1,800 SKUs from an electronics company is analysed for the purpose of addressing the research questions. In addition to empirical exploratory analysis, a simulation experiment is performed in order to evaluate in a dynamic fashion what are the effects of adjustments on the performance of a stock control system.

Findings:

The results on the simulation experiment reveal that judgementally adjusted replenishment orders may improve inventory performance in terms of reduced inventory investments (costs). However, adjustments do not seem to contribute towards the increase of the cycle service levels (CSL) or fill rates.

Value & practical implications:

Since there have been no studies addressing similar issues to date, this research should be of considerable value in advancing the current state of knowledge in the area of inventory management. From a practitioner's perspective, the findings of this research may guide managers in adjusting order-up-to levels for the purpose of achieving better inventory performance. Further, the results may also contribute towards the development of better functionality of inventory support systems (ISS).

Research limitations/implications:

This study is the first of its kind. Further research is needed in terms of reaching generalisable conclusions through other datasets (companies) and other inventory policies used in practice.

Keywords

Inventory control, human judgement, decision support systems (DSS)

1. INTRODUCTION

Inventory control is an essential function in the supply chain since it plays an important role in improving the service level and reducing the operation cost of logistic systems. It determines the safety stock that needs to be maintained to ensure that products are readily available when the customers require them. The trade-off between customer service levels and inventory investment is addressed in practice by formal quantitative inventory management (stock control) solutions.

Commonly, an inventory system consists of two main stages - forecasting and stock control. Given the tremendous number of SKUs that contemporary organisations deal with, the solutions need to be fully automated. However, and although such systems are indeed in principle fully automated, what most often happens in practice is the following: managers intervene in the software system and judgementally adjust various quantitatively/ statistically derived outputs. With regards to forecasting, empirical research suggests that practitioners rely heavily on judgemental forecasting methods (e.g. Sanders and Manrodt, 1994; Klassen and Flores, 2001). Similarly, all too often an integrated approach is essentially used whereby statistical forecasts are judgementally adjusted (e.g. Syntetos et al., 2009).

There is a growing body of empirical knowledge in the area of judgementally adjusting statistical forecasts. However, at the moment, there is not a single paper in the academic literature that explores the effects of such judgemental adjustments into replenishment decisions. This study aims to analyse the effects of incorporating human judgement into inventory decision-making. (It does so by means of using data from the service parts logistics network of a major Japanese Electronics manufacturer.) From a theoretical perspective there is tremendous scope for contributing to and further advancing the current state of knowledge, since there have been no studies addressing this issue to date. From a practitioner perspective, the findings of this research result into tangible suggestions and recommendations to inventory managers, in addition to the obvious implications for decision support systems (DSS) design and improvement.

2. RESEARCH BACKGROUND

2.1. Judgemental adjustments in forecasting

A plethora of studies have considered the process of judgementally adjusting statistical forecasts. Many studies have concluded that managerial interventions in statistical forecasts improve forecast accuracy (Angus-Leppan and Fatseas, 1986; Lawrence et al., 1986; Mathew and Diamantopoulos, 1986, 1990, 1992; Diamantopoulos and Mathews, 1989; Wolfe and Flores, 1990, Syntetos et al., 2009). The knowledge of the effects of judgement into demand forecasting is most useful in terms of potential amendments of the forecasting process and Forecast Support Systems (FSS) (Goodwin and Wright, 1994; Goodwin, 2000). For example, Fildes et al. (2009) found large adjustments to be more effective in improving forecast accuracy than small adjustments. This is because small adjustments indicate reaction to noise, whereas large adjustments may carry some genuine piece of information that is not included in the historical data. Syntetos et al. (2009) found that large negative adjustments perform very well in improving forecast accuracy (as they are also associated with some genuinely important information); the relatively poor performance of positive adjustments may be a result of an optimism bias on the part of the forecasters or gaming behavior in order, for example, to get priority from the suppliers or ensure high service levels. That is, when people adjust forecasts downwards means that they do know something important. Adjustments should ideally reflect information that it is not available in the statistical model. Knowledge such as that discussed above may then be reflected in the design of DSS.

2.2. Judgemental adjustments of inventory parameters

Despite the prevalence of statistical forecast adjustments, what is even more common in practice is that managers adjust stock replenishment orders, not the forecasts. Kolassa et al. (2008) reported that judgemental adjustments of stock control quantities occur more often than forecast-related adjustments. Moreover, Syntetos et al. (2011) explored the effects of adjusting forecasts and/or replenishment orders by deploying a system dynamics (SD) methodology in a simulated three-stage supply chain. This research found that human intervention in forecasting seems to have more significant effects than replenishment order judgemental adjustments. It was also found that the impact of the forecast and order adjustments is less prominent as the intervention point moves upstream in the supply chain (from Client to Home to Factory); and also, the re-order point s , order-up-to-level S , inventory control policy appears to be less sensitive to judgemental adjustments than the classical order-up-to-level S and the Anchor-and-Adjust policy.

3. CASE STUDY ORGANISATION

The database available for the purposes of this research comes from the service parts logistics network of a major Japanese electronics manufacturer. The entire database relates to service parts used for supporting the final pieces of equipment sold in Europe. The organisation implements an ERP package, SAP R/3 (SAP-AG, Germany). In this software, the materials management (MM) module is essentially used to control service parts. The database consists of the individual demand histories of various stock keeping units (SKUs). The demand histories have been made available to us in a time-series format covering weekly information in 26 periods. The case organisation categorises the SKUs considering a cumulative demand value (DV) based Pareto classification, where: $DV = \text{SKU cost} \times \text{quantity required}$. In addition, managers in the company under consideration adjust inventory quantities, often providing a qualitative justification for their actions. Linking the effects of adjustments to the justification provided for such adjustments has never been discussed in the academic literature before (not even in the forecasting context); this linkage (on its own) is perceived as a major contribution of the research.

3.1. SKUs classification, forecasting and stock control

In this research we used only A and B items as C parts are managed outside the system through a manual process. In total, there are 4,661 A-class SKUs and 15,365 B-class SKUs. With regards to forecasting, at the end of every month, a six-month (24 weeks) Simple Moving Average, SMA(24), forecast is produced. This forecast is also used to compute the safety stock for every SKU by multiplying it by a safety target (expressed in terms of time requirements). This safety target equates to eight weeks availability for A items and 12 weeks for B items. Following this, the order frequency and the lead times are also taken into account in order to calculate the order-up-to (OUT) level for every SKU. The periodic nature of the system is reflected in an order frequency adjustment of 2 weeks. Lead times are assumed to be fixed and equal to nine weeks (average lead times are 60 days). Inventory control takes place through a periodic OUT level system (which in the company is, erroneously, referred to as a re-order point (ROP) system). The OUT replenishment level is calculated at the end of every month by multiplying the SMA(24) forecast by 19 (8 weeks safety stock + 9 weeks lead time + 2 weeks order frequency adjustment) in the case of A items, and 23 (12 weeks target safety stock + 9 weeks lead time + 2 weeks order frequency adjustment) in the case of B items.

3.2. Judgemental adjustment process

Initially, the OUT level is produced by the SAP system (hereafter termed as the *System OUT replenishment level*) and when managers feel it is necessary they may alter it by integrating their own judgement. This should ideally reflect information that is not captured in the quantitative (time series) data. When making the adjustments, another OUT level (this will be referred to as the *SMA-Based OUT replenishment level*) is taken into account which is the one calculated based on the descriptions provided in the previous sub-section. So essentially managers make adjustments to the *System OUT*

replenishment level by considering the OUT level calculated using the company's formula. The adjusted OUT level is the manager's final decision for the end of the current month and will be used to drive replenishment decisions in the following month. This will be referred to as the *Final OUT replenishment level*. On the other hand, if managers do not make any changes to the order replenishment level, the *System OUT replenishment level* is recorded as the final decision for the current month and it constitutes the initial OUT level for the next period.

4. RESEARCH METHODOLOGY

This study aims to investigate the effects of incorporating human judgement into inventory related decisions and it is the first study to do so empirically. First, a set of relevant research questions is developed based on a critical review of the literature. The research questions are as follow:

1. Is there any improvement resulting from judgementally adjusting stock control-related decisions and if so why?
2. How the sign and size of the adjustments affects the performance of the inventory system?
3. Is there any improvement achieved by the adjustments for which justification is offered as compared to those without a justification and if so why?
4. Are judgementally adjusted stock control decisions biased?
5. Is there any learning taking place in the process of adjusting stock control quantities and if so how?

Then, an extended database is analysed for the purpose of addressing the research questions. Moreover, a simulation experiment is performed in order to evaluate in a dynamic fashion what are the effects of adjustments on the performance of a stock control system. Only 179 A-class and 228 B-class SKUs are being utilized for simulation purposes on the basis of having at least eight consecutive replenishment order observations. Demand data series over 26 periods (monthly), the prices of SKUs and the replenishment orders (unadjusted and adjusted) are available. We consider three opportunities for replenishing stock: the System OUT level (unadjusted OUT level), the Final OUT level (adjusted OUT level), and the SMA-Based OUT level. Two scenarios are considered for simulation purposes. The first one is an intuitively appealing representation of the process, whereas the second is the standard one used in analytical evaluations of the OUT policy. In the first scenario, the stock on hand and the orders are calculated as follows (where t is the current time period, and given that the lead time is 2 months, orders placed in period $t-2$ are received in period t):

$$\begin{aligned} \text{Stock}_t &= \text{Stock}_{t-1} - \text{Demand}_t + \text{Order}_{t-2} \\ \text{Order}_t &= \text{OUT Level}_t - \text{Stock}_t \end{aligned}$$

In the second scenario, the stock on hand is calculated as above but the order quantity is defined as

$$\text{Order}_t = \text{OUT Level}_t - \text{OUT Level}_{t-1} + \text{Demand}_t$$

In terms of the output of the simulation experiment we record the inventory investment (inventory holding cost), cycle service level (CSL) and fill rate for each SKU.

5. RESEARCH RESULTS, ANALYSIS AND DISCUSSION

5.1 Goodness-of-fit tests and distributional considerations

The magnitude of the adjustments (and their sign) may be calculated by observing the difference between two consecutive Final OUT replenishment levels. Adjustments are assessed and analysed in terms of the distribution of their signed size, absolute size, relative signed size and relative absolute size, to capture collectively the characteristics of both magnitude and direction (both in absolute and relative terms, the latter relating to the level of the demand). The relative signed size and absolute size of Final OUT replenishment levels is calculated by dividing the difference between successor and predecessor over the predecessor. The goodness-of-fit of various plausible theoretical

statistical distributions is analysed using the Kolmogorov-Smirnov (K-S) test statistic. The summary of the best fitting distributions can be seen in Table 1.

	A items	B items
Signed size of adjustment	<ul style="list-style-type: none"> • Most adjustments are between 0 – -20 units • Cauchy distribution 	<ul style="list-style-type: none"> • Most adjustments are between 0 – 10 units • Weibull distribution
Absolute size of adjustment	<ul style="list-style-type: none"> • Most adjustments are between 0 – 20 units • Gamma distribution 	<ul style="list-style-type: none"> • Most adjustments are between 0 – 10 units • Gamma distribution
Relative signed size of adjustment	<ul style="list-style-type: none"> • Most adjustments are between -25% – -30% (negative adjustments) and 5% – 15% (positive adjustments) • Cauchy distribution 	<ul style="list-style-type: none"> • Most adjustments are between -30% – -35% (negative adjustments) and 35% –40% (positive adjustments) • Cauchy distribution
Relative absolute size of adjustment	<ul style="list-style-type: none"> • Most adjustments are between 20% – 25% • Gamma distribution 	<ul style="list-style-type: none"> • Most adjustments are between 30% – 35% • Cauchy distribution

Table 1. Distributions of adjustments for A and B items.

Knowledge of particular distributions that provide a good fit to the adjustments is extremely useful towards the design of relevant DSS. Since the parameters of the distributions can be calculated based on past data (past adjustments) percentiles may be specified that relate to, for example, authorization points. That is, adjustments greater than x amount (expressed either in signed/absolute or relative terms) need to be authorized whereas adjustments below the authorization point may be freely conducted.

5.2. Analysis of the justification of adjustments

The majority of the justifications provided for adjusting the OUT levels related to perceived changes in the underlying demand patterns; managers will indicate 'increasing' or 'decreasing' demand as the reason for altering the OUT levels. A linear regression analysis was considered using the past 24 weeks' demand data (for each point of intervention/ adjustment when such a justification has been provided) to assess whether or not a non-stationary behavior (positive or negative slope) was present on the data. There were 1,461 A-class (31.35%) and 2,958 B-class SKUs (19.25%) associated with a justification (reason provided) for adjusting an OUT level. 1,160 (79.40% of those) A-class SKUs related to a consistency between what was identified by the managers and what our analysis has shown. That is, there was for example an increasing demand when such an increase was indeed perceived by the managers. However, there was a great proportion of SKUs (20.6%) associated with the managers seeing a direction in the evolution of the demand series opposite to what was actually happening (184 demand patterns perceived as increasing, when in fact demand was decreasing, and 117 demand patterns where the opposite was the case). For B-class SKUs, there were 2,234 (75.52%) cases where the justification and actual behavior of the series were in accordance and 724 (24.48%) cases where a wrong direction of the demand data was perceived (388 decreasing demand patterns were perceived as increasing, and 336 increasing demand patterns were perceived as decreasing). The above results indicate that, in adjusting the Order-Up-To level, managers may make significant errors. This may be explained in terms of the apparent arbitrary nature of the adjustments or, another possibility may relate to the adjustments facilitating some sense of ownership of the process on the part of the stock controllers. Furthermore, they may also be interpreted as follows: important contextual information was indeed available to managers, but for reporting purposes (and for convenience) they always resort to documenting the same justification (i.e. a perceived change in the demand pattern).

5.3. Simulation results

Table 2 presents the results obtained from the two simulation scenarios conducted on A and B items. As can be seen from this table, the total inventory investment related to adjusted orders of A items is slightly lower than the unadjusted ones for both scenarios. The decrease of inventory investment is about 0.61% and 3.16% for scenario 1 and 2 respectively. Considering the trade-off between inventory cost and service, it seems that judgemental adjustments account for an improvement in terms of inventory investment at the expense though of an expected service reduction. Turning now to the results for B items, it can be seen that the Final OUT replenishment level is associated with a higher inventory investment as compared with the System OUT replenishment level for both scenarios. The increase was 0.95% and 0.10% for scenario 1 and 2 respectively. This increase also results to the increase of the service provision, though it is not particularly prevalent (less than 1%).

Replenishment order system	Performance indicator	A items		B items	
		Scenario 1	Scenario 2	Scenario 1	Scenario 2
System OUT replenishment level	Total inventory investment (€)	1,075,021	750,397	131,876	108,469
	Average CSL	0.991	0.924	0.986	0.889
	Average fill rate	0.993	0.948	0.962	0.891
Final OUT replenishment Level	Total inventory investment (€)	1,068,503	726,701	133,133	108,580
	Average CSL	0.991	0.905	0.987	0.889
	Average fill rate	0.993	0.930	0.965	0.893
SMA-based OUT replenishment Level	Total inventory investment (€)	1,036,226	685,263	135,394	109,746
	Average CSL	0.991	0.861	0.988	0.886
	Average fill rate	0.993	0.892	0.968	0.892

Table 2. Simulation results for A and B items

From the above discussion we may provide an answer to the first research question, about the potential performance improvement resulting from judgementally adjusting stock control-related decisions; we find that human intervention seems to offer a reasonable advantage in stock control decision making.

5.4. The effects of the sign of adjustments on inventory performance

The purpose of this analysis is to evaluate the effects of the sign of adjustments (positive/increasing adjustments and negative/decreasing adjustments) on inventory performance. The simulation results for A items indicate that negative adjustments perform better than positive ones in improving the performance of the inventory system. For B items, negative adjustments were found to produce lower inventory investments (than not adjusting the OUT levels) whereas positive adjustments accounted for higher inventory investments. The experiment, with or without adjustments, shows similar values for CSL and fill rates. Thus, as the results are the same with the A-class items we may conclude that negative adjustments may deliver more benefit than positive adjustments towards the improvement of inventory systems. The relatively poor performance of positive adjustments may be a result of an optimism bias on the part of the stock controllers. Managers tend to over-weight the statistical system's replenishment levels when contextual information is available (but in the absence of reliable evidence). Alternatively, excessive upward adjustments may be motivated by political factors such as pressure from senior management to achieve high service levels or obtain priority from suppliers, as previously discussed in sub-section 2.1.

5.5. The effects of the absolute size of adjustments on inventory performance

The analysis of the effects of the size of adjustments is conducted using the average of the absolute size of the adjustments (the sign of adjustments is not considered in calculating the average). The next step is to calculate the percentage adjustment from the average demand for every SKU for the purpose of classifying the SKUs into *small*, *medium*, and *large* adjustments: i) small adjustments: $0 < \text{average adjustment/average}$

demand $\leq 10\%$,ii) medium adjustments: $10\% < \text{average adjustment/average demand} \leq 20\%$,iii) large adjustments: $\text{average adjustment/average demand} > 20\%$. (The particular cut-off points used for the categorization are motivated by previous research in the area of forecasting by Fildes et al. (2009)). Then the inventory performance (inventory investment, CSL, and fill rate) is compared for each category in every scenario. This performance analysis is based on the average of the adjustments across time since the signs of adjustments for each SKU cannot be useful. The simulation results indicate that, for A-class items, the inventory investment of adjusted replenishment orders is lower than that associated with unadjusted replenishment orders. Further analysis on the size of the adjustments for both scenarios revealed that the 'large adjustment' category (adjustments higher than 20% relative to the system replenishment level) results to the best performance as the decrease of inventory cost is not accompanied by an expected decrease of service provision. The opposite result was found for the B-class items - that is, adjusted replenishment orders seem to be associated with a higher inventory investment compared to the unadjusted ones although the differences are very small (mostly less than 0.5%). The slight increase in cost also results in a small improvement of the CSL and fill rate. From these results we may see that the best performance is resulting from the 'large adjustment' category; the smallest increase in inventory investment may result in the highest CSL and fill rate as compared to other categories.

5.6. The effects of justification of adjustments on inventory performance

This part of the analysis is a continuation of the research described in sub-section 5.2 to examine the effects of the justifications of adjustments on inventory performance. It is achieved by calculating the number of justified adjustments for each SKU. Then, the adjustments are separated into four categories, based on the number (%) of justifications provided: i) $\leq 25\%$; ii) $> 25\%$ and $\leq 50\%$; iii) $> 50\%$ and $\leq 75\%$; iv) $> 75\%$. Inventory performance is then assessed for every category and scenario considered. The findings show that the SKUs associated with more than 75% justifications produce the highest stock control performance. The recorded reasons or justifications behind managers changing the OUT levels produced by the software system in the past may be the factor that helps decision makers to successfully intervene into the system (i.e. a database is being developed that may be used for reference purposes and establishment of analogies etc.)

5.7. The effects of the bias of adjustments on inventory performance

For this analysis, identification of bias of adjustments is achieved by calculating the average adjustment per SKU (across time). Then the maximum and minimum values of adjustments are recorded. The next step is to calculate the value of 10% of the maximum of negative adjustments and 10% of the minimum of positive adjustments, to classify the average adjustments as positive biased, unbiased or negative biased. For this categorization: i) positive bias relates to an average adjustment per SKU $> 10\%$ max, ii) unbiased adjustments relate to: $\min 10\% < \text{the average adjustment per SKU} \leq 10\%$ max, and iii) negative bias relates to an average adjustment per SKU $\leq 10\%$ min. Next, inventory performance is averaged across the SKUs in each of the categories, and comparisons across categories take place. For A items, it is found that inventory investments associated with the Final OUT replenishment levels are generally lower than those associated with the System OUT replenishment levels for both scenarios. Moreover, we can conclude that the 'negative biased adjustment' category performs well in improving the performance of the inventory system since it results in the lowest inventory investment and does not imply (or it does only marginally) a reduction of the CSL and fill rate. In the analysis of B items we found that the inventory investment of the Final OUT replenishment levels seems to be lower than that of the System OUT replenishment levels only in the 'negative biased adjustment' category for both scenarios. This indicates that 'negative bias' performs better than the other categories. It means, as previously discussed, that negative adjustments perform better than positive ones.

5.8. Learning effects of making adjustments on inventory performance

This part of the analysis is based on the number of adjustments for each SKU. The number of adjustments is grouped in three categories: i) Low: number of adjustments ≤ 13 , ii) Medium: $13 < \text{number of adjustments} \leq 21$, iii) High: number of adjustments > 21 . We then compared the inventory performance resulting in these three groups, assuming the more adjustments are associated with a higher learning effect (the more the process of adjusting is repeated, the more the individual who performs the adjustments learns and the better s/he performs.). For A-class items, judgemental adjustments generally lead to inventory investment reductions. However, it was found that a high number of adjustments does not improve the inventory system performance. This might be due to more than one managers adjusting replenishment orders (or people swapping over to do the job). As a result, no learning effects were found; similar results have been reported for the forecasting process and from an organizational perspective by Nikolopoulos et al. (2006). For the B-class items, some occurrence of learning was reported although the results were not conclusive.

6. CONCLUSIONS AND EXTENSIONS

This study aimed to investigate the effects of incorporating human judgement into inventory-related decisions. By conducting a simulation experiment, we found that judgemental adjustments account for an improvement in inventory investment. However, the effects are not too prevailing in increasing the CSL and fill rate. Overall, the results indicate that human intervention seems to offer a 'reasonable' advantage in stock control decision making, important enough to offer a justification for these interventions in the first place. This result is in line with the previous empirical research in the area of demand forecasting conducted by Syntetos et al. (2009) and Syntetos et al. (2010) which shows that the inventory implications of adjusting demand forecasts are prominent. Moreover, the outcome of our empirical research shows (indirectly) that the effect of adjusting inventory decisions is less significant than that associated with adjusting forecasts. This finding confirms the previous study conducted by Syntetos et al. (2011) about the comparatively bigger importance of adjusting at the forecasting rather than at the inventory control level. With regards to the characteristics of the adjustments, we have found that negative adjustments result in better performance than positive ones, and that adjustments of a medium/large size perform better than small ones. This is aligned with the main conclusions derived in the forecasting literature. We have also explored this bias-related properties of judgemental adjustments and have found that indeed bias may be present in such a system. Furthermore, negative bias leads to better performance than positive bias. Some learning effect seems to take place in the process of adjusting stock control quantities, as it was found that SKUs associated with a high number of adjustments are indeed also associated with a better inventory control performance. Moreover, we attempted to assess whether offering a justification is associated with better performance and found that providing a justification for adjusting stock control quantities may indeed lead to an improved performance. Justifications very often related to a perceived change in the underlying demand pattern, (recorded as 'demand increasing' or 'decreasing') and the results indicate that managers may make significant errors in adjusting the OUT levels. They often seem to make judgements in an arbitrary way, reflecting the managers' need for a 'sense of ownership'. Finally, knowing the distribution that resembles the range and shape of the relevant decisions made by humans is most important in terms of the design of support systems. In the next steps of this research we intend to replicate the analysis in other datasets/organizations in order to further understand and clarify 'how' and 'why' managers perform adjustments in stock control. Moreover, development of more suitable scenarios using a system where adjustments are performed at both the forecasting and inventory control stage seems very much needed. Finally, it is important to develop a DSS for stock control purposes.

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Section 6: Customer-Supplier Collaboration and Relationships

ECONOMIC LOT-SIZING OPTIMIZATION UNDER THE CARBON EMISSION CONSTRAINT

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ABSTRACT

This paper incorporates the carbon emission constraint into the traditional production planning optimisation under the stochastic make-to-order (MTO) supply chain mode, so as to examine the effects of these constraints on the environment as well as the profitability. Propositions are proved to analytically demonstrate that the carbon emission constraint is able to reduce the emission of greenhouse gases (GHGs), but at the cost of sacrificing the profitability. This analytical result highlights the critical role of carbon management in production planning for achieving both the environmental and economic benefits. It also provides managerial insights into operations management to help to mitigate environmental deterioration arising from carbon emissions.

KEYWORDS

Production planning, Carbon emission, Lot-sizing, Stochastic, MTO

INTRODUCTION

The climatic change and environmental pollution problem, mainly arising from excessive carbon emission, has received worldwide attention in the most recent years. Large-scale emissions of GHGs, especially its main component—carbon dioxide (CO₂)—are leading to the widespread global warming on the global scale, imposing adverse impacts on the physical and biological systems on the earth.

The recent global-scale assessment made by the Intergovernmental Panel on Climate Change (IPCC) has shown that the anthropogenic global warming over the last three decades has posed a discernible influence on our planet (Parry et al., 2007). Archer and Pierrehumbert (2011) reported the number of great inland flood catastrophes per decade between 1996 and 2005 is twice as large as between 1958 and 1980, while the resultant economic losses have to be increased by a factor of five. Annamalai et al. (2012) also reported that monsoon rainfall over South Asia has decreased while sea surface temperature over the warm pool increased during the last several decades, according to several observations.

Despite the far-reaching impingements of carbon emissions and growing public awareness of environmental protection, quite few studies in the operations research have thus far explored this problem, leading to environmentally unsustainable optimisation results.

Absi and Sidhoum (2009), for example, attempted to incorporate constraints on carbon emission into a multi-sourcing lot sizing supply chain environment, aimed at minimising the total cost expense, as well as limiting the carbon emission per unit product. Yalabik and Fairchild (2011) conducted an economic analysis in order to examine the effects of customers, regulations, and competitive pressures on a firm's investments in environmentally friendly productions. Helmrich et al. (2012) studied the generalization of a lot sizing problem under the production environment with a carbon emission constraint. The carbon emission was introduced as a constraint condition imposed on an alternative cost function.

Different than these literatures, this article attempts to consider a lot sizing

production planning problem under the uncertain MTO supply chain mode, constrained by a carbon emission cap. This problem is firstly formulated as a stochastic queuing system with lot sizing. The stochasticity involved is characterized by their own probabilistic merits without any assumptions on them, so as to improve the generality as well as exactness of the proposed approach. Proofs of propositions are given to analytically illustrate the proposed model and to study effects of carbon emission constraints on production planning.

The remainder of the article is organized as follows. Section 2 gives a detailed introduction of the concerned production planning problem and its mathematical formulation. Analytical results for the problem are stated in Section 3. Section 4 concludes this article.

PRODUCTION MODEL FORMULATION

Problem Description

This article considers an uncertain single-product MTO manufacturing environment with stochastic interarrival orders, as illustrated in Figure 1. Individual orders randomly arrive at the manufacturing firm. When these orders accumulate to a batch of a given size Q , they are gathered and transferred to the setup stage for initial setup on a batch-by-batch basis. Subsequently, these partially completed orders are released to the processing stage to be processed and completed one by one. Finally the completed orders are individually delivered to end customers without waiting until the whole batch is finished.

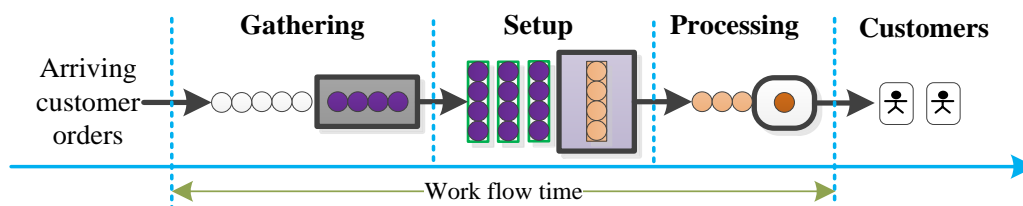


Figure 1: Stochastic MTO production work flow

The lot sizing policy is critical to the performance of the manufacturing system. Smaller lot sizes tend to produce frequent setups, while larger lot sizes decrease frequency of setups, but often result in higher work-in-process (WIP) inventory and carrying costs. In addition, uncertainties involved in the system poses a challenge to the production planning problem. These uncertainties are mostly attributed to a series of inherent factors, such as changes in customer preferences and needs, entry or exit of competitors, equipment failures, changes in processing rates, and so forth.

Assumptions

First, several assumptions need to be made so as to precisely formulate this manufacturing problem. They are listed as follows:

- (1) Orders are independent. This way all upcoming orders constitute a stochastic process with the independent and stationary increments.
- (2) All the machines are supposed to be independent. Machine breakdown is not allowed.
- (3) Once competing for capacitated resources, all orders would be served according to the first-come first-served principle. Preemption is not allowed.
- (4) Without loss of generality we suppose that each order contains only one single product.
- (5) The manufacturer is assumed to be a price taker in either the perfect or the monopolistic competition environment, that is, product prices are exogenous.
- (6) The decision and state variables pose no influence on the stochastic

processes.

Notations

All notations used in the article are listed as follows to clarify model derivation.

Q	Lot size.
\mathcal{R}	Operational profit.
D	Uncertain market demand.
γ	Unit sales price.
C_V	Variable costs.
C_F	Fixed costs.
s	Unit setup cost.
h	Unit WIP carrying cost.
ω	Sum of other variable costs.
W	Total work flow time.
W_{qg}	Queuing time for gathering.
W_g	Uncertain gathering time.
W_{qs}	Queuing time for setup.
W_s	Uncertain setup time.
W_{qp}	Queuing time for processing.
W_p	Uncertain processing time.
X_i	Interarrival time of the i^{th} order, all X_i 's are independent and identically distributed (<i>IID</i>).
Y_i	Setup time of the i^{th} batch, all Y_i 's are <i>IID</i> .
Z_i	Processing time of the i^{th} order, all Z_i 's are <i>IID</i> .
X^b	Interarrival times of batches for the assumed GI/G/1 queuing model.
T^b	Service time for the assumed GI/G/1 queuing model.
σ_X^2	Variance of interarrival times of orders.
σ_Y^2	Variances of setup times.
σ_Z^2	Variance of processing times.
τ	Mean setup time.
μ	Mean processing rate.
ρ	Traffic intensity.
e_m	Carbon emission from manufacturing.
κ_0	Fixed carbon emission factor in manufacturing.
κ_1	Variable carbon emission factor in manufacturing.
e_{WIP}	Carbon emission from WIP inventories.
g_0	Fixed carbon emission factor in WIP inventories.
g_1	Variable carbon emission factor in WIP inventories.
e	Total emission of GHGs.
M	Emission cap.
$E(\cdot)$	Expected function.
$Var(\cdot)$	Variance function.

Benchmark Model Derivation

This section derives the operational profit of the proposed manufacturing problem without considering carbon emission, serving as a benchmark against the production optimisation under the carbon emission constraint. The operational profit can be formulated as

$$\mathcal{R} = D\gamma - C_V - C_F, \quad (1)$$

with

$$C_v = D \left(s \frac{1}{Q} + E(W)h + \omega \right), \quad (2)$$

where ω denotes the sum of all the unit variable costs irrelevant to both the lot size and the expected lead time, such as the purchasing cost, the tax cost, and the sales cost. $E(W)$ represents the mean WIP inventory time.

Then we solve for $E(W)$ in a general way by characterizing all the involved random variables by their expected values and variances without making any unrealistic assumptions on their distributions. From Figure 1 it follows that the total work flow time W is the sum of the following six components

$$E(W) = E(W_{qs}) + E(W_g) + E(W_{qs}) + E(W_s) + E(W_{qp}) + E(W_p). \quad (3)$$

Next we will illustrate how to solve for these six components and thus for $E(W)$.

Upon arriving, an order is immediately gathered into a batch without waiting in a queue, leading to

$$E(W_{qs}) = 0. \quad (4)$$

The time that the i^{th} order takes in the gathering stage is the time that it waits for the remaining $Q-i$ orders to be gathered together with itself in a batch, i.e.,

$$E(W_g | i) = E \left(\sum_{j=i+1}^Q X_j | i \right) = \frac{Q-i}{D}, \quad (5)$$

where $i (1 \leq i \leq Q)$ represents the relative position of the order in the batch. It readily follows from (5) that

$$E(W_g) = E_i \left(E(W_g | i) \right) = \frac{Q-1}{2D}. \quad (6)$$

In order to obtain $E(W_{qs})$, suppose that finished orders would not individually leave the processing stage one by one until the whole batch was gathered. By this way the setup and processing stages may be simplified as a GI/G/1 queuing model, which is similar to the manufacturing environment, except for an overestimation on the processing time, but without any effect on W_{qs} . The equations for the GI/G/1 model, given by Bhat (2008), suggest

$$E(W_{qs}) = \frac{\text{Var}(X^b) + \text{Var}(T^b)}{2[E(X^b) - E(T^b)]}. \quad (7)$$

Considering the IID merits of X_i and Y_i ,

$$E(X^b) = \frac{Q}{D}, \text{Var}(X^b) = Q\sigma_x^2, E(T^b) = \tau + \frac{Q}{\mu}, \text{Var}(T^b) = \sigma_Y^2 + Q\sigma_z^2, \quad (8)$$

with a traffic intensity $\rho = E(T^b)/E(X^b)$.

Before being processed individually, the i^{th} order in a batch has to wait for the first $i-1$ orders ahead of it in the batch to be processed. Thus,

$$E(W_{qp} | i) = E(Y_1 + Y_2 + \dots + Y_{i-1} | i) = \frac{i-1}{\mu}, \quad (9)$$

$$E(W_{qp}) = E_i(E(W_{qp} | i)) = \frac{Q-1}{2\mu}. \quad (10)$$

In addition we can readily obtain that

$$E(W_s) = \tau, E(W_p) = 1/\mu. \quad (11)$$

Substituting (4), (6), (7), (10), and (11) into (3) yields

$$E(W) = \frac{Q-1}{2D} + \frac{Q(\sigma_x^2 + \sigma_z^2) + \sigma_y^2}{2 \left[Q \left(\frac{1}{D} - \frac{1}{\mu} \right) - \tau \right]} + \frac{Q+1}{2\mu} + \tau. \quad (12)$$

For a practical manufacturing environment, under no circumstance does the lot size Q may be less than one; the traffic intensity ρ has to be less than 100% for a realistic queuing model. Consequently, the constraints on the proposed model can be summarized as

$$\rho < 100\%, Q \geq 1. \quad (13)$$

Model Reformulation under the Carbon Emission Constraint

As mentioned previously, the most important concern in this article is to explore the effects of carbon emission constraints on production planning. The concerned manufacturing problem in Figure 1 involves two carbon emission sources—the manufacturing procedure and the WIP holding inventory.

Carbon emission produced in the manufacturing procedure arises mainly from consumptions of fossil fuel and electricity to power vehicles and machines, formulated as

$$e_m = \kappa_0 + D\kappa_1, \quad (14)$$

where κ_0 denotes the fixed carbon emission factor, amounting to the carbon emissions from vehicles driven empty and machines run without processing products. κ_1 represents the variable carbon emission factor, measuring the surplus marginal carbon emission to produce one more product.

The WIP inventory consumes energy similar to manufacturing, since partially completed goods need to be frequently transferred from one place to another for storage. Differently, the WIP inventory is not only relevant to the demand, but also closely to the inventory holding time $E(W)$. Thus, the carbon emission incurred in the WIP holding inventory is

$$e_{WIP} = g_0 + g_1 DE(W) \quad (15)$$

where g_0 and g_1 respectively denote the fixed and variable carbon emission factors involved in the WIP holding inventory, having the analogous practical implications as κ_0 and κ_1 .

As a consequence the total emission of GHGs is

$$e = e_m + e_{WIP}. \quad (16)$$

Given the carbon emission cap M , the benchmark model needs to be extended to account for another constraint, i.e., carbon emission constraint

$$e = e_m + e_{WIP} \leq M. \quad (17)$$

MODEL ANALYSIS

The first step in the analysis is to derive optimality properties pertinent to the benchmark model. Subsequently we examine the effects of the carbon constraint on the optimal lot size and profit, so as to obtain a complete understanding of the difference made when carbon emission is considered.

Benchmark Production Model Analysis

Proposition 1. In the benchmark model \mathcal{J} is concave in its domain.

Proof. Substituting (2) and (12) into (1) yields

$$\bar{\mathcal{H}} = -\mathcal{H} = f_1 + f_2 + f_3 \quad (18)$$

with

$$f_1 = \frac{hD}{2} \frac{(\sigma_x^2 + \sigma_z^2)Q + \sigma_y^2}{\left(\frac{1}{D} - \frac{1}{\mu}\right)Q - \tau}, f_2 = \frac{sD}{Q}, f_3 = hD \left(\frac{Q-1}{2D} + \frac{Q+1}{2\mu} + \tau \right) - (D\gamma - \omega D - C_F). \quad (19)$$

In the domain of \mathcal{H} , f_1 , f_2 , and f_3 satisfies the first-order convexity condition (Boyd and Vandenberghe, 2009), that is, $\forall Q_1, Q_2$

$$f_{1,2,3}(Q_1) - f_{1,2,3}(Q_2) - \nabla f_{1,2,3}(Q_2)^T (Q_1 - Q_2) \geq 0 \quad (20)$$

As the sum of convex functions remains convex, $\bar{\mathcal{H}}$ is a convex function and its negative \mathcal{H} is concave. \square

Proposition 1 implies that there is only one optimal lot size for the benchmark production planning model.

Proposition 2. The optimal lot size Q^* for the benchmark model to maximise \mathcal{H} must meet the following quartic equation

$$\frac{AB^2h}{2}Q^4 - ABh\tau Q^3 + \left(\frac{Ah\tau^2}{2} - \frac{Ch}{2} - sB^2 \right)Q^2 + 2Bs\tau Q - s\tau^2 = 0 \quad (21)$$

where $A = \frac{1}{D} + \frac{1}{\mu}$, $B = \frac{1}{D} - \frac{1}{\mu}$, and $C = (\sigma_x^2 + \sigma_z^2)\tau + \left(\frac{1}{D} - \frac{1}{\mu}\right)\sigma_y^2$.

Proof. From the continuity and differentiability of \mathcal{H} it follows that

$$\mathcal{H}'|_{Q^*} = \frac{d\mathcal{H}}{dQ}|_{Q^*} = -\frac{dC_V}{dQ}|_{Q^*} = 0, \quad (22)$$

i.e., Q^* is subject to

$$\frac{dC_V}{dQ} = -\frac{sD}{Q^2} + hD \frac{dE(W)}{dQ} = 0. \quad (23)$$

Reorganizing the last equality completes the proof of Proposition 2. \square

Proposition 2 gives a necessary condition for the optimal lot size. Indeed, considering the uniqueness of the optimal lot size suggested in Proposition 1, it acts like a sufficient condition. This conclusion is summarized in the following proposition.

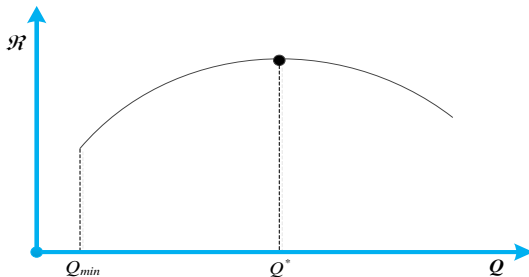


Figure 2: Changes of the profit in terms of the lot size

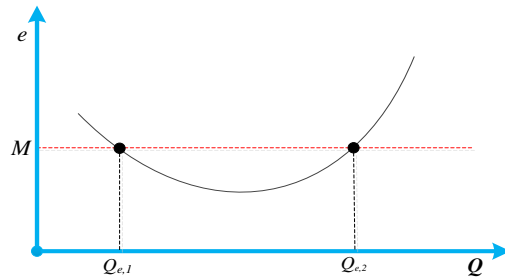


Figure 3: Carbon constraint on the lot sizing policy

Proposition 3. There exists only one optimal lot size Q^* for the benchmark model.

Proof. We see from (2) that there must be optimal lot size(s) for maximisation of the profit. Due to the concavity of \mathcal{H} stated in Proposition 1, we know that there is only one such optimal lot size, as illustrated in Figure 2 where the optimal lot size is denoted by Q^* . \square

Proposition 4. For the benchmark production model the profit curve is (1) positively sloped in the interval $[Q_{\min}, Q^*]$; (2) negatively sloped in the interval $[Q^*, +\infty]$; where $Q_{\min} = \max\left\{\tau/\left(\frac{1}{D} - \frac{1}{\mu}\right), 1\right\}$.

Proof. It follows from (13) that $Q \geq Q_{\min} = \max\left\{\tau/\left(\frac{1}{D} - \frac{1}{\mu}\right), 1\right\}$. The convexity of \mathcal{H} and its second differentiability lead to $\mathcal{H}'' < 0$, i.e., \mathcal{H}' is a monotone decreasing function in $[Q_{\min}, +\infty]$. As $\mathcal{H}'|_{Q^*} = 0$, we infer that $\mathcal{H}' > 0$ when $Q_{\min} < Q < Q^*$ and $\mathcal{H}' < 0$ when $Q > Q^*$, as illustrated in Figure 2. \square

Model Analysis under the Carbon Emission Constraint

We now turn to the impacts of carbon emission on the optimal lot size and profit.

Proposition 5. The carbon emission e is convex in terms of Q in its domain.

Proof. By the identical method as in Proposition 1, we can prove Proposition 5. \square

Proposition 5 implies that the carbon emission constraint limits the lot size to a smaller interval, that is, $Q_{e,1} \leq Q \leq Q_{e,2}$, as illustrated in Figure 3. Its effects on the optimal lot size and profit are stated in the next proposition.

Proposition 6. For the model under the carbon emission constraint,
 (1) when $Q_{e,1} \leq Q^* \leq Q_{e,2}$, the optimal lot size is still Q^* with the profit unchanged;
 (2) when $Q^* < Q_{e,1}$, the optimal lot size is $Q_{e,1}$ with the profit decreased;
 (3) when $Q^* > Q_{e,2}$, the optimal lot size is $Q_{e,2}$ with the profit decreased;

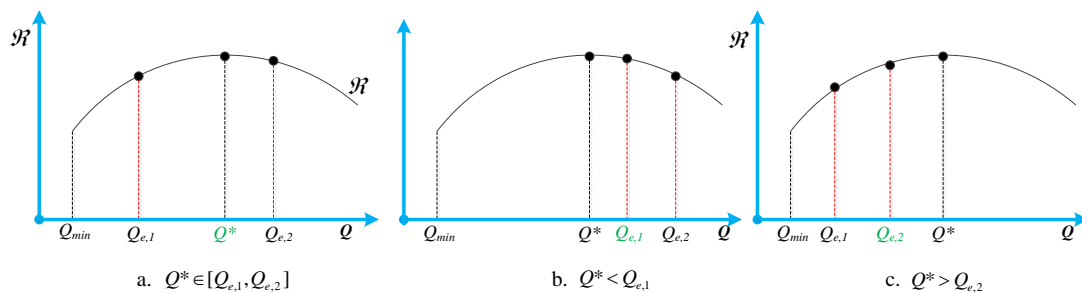


Figure 4: Impacts of the carbon constraint on the lot sizing policy and profit

Proof. Considering the emission constraint $Q_{e,1} \leq Q \leq Q_{e,2}$ on the benchmark model, there exist three cases.

The case of $Q^* \in [Q_{e,1}, Q_{e,2}]$ implies that under the optimal lot size, the incurred carbon emission is below M , and thus have no effect on the optimal lot size and profit. Both of them stay unchanged in this case, as illustrated in Figure 4(a).

When $Q^* < Q_{e,1}$ the interval $[Q_{e,1}, Q_{e,2}]$ lies within the negatively-sloped section of \mathcal{H} , as illustrated in Figure 4 (b). Now \mathcal{H} is monotonically decreasing, and thus the maximal profit is achieved when $Q^* = Q_{e,1}$ with the profit reduced.

In the case of $Q^* > Q_{e,2}$ the interval $[Q_{e,1}, Q_{e,2}]$ resides within the positively-sloped section of \mathcal{H} , as in Figure 4 (c). \mathcal{H} is now monotonically increasing, and thus the profit can be maximised when $Q^* = Q_{e,2}$ with a decreased optimal profitability.

In cases (2) and (3), the optimal lot size has changed (increased for (2) and decreased for (3)). However, the optimal profit decreases for both cases, dependent on M , as illustrated in Figure 4. \square

Indeed, case (1) stated in Proposition 6 would nearly never occur in the real world, for no agency imposes on firms a carbon emission cap less than its current emission quantity. Only the other two cases are the practical situations facing the manufacturing firms. Hence, Proposition 6 clearly demonstrates that it is not beneficial for firms under the carbon emission constraint imposed by the governing agencies, despite the resultant reduction in carbon emission.

CONCLUSIONS

This paper explores optimisation of lot sizing with carbon emission management in a stochastic MTO manufacturing environment. Several relevant propositions are conducted to analytically validate the proposed manufacturing optimisation model and to highlight the important significance of carbon management in both manufacturing optimisation and environmental protection.

Analytical results illustrate the significant influences of carbon emission constraints on the dynamic decisions of the lot sizing policy. The results highlight the critical roles of carbon management in production planning for the environment benefit. However, the environmental and social benefits are achieved at the cost of reducing manufacturing firm's economic earnings. Carbon emission constraints force manufacturers make a compromise between their economic profitability and their environmental responsibility.

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FRAMEWORK FOR CUSTOMER COLLABORATION: A CASE STUDY IN FMCG

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ABSTRACT

This thesis aims to help companies looking to collaborate with their customers answer three essential questions:

- i. How should customer segmentation be conducted from a supply chain management point of view?
- ii. What collaboration levels are appropriate for different segments?
- iii. What are the driving forces and resisting forces of creating customer buy-in for collaboration and how do they interact with each other?

The work proposes a framework to segment customers from the point of view of an FMCG manufacturer, to achieve supply chain collaboration with the customer as the focus, by matching customer segments with different collaboration levels on a Delta Model framework. It uses a System Dynamics approach to understand the driving and resisting forces of creating customer buy-in to collaborate. The model is developed in collaboration with and is applied on a global FMCG's Malaysia operations.

Segmentation results were welcomed by the Case Study Company and a decision to implement the results has been taken. System Dynamics analysis suggested six input variables that can be utilized to create customer buy-in. Among those, Case Study Company's investment in supply chain training and people skills is identified as the most influential input to achieve customer buy-in. In cases where the interplay of cost of transformation, external shocks, internal motives and bargaining power was not enough to achieve customer buy-in, complementor benefits (benefits such as advertising support or bank credit support that are offered to customers) emerged as critical to bridge the gap.

BACKGROUND

Chocolate Co. operations span the globe with 100.000 employees and a turnover exceeding \$30b in 2012. 60% of revenues come from Western Europe and North America while Asia Pacific accounts for 15% of revenues.

Malaysia operation is run through an HQ in Kuala Lumpur and three production centers. Transportation of goods is outsourced. 70% of revenue comes from 13 distributors each with exclusive regional coverage of traditional trade channels. Remaining 30% revenue comes from modern trade accounts of multinational players and away from home accounts of players which use company's products as inputs for their products and services.

PROBLEM

Suffering from the side-effects of aggressive growth, Chocolate Co. would like to develop an effective collaboration model to engage with its customers. Traditionally the relationships with the customers have been on a transactional basis: receiving and delivering orders. This has been creating a competitive disadvantage since other competitors have been collaborating with the customers to achieve greater profitability and deeper relationships.

Nevertheless, there have been efforts to enhance relationships with customers at the customer service side. The efforts mainly focused on increasing service levels. Efforts have

paid off and case fill rates have improved from 79% to 90% in some cases. The company realizes that without a well-planned strategy and execution, such efforts will have temporary effects. During initial meeting to define scope, five points were assessed:

I. Internal alignment

Ensure Chocolate Co.'s supply chain is operating in cooperation between sales, marketing and customer service teams and no value is lost due to frictions. This was recognized but was agreed to be kept out of scope since the organization was undergoing restructuring.

II. Customer Segmentation

Develop a customer segmentation model for Chocolate Co. so that different collaboration models can be matched with relevant segments.

III. Customer Collaboration

Identify different levels of collaboration on an agreed strategy framework and identify the level of collaboration needed for each customer segment. Map customers' current positions and identify gaps.

IV. Road Map

Design a road map that will enable Chocolate Co. move customers to higher tiers of collaboration to address the gaps identified.

V. Measure Success

Develop a dashboard to track progress and identify upcoming issues to pro-actively deal with them. This was recognized as important however was kept out of scope due to time limitations.

METHODOLOGY

The study employs a proposed segmentation approach and the use of delta model to identify appropriate collaboration levels for each of the segments. For the customers whose current collaboration levels don't match with those identified levels, a system dynamic analysis is conducted to identify the driving and resisting forces of getting customer buy-in to collaborate at the desired levels.

ANALYSIS

Segmentation (1)

The firm has limited resources and collaboration efforts may require significant time, skills and monetary investment. As such, engaging with all customers at highest levels is not an option. The aim of customer segmentation is to develop an understanding of customers from both financial and supply chain viewpoints so that customers can be engaged at right levels. Ideally more profitable / higher volume customers will be locked in to preserve profitability and requirements of customers with higher service expectations will be fulfilled better through closer collaboration. To achieve this, a multi-step approach was developed which incorporates both financial and supply chain related info.

Customer segmentation is conducted based on:

I. Financial criteria: Revenue vs. Margin

II. Non-financial criteria: Chocolate Co. bargaining power over customer vs. customer service level expectations (An & Srethapakdi, 2006)

III. Other relevant data: strategic relevance, management style, existing relationships, demand variability, complexity of serving, delivery locations

First, segments candidates for financial and non-financial segments were determined. Then, to finalize segments the following decision rule was used:

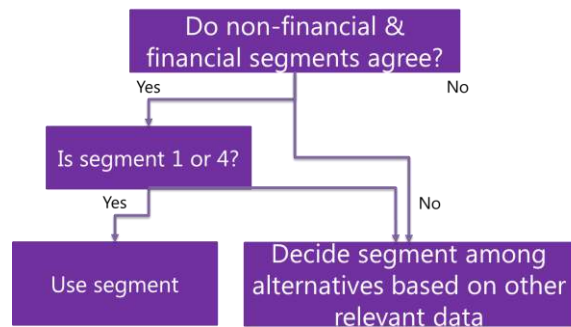


Figure 2: Segmentation rule

Customer Collaboration (2)

With a comprehensive literature review, the following collaboration levels were identified:

- I. None
- II. Communication: information exchange only; shortest horizon. Quick Response (QR) scheme
- III. Operational: supplier replenishes customer inventory. Continuous Replenishment (CR) or Vendor Managed Inventory (VMI)
- IV. Tactical: supplier and customer forecasts demand and plans promotions together. (Continuous Forecasting & Replenishment (CFR) or Continuous Planning Forecasting & Replenishment (CPFR)
- V. Strategic: joint strategic planning, product planning; longest horizon. Strategic Collaboration (SC)

Delta Model (3)

Delta model is a strategy framework that places customer rather than the product at the center (Hax, 2010). 3 possible positionings:

- I. Best Product: cost leadership or differentiation
- II. Customer Lock-in: aim to bond with customer by offering integrated solutions for the critical needs of customer
- III. Competitor Lock-out: most profitable position. Achieved by owning the standards of the industry (Windows and Intel), becoming an exclusive interface between suppliers and customers (iTunes), or restricting competitor access (Walmart)

Each position is represented as a corner of a triangle and customers are placed on the triangle as per their positionings. Below is a visual representation:

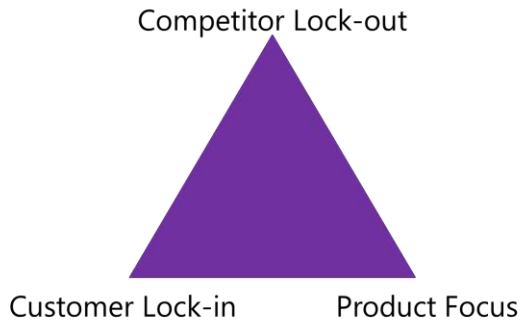


Figure 4: Delta Model

In Delta Model, introduction of complementors is key in moving customers towards customer lock-in and competitor lock-out positions.

Complementor suggestions:

- I. Bank to improve Credit
- II. Media provider for advertising support
- III. Non-competitive suppliers to decrease costs
- IV. Non-competitive sourcing support
- V. Provide consumer insight

Matching Segments with Collaboration Levels (3)

Least important or unactionable customers are placed in Tier 4 with product focus. QR may be attempted for them. More of the important customers will be placed on customer lock-in or competitor lock-out positions to secure long lasting and profitable relationships. Ultimate competition is on locking competitors out of shelf space and full CPFR and SC will be aimed with Tier 1 customers to focus on that goal. Below is a visual representation of matching customer tiers and collaboration levels on a delta model.

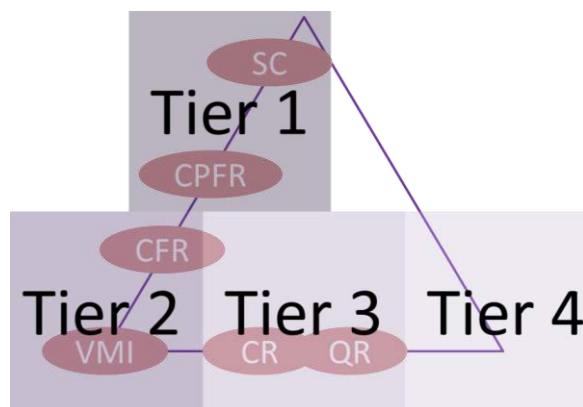


Figure 5: Matching segments with collaboration levels

Creating Customer Buy-in (4)

In order to tackle the question of how to create customer buy-in, Fawcett et al.'s (2008) force field approach was adopted. According to his approach, an entity must be first unfrozen from its existing state to initiate change. When the entity is unfrozen, the balance

of driving and resisting forces will determine whether a change will take place. If the desired change takes place, the entity is refrozen in that state.

Main variables

Below is a visualization of the main variables and their interactions.

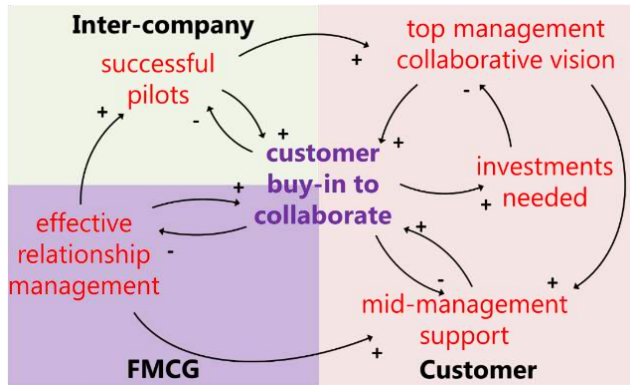


Figure 7: Creating customer buy-in model summary

Customer buy-in to collaborate is the main variable that the model focuses on. Creating customer buy-in is defined as convincing both mid-management and senior management of customer to adopt desired collaborative practices.

From literature and meetings with Chocolate Co.'s representatives five main variables influencing customer buy-in in three mediums are identified and the model is established around those. Below figures summarize the model. (Cao, et al., 2010), (Fawcett, et al., 2008)



Figure 9: CLD at Chocolate Co.'s side

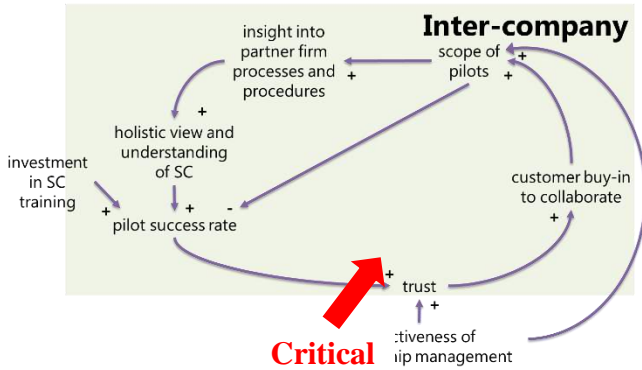


Figure 10: CLDs at inter-company

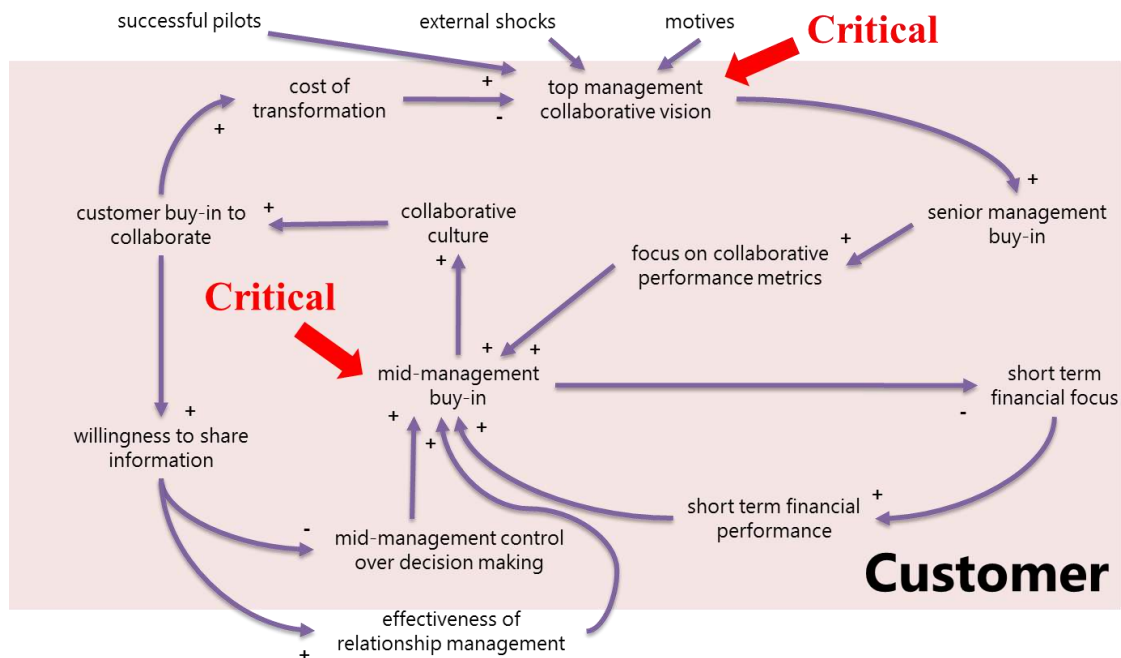


Figure 11: CLDs at customer side

Chocolate Co. must manage three mediums concurrently to achieve customer buy-in: Chocolate Co. side, customer side and inter-company. Customer buy-in is at one side driven by trust between to-be-partner companies and trust can be broken into trust in intentions and trust in capabilities. At the customer side, top management collaborative vision and mid-management buy-in drives customer buy-in. Chocolate Co. must have a benefits case prepared for the customer which will be used to generate customer buy-in.

Trust in intentions can be enhanced by effective relationship management, however as effectiveness of relationship management increases, service expectations increase and this decreases adequacy of skills employed, which in turn decreases effectiveness of relationship management which drives down trust in intentions. Appropriate levels of investment in supply chain skills and people skills help here overcome the skills gap and reinforce trust formation.

Trust in capabilities can be enhanced by successful pilots. Here effective relationship management can help start pilot projects with the customer. As scope of pilots increase,

pilot success rate decreases and this drives down trust in capabilities. Appropriate levels of investment in supply chain and project management skills can be adopted to address this and reinforce trust in capabilities.

At the customer side, as customer buy-in increases mid-management buy-in is put under pressure because of mid-management's fear of losing power and focus on short term performance. Effective relationship management is key in gaining mid-management support at this point. One other driver of mid-management buy-in is top management collaborative vision although a considerable time lag has been identified between the two.

Customer top management collaborative vision is driven by cost of transformation, external shocks (such as an increase in demand uncertainty), internal motives (such as long term orientation) and persuasiveness of benefits case. Persuasiveness of benefits case increases with pilot success rate and bargaining power over the customer.

As customer buy-in increases, cost of transformation increases and this decreases top management collaborative vision. External shocks, internal motives and relative bargaining power are exogenous to the identified loops; they are not under control of Chocolate Co. and they may have mixed effects on collaborative vision. The benefits case can be further tailored for a given level of external shocks, internal motives and bargaining power. Complementor benefits can be included as part of the partnership between companies to decrease or offset the cost of transformation or any gap arising due to adverse levels of variables not under control of Chocolate Co.

Since the variables identified were highly qualitative in nature, a conventional stock and flow diagram with measurable stock levels wasn't possible. To be able to analyze the variables of interest an approach was proposed that would enable comparison of patterns of behaviour rather than quantitative values of stocks. The following approach gives indications of the signs of stocks (i.e. whether a variable is constantly increasing or decreasing or changing behaviour between the two) and deemed as satisfactory for the purpose of the thesis.

- I. Represent all variables as stocks with inflows. Each stock will represent the time rate of change in the underlying variable.
- II. Replace each arrow in the causal loop diagrams with two auxiliary variables and two delays.
- III. Connect input variables to inflows of relevant variables

Simulation and Results (4)

Two important results were reached:

- I. Investment in supply chain training and people skills are the most influential inputs to achieve customer buy-in.
- II. Complementor benefits emerged as adequate to bridge the gap to achieve customer buy-in when inputs not under control of Chocolate Co. (I4, I5, I6) are at adverse levels.

EXTERNAL VALIDITY

The customer segmentation approach detailed in the thesis can be applied to any manufacturer looking to collaborate with customers. It can be utilized for suppliers as well. For a supplier collaboration case, the non-financial segmentation criteria will have less importance since customer buy-in will already be present and bargaining power will be less important. Nevertheless, service level requirements (service level expectations in the model) will still be important, given different service levels are required from different suppliers.

The proposed causal loop diagram for creating customer buy-in isn't specific to an FMCG manufacturer looking to collaborate with customers. It can be applied to any case of a company convincing another company to collaborate.

FUTURE RESEARCH

The approach proposed to translate causal loops into stock and flows and simulate can be adopted in a number of settings where the variables are qualitative in nature and a binary answer is sought. In this thesis, the question was whether customer buy-in is achieved or not given a set of input variables and the causal loop diagrams. Some other occasions where the method can be applied is listed below:

- I. Customer satisfaction studies given the effect of various service factors and occasions
- II. Effect of political campaigns on public
- III. Reputation of a company given various events / publicities
- IV. Employee morale given various company policies

As an alternative path, quantitative measures can be attempted that can capture the variables in question and a more rigorous stock and flow diagram can be built. However the success of the attempts will be limited since the model contains variables such as trust.

Another approach would be to replace transformation functions with further variables that form the function. For instance when the link between willingness to share information and effectiveness of relationship management is examined, it can be concluded that the transformation function used represents two additional stocks: effectiveness of information systems and information sharing. By replacing the transformation function with these two stocks, a finer model can be created and simulated. This process can be repeated until a comfortable level of detail is achieved. For this thesis, the proposed variables were deemed satisfactory.

Lastly, an expansion would be on developing success measures for customer collaboration.

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BUSINESS PROCESS MANAGEMENT AND SUPPLY CHAIN COLLABORATION: CRITICAL COMPARISON OF FOUR THAI CASE STUDIES

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ABSTRACT

This paper uses four Thai case studies to illuminate the results from a large-scale survey data analysis (204 completed questionnaires) of the relationships between Business Process Management (BPM), Supply Chain Collaboration (SCC), collaborative advantage and organisational performance. The case studies were undertaken to gain a greater understanding from extensive discussions about these relationships. Hence, four case companies were selected from the first stage of the large-scale data collection: one medium and one large-sized manufacturing company in both the electronics and automotive manufacturing sectors in Thailand. Semi-structured interviews were employed, with the same managers from the large-scale data collection. The case study analyses justify BPM roles on collaborative activities with Supply Chain (SC) partners and clarify the benefits achieved in terms of collaborative advantage and organisational performance. Additionally, the comparisons in issues of firm size, industry type, closeness and relationships lengths were also included in this study.

INTRODUCTION

Internal and external business process collaboration is vital for effective Supply Chain (SC) management. Building relationships between companies can lead to their competitive advantage, resulting in organisational performance improvement than when working individually (Cao and Zhang, 2011). The earlier phase in our research empirically tested the interrelationships between Business Process Management (BPM), Supply Chain Collaboration (SCC), collaborative advantage and organisational performance. This study is a step further and aims to illuminate the findings from the large-scale survey data analyses. This was achieved by gathering practitioners' opinions to provide an in-depth and detailed understanding of the meanings, actions and experiences of practitioners in their specific contextual situations.

The following section provides a brief review of the relevant literature on the relationships between BPM, SCC, collaborative advantage and organisational performance. This is followed by a summary of the large-scale survey results. The research methodology is subsequently presented. The case studies analysis is explained next. Finally, key research findings, managerial implications and conclusions are highlighted.

LITERATURE REVIEW

BPM is defined as a process-oriented organisational approach, used to design, analyse and improve business processes that results in increased organisational performance (Chang, 2006). It uses various methods, techniques and technology to support changes in business process and encourages employees to become more involved in the workplace (Van der Aalst *et al.*, 2003). Crossing individual organisational boundaries, SCC is defined as when two or more companies in an SC work closely in delivering products to end customers, to optimise profits for the SC members and create competitive advantage (Simatupang and Sridharan, 2008). Ultimately, the benefits from working collaboratively with SC partners can be explained in terms of collaborative advantage and organisational performance. Collaborative advantage can be defined as strategic benefits achieved over competitors in the market place that could not have been achieved without working through the SC partnership (Malhotra *et al.*, 2005; Cao and Zhang, 2011). Organisational performance is defined as how well an organisation fulfills both financial and its market-oriented goals (Li *et al.*, 2006). Previous research has suggested that both BPM and SCC are important for improving performance and competitiveness, yet these two approaches have usually been studied separately (e.g.,

Zacharia *et al.*, 2009; Nyaga *et al.*, 2010). The scope of business processes is often defined within organisational boundaries, rather than being linked to SC partners. Additionally, there is evidence suggesting that SC relationships are dependent on organisational, competitive and relationship-specific attributes (e.g., Sila, 2007; Tang and Rai, 2012). However, there is also a lack of empirical research elaborating on the impact of context-dependent factors have on the interrelationship between the competitive and performance linkages, on both the individual operation and the SC.

Earlier stage in our research empirically tested the interrelationships between BPM, SCC, collaborative advantage and organisational performance. The moderating effects of the contextual factors of firm size (medium and large firms), industry type (automotive and electronics industries), closeness (supplier and customer) and relationship length (short and long term relationships) were also included. The hypotheses were developed and tested by using the Partial Least Squares approach to Structural Equation Modelling (PLS-SEM). A range of Thai manufacturing firms were surveyed and 204 completed questionnaires were analysed. The results confirmed that (a) there is a positive relationship between BPM and organisational performance; (b) BPM is also a driver of SCC; (c) the effect of BPM on organisational performance is partially mediated by SCC; (d) firms which collaborate with SC partners are better positioned to achieve collaborative advantage; (e) the effect of SCC on organisational performance is partially mediated by collaborative advantage; and (f) there are no significant differences in firm size, industry type, closeness and relationship length on the relationships between BPM, SCC, collaborative advantage and organisational performance.

This study is a step further, the aim was to capture instances of the practitioners' views on the relationships between BPM, SCC, collaborative advantage and organisational performance, and develop understanding on the underlying factors guiding these interrelationships.

METHODOLOGY

This study employed the case study approach as a follow-up to the large-scale survey (Yin, 2014) to gain a deeper understanding of the empirical results. Some level of triangulation above the company level was achieved, namely industry and firm size, considering the focus of the research is on the manufacturing industry in Thailand. Four case companies were selected, which presented different types of firms in terms of size (medium and large) and industry (automotive and electronics industries). All selected companies had participated in the previous quantitative phase. The size distinction was based on the official Thai definition: a medium-sized firm having 51-200 employees and a large-sized firm employing more than 200 people (The Ministry of Industry Thailand, 2013). The selected case studies allowed for a comparison of similarities and differences between firm size, industry type, closeness and relationship length. An interview protocol was developed, based on the results of the large-scale survey, to ensure that all issues required were addressed. Semi-structured interviews were employed, in order to understand the practitioners' opinions, and to give them the opportunity to elaborate on their opinions and to highlight specific issues of the proposed model, resulting in more in-depth evidence from key practitioners. The first interview served as a pilot to allow for improvements in the interview protocol. The average duration for the interviews, which took place over the telephone in February 2014, was one-and-a-half hours.

For the case study analysis, the main themes were developed to elaborate on the quantitative results. These themes are: (i) the link between BPM and organisational performance; (ii) the link between BPM and SCC; and (iii) the contextual factors and benefits achieved from working collaboratively with SC partners. Based on the data collection in this phase, the company's background and the key findings from the cross-case analysis related to the investigated issues are presented in the following section.

CASE STUDY ANALYSIS

Regarding the companies backgrounds, *Case ELC* is a large electronics company with a capital investment of 810 million Thai baht (approximately 24,873,500 USD), employing 2,200 people. It is a wholly-owned Japanese company, which has achieved sustainable growth and operates in various countries. It produces elevators, escalators and moving walk ways for export and the domestic market. The interview participant from this company was the SC Manager. *Case ALC* is also a large wholly-owned Japanese company, which produces automotive and motor vehicle batteries. The company has a registered capital investment of 240 million Thai baht (approximately 7,370,000 USD), and 600 employees. The interview participant from this company was the Production Manager. *Case EMC* is a medium-sized example from the electronics industry. It is a joint venture, with 94.33% Japanese and 5.67% Thai ownership. Its registered capital investment is 30 million Thai baht (approximately 921,250 USD), and employs a total of 98 employees. The company produces electrical component inverters, switch boxes and wire harnesses for air conditioners. The Production Manager participated in the interviews. *Case AMC* was selected to represent a medium-sized company in the automotive industry. The company is wholly-owned Japanese company and was established in Thailand with a capital investment of 20 million Thai baht (approximately 615,000 USD), employing over 100 employees. Automotive parts are produced both for the domestic market and for export. The information was provided by the Factory Manager. All of these four case companies have achieved ISO 9001 certification which emphasise process management.

The link between BPM and Organisational Performance

The four cases provided four common characteristics of BPM practices namely, long-term planning, Information Technology (IT), process improvement, and top management support & employee involvement. *Long-term planning* needs to be based on customer requirements and should cover aspects of production planning, promotional events and supplier development. This plan has to be jointly developed with the SC partners. For instance, the Production Manager from ALC suggested that: "*The company has set a long-term policy, which is for three years. However, at the end of each year there is a review of the situation, and if necessary there is a change to or an improvement to the plan. The company has jointly developed production forecasts with its suppliers.*" Thus, the firm and its main suppliers use the same production forecast plans. *IT* is important to accomplish the business plan and to improve operational processes, and IT is used to share information both within an organisation, from top management to employees, and with their SC partners. For instance, it was suggested that: "*The use of IT is very important to accomplish this plan, and information sharing includes both top management and all the employees*" (ELC).

The four cases have used various *process improvement* techniques such as Total Quality Management (TQM), Lean Manufacturing and Kaizen to improve their business processes. The managers pointed out that their process improvement techniques were often the same techniques as their SC partners (ALC, EMC and AMC). The use of process improvement techniques also leads to more employee involvement; for instance, it was suggested that the use of 'Kaizen' provides opportunities for employees to contribute any suggestions they may have for work improvements (ELC). *Top management support* is very important for successful BPM practices, as participants in all the four cases suggested that their BPM practices were fully supported and led by top management. Additionally, good relationships between top management, managers and employees have been developed. For instance, one company provides a 'President box', for employees to contact the president of the company directly (ELC). Additionally, employees are involved in decision making; it was reported that: "*Top management has to set policies that should lead to improvements. However, before the policies have been set, there is an internal meeting, including managers of each department, where they discuss any problems. Also, employees can give any suggestions they have to their manager*" (ALC). Regarding training and skills development, it was explained that: "*We have sent employees to train in Japan to learn new technology and innovations, so they*

can come back to improve our products" (ELC). Thus, employees have opportunities to learn new technology to improve products to meet customer requirements.

The four participants explained that BPM practices had helped to improve their organisational performance, both financial and non-financial. In terms of financial performance, all of the four cases emphasised that sales growth and cost reduction were the most important dimensions. Sales growth and cost reduction referred to the improvement of production processes, the policies adopted to reduce costs and the reduction of waste. The manager explained that: *"In terms of cost reductions, the company has set targets for cost reductions, improved sales growth and improved product quality, in each department" (EMC).* Regarding non-financial performance, two cases focused on overall competitive position and core competencies (ELC, ALC). Case ALC, for example, has a strategy in place in which a team has been settled to analyse and develop strategy to be able to compete in the market place. For all cases, quality is an important issue (ELC, ALC, EMC and AMC). For instance, the SC Manager from ELC indicated that: *"Quality is the first priority for our operations."* The four companies have continued to carry out quality improvement activities such as recording problems and the improvements and preventive measures, in response to quality non-conformity and the monitoring of progress. Waste reduction was also important for all cases.

The link between BPM and SCC

From our investigation, BPM practices help various collaborative activities, which we have divided into four types: information sharing and communication, joint activities, sharing common goals and sharing costs, risks & benefits. The analysis provided evidence of the importance of *information sharing and communication* within a firm and with SC partners. For instance, in the case of ELC, an Enterprise Resource Planning (ERP) system is used to share information within the company and with its SC partners. Technical and non-technical information is also shared with suppliers (ALC). Relevant knowledge, regarding collaborative activities and process improvements, are shared between a firm, suppliers and customers (ELC, ALC, EMC and AMC). For instance, knowledge regarding process improvement techniques and knowledge that can be used to reduce costs in production process are being shared. Also, all cases indicated the importance of open and clear communication, both formal and informal, with suppliers and customers. All cases have some form of *joint activities* with their SC partners. For instance, jointly planning demand forecasts, resolving forecast errors and jointly working out solutions of any problems within an SC. Regular meeting with suppliers and customer are held to jointly plan and jointly solve problems and to update any changes and improvements in terms of production planning, process improvement and technology. For instance, case ALC has set up a team to work closely with its suppliers, to improve and develop the relationships and grow together. It is important for working collaboratively with SC partners that *mutual benefits* are highlighted (ELC, ALC, EMC and AMC). Thus, the Production Manager in case AMC stated that: *"if there is no agreement about goals and objectives from working collaboratively, this could create problems rather than benefits within the chain."* Thus, a firm, suppliers and customers need to develop and grow together (ELC, ALC, EMC and AMC). A firm has also co-developed systems by setting and sharing Key Performance Indicators (KPIs) together with its suppliers (ALC). Taking into account the joint activities and the sharing of mutual benefits between a firm and its SC partners, the case studies results show that all cases have some form of sharing *cost, risk and benefit* with their SC partners.

The four cases illustrate that an intra-organisational focus (on BPM) is a prerequisite for inter-organisational activities (SCC). The managers suggested that working collaboratively with SC partners would pay back to the company in terms of benefits along the SC, and this can help to improve the firm performance (ELC, ALC, EMC and AMC). The Production Manager from case ALC suggested that: *"To collaborate successfully with SC partners; firstly, we have to improve and develop both human resources and technology. Secondly, we have to drive the growth of our suppliers at the*

same time as our company. Thirdly, we have to follow the 'voice of the customer' as much as we can, in order to meet customer requirements and to achieve customer satisfaction. Finally, these three will be paid back to the company in terms of mutual benefits along the SC and this must help to improve our firm's performance."

Contextual factors and the relationships benefits

The cases companies explained the mutually beneficial outcomes of BPM practices and working collaboratively with SC partners in terms of collaborative advantage and organisational performance. Regarding, collaborative advantage, the initial terms from these four case studies are time to market, quality and the meeting of customers' requirements. The Production Manager in ALC explained that: *"Time to market and quality are essential because we produce automotive parts, which means that if the car is sold then we will automatically hit the market. The others are product variety, meeting customers' requirements, the effective use of technology and innovation and the sharing of system controls with customers, which we can use in our own company."* The results from the case studies also illustrate that working collaboratively with SC partners improves both financial and non-financial organisational performance (ELC, ALC, EMC and AMC). In terms of financial performance, it is improved in terms of cost reduction, sales growth and return on investment. Additionally, in terms of non-financial performance, it is improved in terms of quality, overall competitive positions and waste reduction. For instance, The SC Manager in ELC indicated that: *"This has created a win-win situation for the company, customers and suppliers. The collaboration has resulted in the suppliers knowing that they will receive orders from the company, as long as they maintain certain standards, and everyone benefits from working collaboratively."*

The results also indicate that large firms work more closely with suppliers, whereas the medium firms work more closely with their customers. The results show that regardless of firm size similar collaborative advantage can be achieved. However, firm size is important when the priorities of collaborative advantage are taken into account. The two large firms focus more on time to market and quality, while the medium-sized firms concentrate more on quality and meeting customer requirements. The results indicate that product innovation and the effective use of technology are the main focus in the large firms and that they are actively improving their technology and their employees' skills to facilitate these outcomes.

All four companies suggested that the closeness of relationships is usually based on long-term partnerships, so trust with both suppliers and customers have been developed. Additionally, whether the company is working closely with suppliers or customers, they require joint working; for example, it is important to have joint meetings to develop policy, joint decision making, joint problem solving, joint planning of demand forecasts and jointly working together to reduce lead time with suppliers. In relation to the importance of close relationships with SC partners, two practitioners explained that: *"The use of technology and the use of joint activities such as forecasting with suppliers are vital. Also, the company visits suppliers and attempts to solve production problems together" (ELC) and "The activities with close suppliers cover developing policy and technology together, sharing information and sharing knowledge such as product design" (ALC).*

As regards industry type, the results show that the electronics and automotive industries are similar in the way they collaborate with SC partners. Both electronics and automotive industries provide similar results in terms of benefits achieved from working collaboratively with their SC partners. However, the two automotive companies focus more on improving product variety. It was explained that: *"We need to develop technology to support the new automotive models [...]. The company sees innovation as a way to improve our products, so they have a longer life [...] we have to improve our employees' skills, so we can use new skills to improve current products and to provide innovative products" (ALC).*

Regarding the relationship length, the results show that the four cases have been working collaboratively with their closest SC partners since they started the business. All participants suggested that long-term relationships provide fewer problems, more flexibility, and that trust has been developed, so communication can be both formal and informal. For example, the SC manager in ELC suggested that: *"The close relationships and the fact that the companies have been working together for a long time, has resulted in the suppliers opening a warehouse in Singapore in order to support their customers in Asia. This means that the lead time has been reduced because the company can now place orders in Singapore instead of Switzerland."* Additionally, the Production Manager in AMC stated that: *"Communication is easier than when it's a short-term relationship [...] we rely on each other more."* In contrast, dealing with short-term relationships is more complex. The participants indicated that: *"With suppliers who we have had shorter relationships with, we need to spend more time; for example, we often need more communication to explain specific requirements, as suppliers will work based on our requirements"* (ALC). Although, the results reveal that short-term SC relationships can create difficulties, they do not have an impact on the benefits achieved in collaborative advantage and organisational performance. The managers highlighted that: *"Actually, the length of the relationship does not cause any problems, in terms of benefits, but short-term relationships make the collaboration process more complicated than with long-term relationships"* (ALC) and *"Relationship length has not caused any problems because we are continuously improving our systems. However, it is not about relationship length, it is more about how to improve our business, so we are able to compete in the market better than our competitors"* (EMC). Thus, short-term SC relationships can create difficulties, but they do not have an impact on the benefits achieved in terms of collaborative advantage and organisational performance.

THE KEY FINDINGS

The results from the case studies have provided the key common characteristics of BPM namely, long-term planning, IT, process improvement, and top management support & employee involvement. These common characteristics can assist a firm to improve organisational performance, both financial (e.g., sales growth and cost reduction) and non-financial (e.g., quality and waste reduction) performance. It has been established that intra-organisational focus (BPM) is essential for inter-organisational activities (SCC) in terms of information sharing and communication, joint activities, sharing common goals and sharing costs, risks & benefits. A firm and its SC partners need to develop and grow together and work to enhance mutual benefits. The results revealed that BPM not only directly improves organisational performance, but it also assists in collaborative activities which in turn help to improve internal capabilities.

The case studies illustrate that the benefits achieved from working collaboratively with SC partners, in terms of collaborative advantage and organisational performance. They also illustrate practices and approaches across diverse firm sizes, industry types, closeness and relationship lengths. Different firm sizes support collaborative efforts with proportional financial and managerial resources; however, firms develop an appropriate strategy based on common goals with their SC partners to share their, limited occasionally, resources in an effective way to achieve collaborative advantage and improve organisational performance. Additionally, they apply different business strategies. For example, considering our case sample, medium firms tend to focus on cost reduction and sale growth, whereas large firms not only focus on cost reduction and sale growth, but also on their overall competitive position.

The large-scale survey results, from the earlier phase found that a firm working closely with either upstream or downstream SC members can achieve benefits in terms of collaborative advantage and organisational performance. A greater understanding provided from the case studies that firms of different sizes from both the electronics and the automotive industries have chosen to work closely with their SC partners differently.

The larger firms are working more closely with their suppliers, while the closest relationships for medium firms are with their customers. The closest partnerships are characterised as being of a long-term nature including building of trust and jointly working closely together in various activities, such as jointly planning, decision making and sharing knowledge over time. As regards the length of relationships, long-term relationships between a firm and its SC partners, result in working collaboratively with fewer problems, enhanced flexibility and open communication. Nevertheless, the case study analysis shows that short-term relationships can be difficult (e.g., communication and setting policy and conditions) but they do not have any impact on the benefits achieved in terms of collaborative advantage and organisational performance. Hence, collaborative relationships, whether long or short term, both result in mutual benefits and improved organisational performance.

RELEVANCE/CONTRIBUTION

Regarding its theoretical implication, the paper provides a deeper understanding in terms of 'how' and 'why' BPM and SCC interrelate to drive collaborative advantage and organisational performance. A detailed understanding of each contextual factor in terms of firm size, industry type, closeness and relationship length was gained to understand and elaborate the quantitative findings. Also, the important manufacturing sectors, namely the automotive and electronics industries in a developing economy, Thailand were addressed in this study. In terms of practical implications, this study elaborates on the joint role and impact of BPM and SCC. The lessons drawn from the case studies incorporate practical mechanisms of BPM and SCC approaches that are critical to offering benefits in terms of collaborative advantage and organisational performance. From the results, managers should consider these four contextual factors have a minor impact. This means that BPM practices based on the four common features: long-term planning, IT, process improvement and top management support & employee involvement and working collaboratively with SC partners can lead to benefits in terms of collaborative advantage and organisational performance even when firms have different characteristics. Managers should consider allocating sufficient efforts in terms of resources and employee skills, to convince SC partners to implement more collaborative activities. Furthermore, managers should consider collaborating in information sharing and communication, joint activities and the sharing of common goals, costs, risks and benefits, which will enable firms to effectively leverage their capabilities and to accomplish the desired benefits in terms of collaborative advantage and organisational performance.

CONCLUSIONS AND FUTURE RESEARCH

This paper aims to gain a deeper understanding of the large-scale survey results by returning to the participants for a second round of qualitative data collection. Therefore, the reasons behind the results of the relationships between BPM, SCC, collaborative advantage and organisational performance were explained in this paper. The main issues of: (i) the link between BPM and organisational performance; (ii) the link between BPM and SCC; and (iii) the contextual factors and benefits achieved from working collaboratively with SC partners were gained to understand and expand the quantitative findings.

It is acknowledged that there are limitations of the study. Firstly, the data collection was based on a few individual firms. Future research could consider extending this research by collecting and examining these relationships by using a wider sample to compare the differences and similarities to gain a comprehensive understanding within each industry type. Secondly, the data collection was based on one key respondent per company. Future research may consider using a broader range of respondents from different positions to achieve a greater understanding of the company's BPM practice, collaborate with its SC partners and the benefits achieved. Lastly, the study is scoped at specific industry types and limited on the considerations of the contextual factors. Therefore, future research could consider other industry sectors and other contextual factors (e.g.,

type of ownership) in order to identify the relationships between BPM, SCC, collaborative advantage and organisational performance.

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EXPLORING LINKAGES BETWEEN CONSUMER TRUST AND E-SCM IN FOOD SAFETY: A CASE OF TAIWANESE ENTERPRISES

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ABSTRACT

Purpose

The purpose of the study is to understand food enterprises' perception toward the implementation of e-supply chain management technologies for the assurance of safety and preservation of quality for products in food supply chains which may positively influence consumer trust.

Design/methodology/approach

Multiple methods are employed to study the research problem, both qualitative and quantitative. The approach undertaken is based on grounded theory, interview, and survey. Experts working for food supply chains operating in Taiwan were interviewed and subsequently data was collected for exploratory factor analysis.

Findings

The research revealed that the implementation of track-and-trace technology, warehouse management system, and transportation management system for food supply chains in Taiwan can foster consumer trust when it comes to the management of food safety.

Research limitations/implications (if applicable)

The first limitation in this study stems from the self-report methodology, by reason of responses from the tested sample which may be exaggerated or understated. A second limitation stems from the potential lack of testing for measuring the causal relationships between each of the e-supply chain management technologies and their effects on consumer trust.

Originality/value

This paper offers a pragmatic approach to supply chain management in food safety so that it would guide enterprises in food supply chains to establish an effective foundation upon which to gain consumer trust.

Keywords:

Food safety, track-and-trace technology, warehouse management system, transportation management system, consumer trust

INTRODUCTION

A number of repeated scandals about product safety and security in global supply chain (Marucheck et al., 2011) have caught the public attention to the issue of product safety. Product safety has received numerous academic studies recently (Lee and Whang, 2005; Pyke and Tang, 2010; Tang, 2008; Wein and Liu, 2005) and it is connected to the process of reducing probability of causing illness, injury, death or negative consequences to people, property or equipment (Marucheck et al., 2011). Along with the product safety incidents that occurred in food industry, the public has paid more attention to the topic of food safety (Chen, 2011; Frewer et al., 2002; Liu et al., 1998; Pennings et al., 2002; Verbeke and Viaene, 1999; Verbeke, 2001). Food safety and health risks, therefore, have emerged within consumers' concern in modern industrial society (Adam, 1999). Food safety refers to the matter of credence which is a characteristic that cannot be realised by consumers either before or after buying the goods (Beck, 1992; Caswell et al., 2002). For a wide range of food products, the growing consumers' interest in food safety and consumption is heightened as regards scope and scale in global economy and society.

Consumer trust is a crucial element influencing consumer behaviour (Bredahl, 2001) and public perceptions of risk assessment and management (Frewer and Salter, 2003). Therefore, consumer trust in food safety has become the question arising as to whether or not there is a relationship with food supply chain management (Grunert, 2005; Röhr et al., 2005; Verbeke, 2005). The concept of trust is multidimensional but providing truthful information is considered as a prominent feature of trustworthiness depending upon sources of information (Frewer et al., 1996). At the present time, information release related to food products emphasises on credible sources that consumers trust most (Chan et al., 2012) because trust has a direct effect on food intake and dietary patterns (Coveney, 2007).

Food industry is comprised of companies from manufacturing, processing, and transportation in supply chain from raw materials to finished products. The process of food supply chain from farm to folk is extremely encountering challenges of safety and hygiene. Logistics and operation support a holistic approach to food safety from primary concern such as agriculture, forestry and fishing (Manzini and Accorsi, 2013). Quality assurance is, hence, the most noticeable feature of food supply chain management (Rong et al., 2011; Trienekens and Zuurbier, 2008; Van der Vorst et al., 2007). In order to assure a high level of food safety, dynamic nature of the chain should be tackled properly e.g. information integration (Wei et al., 2012), inventory system (Goyal and Giri, 2001), transportation (Labuza, 1982) and product quality (Smith and Sparks, 2004) and should be controlled explicitly.

In Taiwan, a series of food scandals has recently been exposed. For instance, the discovery of plastic di (2-ethylhexyl) phthalate (DEHP) within several foods was unveiled by Taiwan health authorities in May, 2011. The illegal use of DEHP in beverages and foods has raised serious long-term health concerns for the public. It follows the news in July, 2009 that found arsenic in cooking oil used by the world well-known fast food chain, McDonald's. The outbreak of these food scandals has influenced consumer trust in food products by associating it with food-related lifestyles (Chen, 2011). Moreover, the phthalate-plasticizer-containing products were exported to mainland China, Hong Kong, Macau, America, Europe, Korea and Vietnam and these products flowed into 217 downstream firms (Tang, 2011). These scandals have negatively affected consumer trust in food safety and called into question the management of food supply chain.

While there is a body of researches that examine consumer confidence in food safety (Chen, 2008, 2011; de Jonge et al., 2010; Vermeir and Verbeke, 2008), as well as sustainable logistics in food products (Carter and Easton, 2011; Manzini and Accorsi, 2013; Pulina and Timpanaro, 2012; Speier et al., 2011), much less attention has been conducted to discover food supply chain management design for food safety. In this

study, the main aim is to identify determining factors of Taiwan-based food supply chain management design for gaining consumer trust in food products. Understanding of which elements of food supply chain management can help in improving consumer trust. To reach such objective, insights into elements of Taiwan-based food supply chain management will be analysed.

LITERATURE REVIEW

Theory of consumer confidence in food safety finds for the implicit belief that makes consumption of food products not harm human health (de Jonge et al., 2007). Verbeke et al. (2007) find that many consumers lack confidence in their ability to assess food quality in general. Therefore, consumer trust in producers, distributors, and regulators who have duty of supervising food safety is an important driver (Berg et al., 2005; Grunert, 2002) because trust makes consumer compensate for the lack of knowledge about the safety of food products (Berg, 2004; Van Kleef et al., 2006). If an individual has enough confidence in the outcome of her/his behaviour, s/he tends to gather and process information without following social norms (Jager, 2000). On the other hand, if an individual has low confidence in need-satisfying capacity of alternatives, s/he is inclined to obtain information or opinion of others (Jager, 2000). Likewise, consumer trust in stakeholders of food supply chain such as farmers, food manufacturers, retailers, and regulators responsible for administering legislation of food safety might assist in the lack of knowledge about cultivation and manufacturing process of food products (Van Kleef et al., 2006; Siegrist and Cvetkovich, 2000). Thus, the less available information is, the less confident consumers might be about choosing safe food.

Although product safety has been viewed as a technical problem, operational risk related to operation process has the possibility of generating negative consequences for several internal and external stakeholders (Lewis, 2003). From a safety perspective, food safety has causal relationships with food supply chain that has a number of vulnerability (Whipple et al., 2009). For instance, natural food products require to meet rigorous management, otherwise many of them are perishable and could result in harm to consumers (Akkerman et al., 2010). In addition, food supply chain is likely to be long, global and highly interconnected, which prolongs exposure to risk (Henson and Reardon, 2005; Roth et al., 2008; Trienekens and Zuurbier, 2008; Whipple et al., 2009). In general, there are trade-offs among price, delivery, quality and safety in selecting supplier. Voss et al. (2009) explore that safety consideration is inclined to be less important than quality, delivery and price. This lower priority could lead to the frequency of food safety incidents, especially when food sources are got from abroad. From time to time, human errors and limitations of food safety technology tend to have serious consequences not only for enterprises involved, but also for consumers (Maruchek et al., 2011; Thomsen and Mckenzie, 2001).

Information technology is used to assist food supply chain management. The application of Electronic data interchange (EDI) technology combining Radio-frequency identification (RFID) is an effective way to trace source of food product including origin, producing dates, and storage information (Van der Vorst et al., 2002). RFID tag is added to finished products, which stores information related to food processing, storage, transportation and logistics. Food delivery to retailer will eventually be tracked in IT system as well (Golan et al., 2003). As a result, traceability of logistics process is an important measure to ensure safety of food as well as to coordinate the various participants to ensure security, reliability and accuracy of information (Yu, 2011). But the breadth, depth, and precision of private traceability systems vary depending on the attributes of interest and each firm's traceability costs and benefits (Golan et al., 2003). In fact, food safety and its supply chain management between upstream and downstream enterprises are totally supported by the use of information technology to build the tracing system (Wang and Huang, 2010).

'Just-in-time' solution is to reduce inventory costs and warehouse stock. But it raises vulnerable risks to food industry (Defra, 2009). Efficient and timely delivery is fundamental necessity for low inventory. Inventory management backs on to reach integrated warehouse management and transportation management rather than managing these functions separately (Aherne, 2002). Therefore, warehouse and transportation management are importance for firms to reduce potential vulnerability (Gulisano, 2003).

Warehouse management system (WMS) is introduced to logistics field to provide a real-time system dealing with information of inventory control, automatic storage and retrieval. Besides, RFID electronic tag is attached to employee and/or forklift with identified information in order to improve efficiency of storage (Yu, 2011). WMS and RFID technology are closely coordinated for data collection, data movement and data management (Tan, 2008). Data collection is obtained through RFID reader exchanging information with an IT network, and is analysed and employed for data management on WMS. Only meaningful data is sent to WMS, based on event triggered basis. Accordingly, the integrated benefits and applications of RFID in warehouses require more value-added applications in performed operations so as to fulfil customers' requirement efficiently and effectively (Lim et al., 2013).

Supply chain includes not only the processor and the suppliers but also warehouses, the transporters and others (Chopra and Meindl, 2008). Across the supply chain, logistics services of distribution and transportation for goods are designed for each segment needs (Kalei, 2008). The goods with different temperature requirement need to be distributed and stored in different facilities to assure quality and reduce health risk. Transportation management system (TMS) is able to effectively plan and execute a robust function with support of RFID technology or any other monitoring sensor that are helpful to monitor goods' status while transporting, according to the TMS' requirements (Qi et al., 2010). So a vehicle-mounted ubiquitous device with well-designed TMS would be the key tool for examining inbound and outbound logistics activities.

RESEARCH DESIGN AND METHODOLOGY

A multi-methodological approach was taken in this study. Firstly, an inductive method using grounded theory approach was employed. The first stage picked over the aforementioned theoretical foundation. The potential validity of the theories was assessed (Strauss and Corbin, 1998). The grounded theory approach encouraged collecting data from the field such as documents, observation, interviews, etc. to capture contextual information related to the matter (Glaser, 2001). Secondly, the study was based on interaction to determine factors in food supply chain management design. There were four interviews with two respondents. Participants included the president of a Taiwan-based enterprise operating in food supply chain and his supplier. Both participants were interviewed twice comprising semi-structured and in-depth interview. All interviews were transcribed in verbatim reports. Key points of the interviews were later clarified by emails. Finally, a quantitative methodology was conducted through utilising questionnaire survey method.

In order to determine the contextual factors which operate to gain consumer trust in food safety, an extensive review of literature formed the bedrock of newly created scales. Consequently, the questionnaire in connection with structure, clarity, ambiguity, appropriateness, and completeness (Rexhausen et al., 2012) was reviewed by two practitioner experts in interviews. The expert interviews identified the initial concepts pertaining to food safety in supply chain management design. Next, the concept of food safety in supply chain management design was categorised to be at the level of meaning for informants and then multi-item measures were developed for each construct (DeVellis, 2003). Prior to data collection, a panel of five researchers well-acquainted with the constructs revised wording of the survey instrument for content validity.

Quantitative research as an element of the multi-method approach was conducted to test the items of the factors proposed in interviews. The data was collected from food enterprises in Taiwan. The sample of Taiwan-based respondents was selected from a list of food manufacturers who have been the trading partners of the president of one Taiwan-based enterprise. The respondents were CEOs and managers in the department of marketing, sales, manufacturing, purchasing, and R&D. The items in construct measures were assessed by means of five-point Likert scale ranging between "not very important" and "very important".

A combination of online survey and hard copy format was used for data collection. For online survey, an email including Participant Information and Consent Form (PICF) was sent to respondents to explain the research scope and objectives. In the email, a link directing respondents to an online survey tool, Qualtrics, was also provided to opt in. The respondents had right to opt out of the survey at any time they want. For hard copy format, the PICF was attached to the questionnaire. The respondents were asked to return the completed questionnaire to the research team by fax, mail or email. The questionnaire was available in English and Chinese version. The survey, conducted from May to August 2013, yield 126 valid responses.

Exploratory factor analysis was employed to study the dimensionality of a set of variables. SPSS 20 was used to acquire the empirical results. Several steps were applied to purifying construct measures. Firstly, principal axis factoring analysis with varimax rotation was utilised to uncover the underlying structure of a set of variables. Next, each of the items which show weak loading on each component was eliminated. Finally, to measure internal consistency of items, commonly measuring the same thing, Cronbach's alpha was assessed for reliability of scales.

RESULTS AND DISCUSSION

As a check on the factors, the items were subjected to a principal axis factoring analysis with varimax rotation. Before conducting factor analysis, the Kaiser-Meyer-Olkin (KMO) test was checked for sampling adequacy. All values of KMO are not less than 0.5 (Table 1), which indicates the sample is adequate (Sharma, 1995, P.116). In addition, the Bartlett's test of sphericity (Bartlett, 1954) should reach statistical significance (i.e. the Sig. value should be 0.05 or less). In this study, the Bartlett's test of all factors are significant (Table 1), therefore factor analysis is appropriate. Next, item assignment to each factor was based on any factor loading of 0.6 or higher (Matsunaga, 2010). With that rule, all of the items loaded on their a priori factors were judged to be supportive. Consequently, Cronbach's alpha was employed to measure internal consistency of each scale. The values of alpha are over 0.9 (Table 2), which are in the acceptable range (Tavakol and Dennick, 2011).

<i>Factor/item</i>	<i>KMO and Bartlett's Test</i>		<i>Factor loadings¹</i>
	<i>KMO Test</i>	<i>Significance of Bartlett's Test</i>	
The use of track-and-tracing technology in supply chain management design	.865	< .01	
Implementing processes to trace information related to food harvest			.779
Implementing processes to trace information related to food production/food processing			.831
Implementing processes to trace and manage food inventory obeying food safety and quality standards of government			.829

agencies			
Implementing processes to trace and manage food inventory obeying food safety and quality standards of international third party certification bodies as ISO, GAP, GHP, GMP, CAS, HACCP			.790
Implementing processes to manage food inventory in transit, including information for tracking and for other inventory visibility needs			.838
Implementing processes to streamline logistics and supply chain operations with third-party service providers (3PLs), including warehousing, distribution, transportation, information, financial, and others			.775
Implementing processes to manage reverse logistics, specifically the recalling of substandard, damaged, or mislabelled food items			.726
The use of warehouse management system in supply chain management design	.500	< .01	
Implementing processes to manage hygiene, humidity, temperature, light as well as other conditions for the preservation of food inventory			.956
Implementing processes to manage the safety of food inventory in the warehouse (food tampering, contamination, damaging exposure from external conditions)			.956
The use of transportation management system in supply chain management design	.500	< .01	
Implementing processes to manage hygiene, humidity, temperature, light as well as other conditions for the preservation of food in transit			.935
Implementing processes to manage the safety of food inventory items in transit			.935

Note: ¹Principal axis factoring analysis with varimax rotation.

Table 1: Factor analysis for food supply chain management design

Factor/item	Cronbach's alpha
The use of track-and-tracing technology in supply chain management design	.922
Implementing processes to trace information related to food harvest	
Implementing processes to trace information related to food production/food processing	
Implementing processes to trace and manage food inventory obeying food safety and quality standards of government agencies	

Implementing processes to trace and manage food inventory obeying food safety and quality standards of international third party certification bodies as ISO, GAP, GHP, GMP, CAS, HACCP	
Implementing processes to manage food inventory in transit, including information for tracking and for other inventory visibility needs	
Implementing processes to streamline logistics and supply chain operations with third-party service providers (3PLs), including warehousing, distribution, transportation, information, financial, and others	
Implementing processes to manage reverse logistics, specifically the recalling of substandard, damaged, or mislabelled food items	
The use of warehouse management system in supply chain management design	.955
Implementing processes to manage hygiene, humidity, temperature, light as well as other conditions for the preservation of food inventory	
Implementing processes to manage the safety of food inventory in the warehouse (food tampering, contamination, damaging exposure from external conditions)	
The use of transportation management system in supply chain management design	.933
Implementing processes to manage hygiene, humidity, temperature, light as well as other conditions for the preservation of food in transit	
Implementing processes to manage the safety of food inventory items in transit	

Table 2: Reliability of the inter-relatedness of the items for food supply chain management design

Transparency in activities of economic actors such as farmers, manufacturers, and supermarket chains is necessary for consumers to monitor processes and activities in supply chain (Kraisintu and Zhang, 2011). Traceability is able to allow consumers to elicit information related to the food system. Consumers can access to the background information of food products for confirmation of details at the point of purchase through mobile devices. Moreover, the tracing system may be useful in making each node of food supply chain including manufacturers, third parties and government regulators monitor the whole process better and easier. By implementing a traceability system, it coordinates all actors in the supply chain (Skilton and Robinson, 2009) as well as all activities along the chain (Lumsden and Stefansson, 2007) to supervise product quality (Lyles et al., 2008).

Apparently, Taiwan-based food enterprises believe that tracing technology has a potential effect on consumer trust in food products. The use of tracing technology in food

supply chain traces foods from source to fork for presenting the required information (Wang and Huang, 2010) at the point of sale such as supermarkets or convenient stores. This practical application can provide a transparent food system (Yu, 2011) which is an important measure to assure consumers of food safety. Stuessi (2010) supported that precise information disclosure greatly assisted in specifically improving material flow and value-added process. Enterprises should fully realise that consumer needs for product information, based on a multi-sourced approach, and practitioners should also be aware that the flow of information is urgently required by consumers in access to data interchange (Quesada et al., 2012).

For a move towards greater internal integration in supply chain management, it is necessary to build integrated management systems. In a supply chain, warehousing occupies a crucial role in linking the material flows between the supplier and customers. With WMS implementation, performance and productivity are improved by exactly pinpointing the location of goods (Ramana et al., 2012). Such a system also involves the packing sequence based on customer orders and the process of giving pickers direction for picking the right goods (Shiau and Lee, 2010). By automating the manual operation, close integration with TMS puts forward the establishment of integrated tracing and tracking key logistics data especially in the food industry. Transport planning, system integration and control are regarded as some of the key factors in achieving a sustainable setup. Collaborative transportation management highlights the flexibility in the physical distribution and diminishes the inefficiency of supply chain management (Chan and Zhang, 2011). Transportation efficiency emphasises the importance of communication and information sharing which is beneficial to goods tracking and vehicle monitoring (Sternberg et al., 2010).

A product safety solution requires a holistic approach to supply chain management design. Leading companies are applying warehouse and transportation management system (Klein, 2008) that enable internal integration with their suppliers and customers (Aherne, 2002). The entire process of product development essentially consists of not only the manufacturers and the suppliers but also the transporters and warehouses (Chopra and Meindl, 2008). Across the primary activities of the value chain, enterprises can examine a pragmatic approach to warehouse and transportation impacts such as safety (Carter and Rogers, 2008), and prevention instead of receiving return from market as defective goods (Ruteri and Xu, 2009). Mishandling, bruising and poor transport, e.g. without refrigerated transport, attribute the condition for health risk to inviting various pathogenic micro-organisms (Ahmad and Fehér, 2008). It stands to reason that the use of warehouse and transportation management system in supply chain management design might respond to consumer trust in important information related to food products.

CONCLUSION

This study represents one of the first attempts to posit a food supply chain design in terms of the use of tracing technology, warehouse management system, and transportation management system to improve consumer trust in food safety. The empirical evidence in Taiwan, in which a series of food safety scandals has been revealed in recent years, determines the factors of Taiwan-based food supply chain design in food safety. It is suggested that the use of tracing technology, warehouse and transportation management system in food supply chain management might be designed to respond to consumer trust in food products. Therefore, food supply chain should be predicated upon food traceability system that may help to meet consumer assurance requirements of food harvest, food production/processing, food inventory, transportation, third-party services and reverse logistics. In addition, transparency is necessary for gaining consumer trust in food safety and hygiene. In order to meet consumer need for food safety, the actors and the institutions involved in the food supply chain need to collaborate closely because food safety requires governance that included administrations of state and non-state actors in

control of food safety at production and marketing stage (Moustier et al., 2010; Pham et al., 2009).

The study presents several implications for food supply chain practices. Firstly, the empirical evidence shows the underlying mechanism that requires internal centralised database in order to facilitate the product traceability. It suits the growing trend in using mobile devices and scanners to monitor the context and produce flow. Another point to note is that all the movement of materials and finished products in food supply chain are necessary to be exposed to consumers. Transparency in data exchange consolidates static and dynamically changing information. Finally, regardless of the size of company, the number of trading partners as well as the complexity of its business, the value of trust is built on integrity and confidence in others. Basic logistics planning and supply chain management are fairly essential to consumer trust in food safety.

There are also several limitations that suggest the need for future research. First, the data is self-reported, hence validity problem exists. Respondents may exaggerate or under-report the symptoms. A future research is encouraged to compare the results of the same self-reported questionnaire with another self-reported on the same topic (McIntire and Miller, 2007). Second, there is a lack of testing the causal relationships between the use of tracing technology, warehouse management system as well as transportation management system in food supply chain management design and consumer trust (Figure 1). Thus, testing the research model in structural equation modelling is useful for extensive investigation into consumer trust in food safety, counted on food supply chain management design.

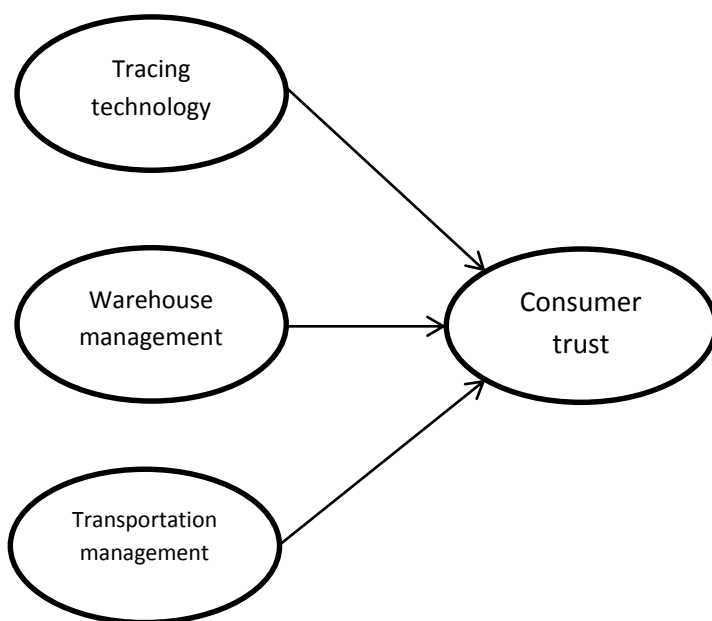


Figure 1. Proposed path model depicting relationships between food supply chain management design and consumer trust

Food safety is a big issue of major concern. Hence, the food sector needs to use its best endeavour to ensure it. The empirical findings are helpful for food-related actors in information sharing, inventory and transportation. Effective information integration handles discrepancies and transparency in investigation. Operators should maintain a central warehouse for distribution. Across the primary activities of the food supply chain, goods should be eventually controlled on the transport through management system. It is expected to bring about the change in actors involved in the food supply chain to improve performance. In fact, consumers do not pay any attention to information about

good governance unless trust is breached (Henderson et al., 2012). The upshot of it all is that transparency may be necessary to functioning in regaining public trust.

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SUPPLY CHAIN COLLABORATION OF THE CHINESE ELECTRONIC AND ELECTRICAL MANUFACTURING FIRMS

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ABSTRACT

This paper explores how supply chain collaboration (SCC) can be employed by the Chinese Electronic and Electrical (E & E) manufacturing firms to enhance supply chain efficiency, thereby contributing to the economic transformation of the country. A multiple case study methodology was adopted to investigate four major E & E manufacturing firms located in Guangdong province of China. Semi-structured interviews with the senior supply chain managers of the four firms were conducted to identify the key elements of SCC in the industry. The findings reveal that SCC of the Chinese E & E manufacturing industry is still at an infancy stage. Timely information sharing has not been achieved due to lack of advanced inter-organizational information systems (IOS) and unwillingness of organizations to share information. Current SCC practices implemented by the four firms investigated are significantly different from the best practices of their counterparts in the developed countries. Majority of the SCC initiatives, such as collaborative planning, forecasting and replenishment and vendor managed inventory, are introduced mainly to maximize local benefits instead of global supply chain surplus. As a result, overall efficiency of the supply chain has not improved but on the contrary reduced. Therefore, it is critical for the Chinese manufacturing firms to overcome the many barriers, such as lack of trust, low operation efficiency, poor IOS and impeding institutional environment, so that substantial benefits of SCC can be reaped to enhance the competitiveness of the entire manufacturing industry.

INTRODUCTION

For the last three decades, China has emerged as the world's second largest economy with a continuous double-digit annual growth in GDP (Schuman, 2013). It is generally agreed that such enormous economic boom is largely built upon a low value-adding, labour-intensive, export and investment oriented development model (Li, 2012). Recently, this powerful growth engine has experienced an obvious slowdown owing to gradual exhaustion of all those once abundant resources. The deceleration in economic growth sends a clear signal that the low value-adding development model is not sustainable in the long run (Zhang, 2014).

Suffering from a prolonged economic stagnation from 1800 to 1978, China's industrialization process almost came to a halt until the adoption of an open-door policy by the Chinese government in the early 1980s (Thomas, 2006). The production model of the manufacturing industry in China has been regarded as primitive for a long time. Majority of the manufacturing companies were originated from unsophisticated family business in small scale and scattered widely in different regions (Zhang, 2012). Products produced were usually short in added value and manufactured with outdated technology in low efficiency. As globalization continues to intensify international competition, the Chinese manufacturing firms are compelled to pursue higher levels of operational excellence so that they can take advantage of globalization as Western peers do. Obviously, a more intensive development model characterized by high added-value, improved efficiency and enhanced innovative capabilities has to be fostered. To achieve this, a major transformation of the Chinese manufacturing industry would be needed.

Three decades after the introduction of the one-child policy by the Chinese government in 1979, the pool of cheap labour supplying workforce to the factory assembly lines is drying up (Schuman, 2013). In 2010, numerous outbreaks of labour suicides and large-scale strikes in multinational corporations petitioning for better pay and working conditions have resulted in significant labour wage increases across the nation (Berthelsen, 2010). Subsequently, labour cost in China has become much more expensive in comparison with its Asian neighbours, such as Vietnam and Bangladesh. In recent years, labour shortage in coastal areas of China has become a common problem (China Daily, 2011). Apparently, the days of abundant cheap labour in China are numbered. For the Chinese manufacturing industry, more advanced manufacturing approaches driving for excellence have to be sought in lieu of cheap labour in order to maintain its long-term attractiveness to foreign investors.

Furthermore, China's export suffered as a result of the financial crises in US and Europe which significantly weakened the global demand (Pettis, 2012). The once flourished and fully occupied Chinese manufacturing industry is now struggling with issues of excess production capacity and even survival in a viciously competitive business environment. Multiple challenges, such as surging raw material price, gradual appreciation of the Chinese currency and strong urge for sustainable business, have left the Chinese manufacturing firms with very little profit margin (Qi et al., 2013). If the manufacturing firms in China continue to focus merely on pure assembly and stay at the point on Stan Shih's "smiling" curve with the lowest value (Shih, 2005, p. 213-215), they could no longer provide a profitable return in the long run. To maintain its competitive position in the global market, the Chinese manufacturing industry has to let go the conventional labour-intensive production model. Instead, they need to climb up from the bottom of the "smiling" curve to participate in a wide range of value-adding supply chain management initiatives to export more skill-intensive goods and services.

As many studies reveal (Horvath, 2001; Sanders & Premus, 2005), supply chain management capability is one big area that can be leveraged to achieve sustainable competitive advantage for an entire industry. Given the nascent logistics development in China, widespread application of end-to-end supply chain collaboration (SCC) through adoption of modern managerial practices appears to be one of the most promising solutions for the Chinese manufacturing industry to realize its transformation. Since supply chain management capability of the Chinese manufacturing industry is still relatively basic (Chen & Yang, 2003), it is necessary to find out the status quo and obstacles to SCC in China before and a widespread SCC implementation can be achieved for the entire manufacturing industry.

Focusing on the electrical and electronic (E & E) manufacturing industry in China, this research attempts to investigate how the industry can adopt SCC as a new source of competitive advantage to maintain growth. Using a multiple case study methodology, four major companies in the E & E manufacturing industry with headquarters in Guangdong province of China were selected for investigation. Semi-structured interviews with the senior supply chain managers of the four companies were conducted to investigate the current status of SCC in the industry. Significance of the various elements of SCC to the firms and the obstacles encountered by the industry during implementation were also explored.

This paper is structured as follows: To begin with, a literature review on supply chain collaboration and its benefits for the Chinese manufacturing firms is reported. Next, the

methodology of the study, which is primarily multiple case studies, is discussed. Then, the findings of the research are presented and analysed. Finally, limitations of the study are discussed.

LITERATURE REVIEW

Supply chain collaboration is getting popular among businesses in recent years. With increasing competition and more demanding customers, single company can hardly compete by all itself while others work in partnership (Min *et al.*, 2005). While there are many ways to collaborate, collaboration is generally described as a cross-organizational activities where members work together to share information (Simatupang & Sridharan, 2002), resources, awards and responsibilities, as well as make decision jointly and solve problem collectively to realize common goals (Stank *et al.*, 2001; Soosay *et al.*, 2008). It is opined that collaboration can create differentiation and competitiveness for the all the collaborating members to achieve greater profitability or meet customer needs than any single member acting alone (Togar & Sridharan, 2002).

Collaboration among supply chain members makes it possible to exploit profit-making opportunities which cannot be realized by a single company (Hoyt & Huq, 2000). Through collaboration, firms are able to leverage the resources or expertise of one another which cannot be easily accessed from elsewhere. Min *et al.* (2005) contend that collaboration can lead to higher efficiency and better market positions for enterprises. Chan *et al.* (2004) believe that supply chain collaboration is able to provide quicker customer responsiveness, enhance flexibility under unstable market conditions, and reduce inventory buffer stock. Based on findings from interviewing 23 managers in 10 logistics organizations, Soosay *et al.* (2008) assert that collaborative relationship is able to integrate operations for improved effectiveness and embark on both radical and incremental innovation. Overall, collaboration is an effective supply chain management approach bringing wide range of benefits to all supply chain members in terms of cost reduction, quality enhancement and operation acceleration through streamlining cross-organizational processes (Simatupang & Sridharan, 2005).

Scholars have gathered much empirical evidence to support the claim that successful application of collaborative practices brings benefits to all participating members. For example, Wal-Mart, the first retailer implementing collaborative initiatives together with Warner-Lambert and Sara Lee, achieved great result in performance. They include improved in-stock levels from 98 to 87 per cent, shortened leading times from 21 to 11 days, lower on-hand inventory, smoothed production cycles and increased sales (Parks, 2001). Based on the findings of a survey of 76 companies in New Zealand, Simatupang & Sridharan (2004) conclude that supply chain members who have higher levels of collaboration practices can achieve better operational performance. Therefore, it is believed that manufacturing firms or the entire manufacturing industry can benefit from the adoption of supply chain collaboration.

METHODOLOGY

This study used a multiple case study methodology to investigate how SCC philosophy and practices could be widely adopted by the Chinese E & E manufacturing industry to achieve economic transformation. The case study method is a research approach putting emphasis on understanding a dynamic event within single settings (Eisenhardt, 1989). It is commonly regarded as an appropriate research technique when "how" or "why" questions are asked, the

examiner has little control over the phenomenon, and the study is concerned with a contemporary event in the real world (Yin, 2009). The method is especially useful for elucidation of assumed causal relations in real-life settings that are too intricate for the use of survey or experimental strategies. Easton (2010) advocates that case studies offer the key opportunity to disentangle the complexity and recognize a phenomenon in depth and comprehensively. Owing to the explorative nature of this research, the use of the case study approach to collecting and analysing data is considered appropriate for achieving an in-depth examination of the complex relationships within and between critical elements of supply chain collaboration and institutional drivers and obstacles.

To obtain a holistic picture of the current status of supply chain collaboration in the Chinese E & E manufacturing industry, four major E & E manufacturing companies in Guangdong province of China were selected for investigation. The selected firms are relative large corporations with 3,000 or more employees and can be regarded as representative of the industry. Based on preliminary Internet-based background search, the involvements in supply chain collaboration activities of the four companies range from collaborating extensively with supply chain partners, actively involved in SCC, limited implementation of collaborative initiatives, to total unacceptance of SCC practices. Semi-structured face-to-face interviews with departmental and senior supply chain managers of the four companies were conducted to explore in depth the key elements of SCC in the industry. To avoid limiting the scope of investigation, interviewees were encouraged to provide any information and personal views on SCC in their respective supply chain so as to examine all critical factors affecting supply chain collaboration. Nevertheless, to ensure an exhaustive exploration, a set of predetermined questions were used as prompts when necessary during the in-depth interviews. Entire conversations of the interviews were recorded with the permissions of the interviewees so that an accurate rendition of all interviews can be provided (Yin, 2009). Each interview lasted from one to three hours during which hand written field notes were taken by the investigator.

FINDINGS

Table 1 shows the company profiles of the four Chinese E & E manufacturing firms in this study.

Table 1 Company profiles

Company	Company A	Company B	Company C	Company D
1. Organization structure	3 manufacturing bases in China Listed in Shenzhen stock exchange	1 manufacturing base in China Listed in Shenzhen stock exchange	5 manufacturing bases in China Listed in Shenzhen stock exchange	4 manufacturing bases in China Private company
2. Annual sales (USD)	>0.16 Billion	0.4 Billion	0.96 Billion	>0.24 Billion
3. Main product	Micro motor	Household appliance	Gas appliance	Printed Circuit Board (PCB)
4. Number of employees	>6000	>3000	>3000	>3000
5. Major markets	Global	Domestic	International	Domestic

The five key elements of SCC of the Chinese E & E manufacturing firms identified in the study are summarized in Table 2. The findings reveal that implementation of world-class SCC is not observed in the four companies investigated. Furthermore, based on their current SCC practices, it appears that the way of collaboration among supply chain partners in China is considerably

different from that of their counterparts in the developed countries.

Table 2 Key elements of SCC

Key Elements	Initiatives	Company A	Company B	Company C	Company D
Strategy Alignment	Strategic cost & risk sharing	Some strategic risk and cost sharing with customers and suppliers on strategic items	Initiated cost and risk sharing with suppliers by aggregating purchasing volume to achieve economies of scale	Very limited strategic cost and risk sharing with suppliers	No cost and risk sharing with customers or suppliers
	Strategic supplier alliance	Having good relationship with strategic suppliers	Started to build up collaborative relationship with suppliers	Maintaining only transactional relationship with suppliers	Passive in supplier relationship due to suppliers' domination of the market
Information Sharing	Information Sharing	Timely information sharing with both international and domestic customers	Working to realize timely information sharing with franchisers and suppliers to improve supply chain visibility	Sharing information with customers but not suppliers	Providing customers the required information but not sharing information with suppliers
Synchronized Supply Chain Operation	Lean operation	Running mature JIT delivery with customers and suppliers but still far from best practice	Started to apply lean operation with 70% of spare parts on JIT delivery	JIT not suitable due to fragmented batches of orders	Special department set up to reduce cost and improve efficiency
	Logistics management	Outsourced to 3PLs	Franchisers and suppliers are responsible for logistics costs	Outsourced transportation to 3PLs	Outsourced transportation to 3PLs
Joint Performance	Collaborative performance measurement	Not implemented	Not implemented	Not implemented	Not implemented
	CPFR	International customers provide clear rolling forecast for production planning while preliminary CPFR with domestic customers are implemented	Franchisers are required to provide sales information for planning and forecasting while suppliers are given monthly production plan and 3+3 days demand forecast	International customers provide clear rolling forecast for the next three months but no joint performance plan with suppliers	Forecasting and planning inaccuracy of big domestic customers leading to waste and insufficient use of facilities and production capacity
	VMI	Providing VMI service to both international and domestic customers	VMI only limited to metal suppliers as JIT instead of VMI is preferred due to big fluctuations in price	VMI not adopted due to unstable and discrete demand	VMI not preferred due to higher level of inventory and risk
Collaborative Investment & Innovation	Collaborative Investment & Innovation	Implementing collaborative investment in facilities with some suppliers while leveraging technology of other suppliers through consultation on part design	Providing suppliers with new technology, new process and quality improvement solutions while involving strategic suppliers in product development and offering them preference policy	No collaborative investment implemented but suppliers are encouraged to improve component design and reduce cost	No collaborative investment implemented but suggestions were made to suppliers on part design so that own manufacturing process can be simplified

As shown in Table 2, Company A implemented relatively better SCC than the other three companies. Supported by a comprehensive inter-organizational information system (IOS), the Company managed to realize timely information sharing among internal departments and external international and domestic customers. While only primitive collaborative planning, forecasting and replenishment (CPFR) and vendor managed inventory (VMI) practices were implemented to work with domestic customers, much more mature and extensive collaboration between the Company and its international customers was in place. Further, very successful collaborative investment was achieved by the Company and its strategic suppliers with facilities and management provided by two parties separately. In sum, Company A has made certain progress in the implementation of SCC initiatives.

Acknowledging the significance of SCC in business success in an escalating competitive environment (Sanders & Premus, 2005), Company B started to adopt SCC by sharing cost and risk with up-stream and down-stream supply chain partners in addition to building up collaborative strategic supplier partnerships. However, various difficulties were encountered in the process. Information sharing was seriously prohibited by a fragmented IOS which had led to the formation of isolated information islets scattered throughout the whole organization. Owing to the lack of sophisticated forecasting knowledge and skills, Company B simply generated its demand forecasts from sales target of the year instead of real market information. Although a "3+3" rolling forecast was provided by the Company to its suppliers to facilitate coordination, accuracy of the forecasts was largely constrained by the capability of downstream franchisers and their unwillingness to share complete sales data for protection of their own interests. The amount of inventory across the entire supply chain could not be determined due to low supply chain visibility which was a significant obstacle that needed to be removed. Basically, Company B was still at a very early stage of SCC.

Although Company C had developed stable business relationship with world leading retailers, advanced SCC initiatives had not been adopted. International retailers provided rolling forecasts to the Company and required them to share information online. While maintaining mainly transactional relationship with suppliers, the Company chose not to share information with them. Orders placed by customers were treated as the real demand resulting in bullwhip effect with drawback not being recognized (Fawcett et al., 2007). Company C focused mainly on local benefits with little attention to the maximization of profit for the entire supply chain (Chopra & Meindl, 2013). Hence, SCC with other supply chain members was very limited in this case.

Company D supplied printed circuit boards to major original equipment manufacturing firms who assembled electronic products, such as mobile phones and laptops, for world leading brands. As a tier-one supplier in the supply chain, the Company adopted a negative attitude towards all SCC initiatives implemented by domestic customers. This was because they were forced to absorb all costs and risks as downstream manufacturing firms hold more bargaining power and inclined to use SCC as a means to push costs and risks to upstream suppliers. As a result of inappropriate implementation of CPFR by local customers, the Company incurred higher costs in terms of waste due to under-utilization of facilities and production capacity. Therefore, Company D basically was not in favour of any SCC initiative.

Through the discussion with the interviewees and analysis of the filed notes and scripts, multiple barriers hindering widespread implementation of SCC in the Chinese E & E industry were also

identified. They include lack of trust, dominance of transactional relationship, low supply chain efficiency, poor IOS and unique institutional environment in China. To leverage SCC as a new competitive advantage and to achieve a widespread implementation across the industry, these obstacles have to be removed and drivers such as top management support be set in place. In view of the current infantry stage of SCC in China and the lack of advanced logistics and supply chain capabilities in the industry in general, it is believed that implementation of SCC has to be conducted in stages to when the industry is ready to fully embrace the concept and adopt the changes. As shown in Figure 1, the first stage of SCC implementation will be to integrate supply chain partners through the use of IOS to enable information sharing and aligned strategy formulation. During this stage, drivers such as trust and commitment and top management support are critical. Once a collaboration platform is developed, participating firms can work together to coordinate activities and synchronize their supply chain processes to increase logistics efficiency. Through knowledge sharing and mutual leveraging of expertise and skills, advanced supply chain management techniques can be introduced and adopted across the entire supply chain to improve overall performance. In the final stage when trust among supply chain members are strong and their supply chain capabilities have been enhanced, a full-scale collaboration can be implemented to develop a joint performance evaluation system to optimize overall supply chain performance. Advanced collaborative initiatives such as CPFR and VMI can be introduced. Collaborative investment and innovation to further develop capabilities and competence of the supply would also become feasible. It is only at this stage that the full advantage of SCC can be realized and leveraged to help the E & E industry to maintain its competitive edge under the increasing global competition.

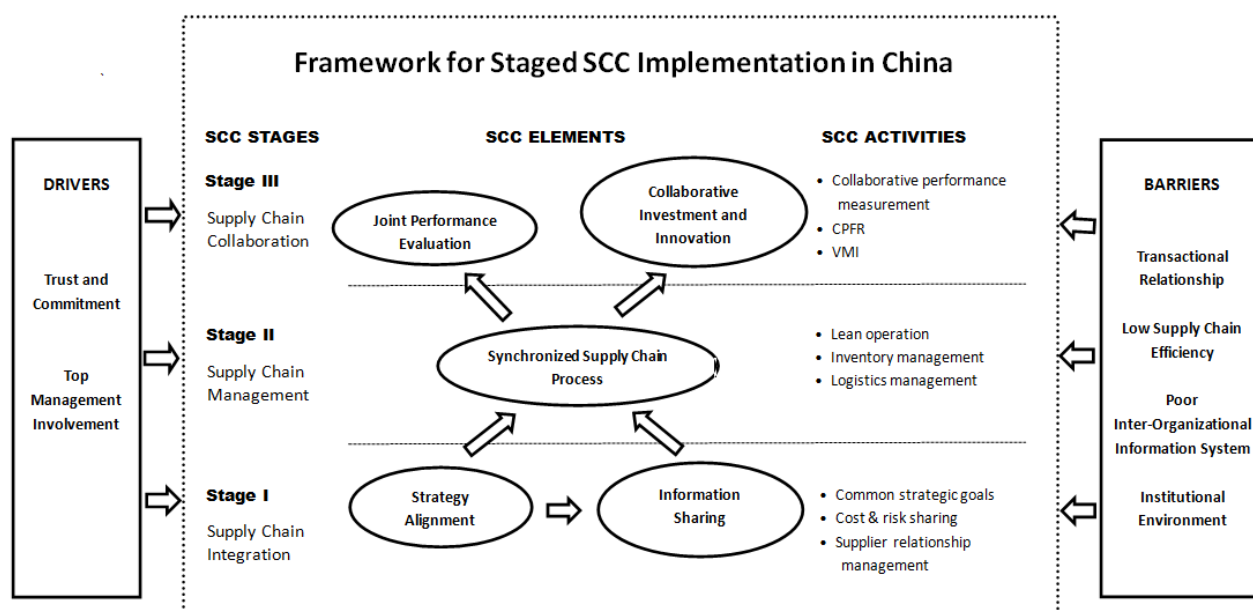


Figure 1 A proposed framework for staged SCC implementation in China

CONCLUSIONS

This study has investigated how SCC can be implemented by the Chinese E & E manufacturing firms to improve supply chain efficiency, thereby contributing to the economic transformation of the country. Five key elements of supply chain collaboration among the indigenous Chinese manufacturing firms have been identified and discussed. The findings reveal that supply chain collaboration is new to the majority of the Chinese E & E manufacturers although the concept is receiving increasing attention. Certain SCC practices have been employed by some of the firms but are introduced mainly to maximize local benefits. As a result, the overall supply chain

surplus has not been increased. To improve the situation, various barriers need to be removed and drivers be provided. In view of the general lack of supply chain capabilities and drivers for collaboration, it is believed that a staged implementation of SCC might be more suitable for China taking into account the various barriers. This approach is different from that adopted in developed countries whereby full collaboration among firms is assumed to be implemented in one go. Staged implementation can ensure a smooth migration and a higher chance of success.

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THE DESIGN AND DELIVERY OF MODULAR PROFESSIONAL SERVICES: IMPLICATIONS FOR OPERATIONS STRATEGY

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ABSTRACT

Purpose of this paper

This paper explores the application of the notion of modularity in professional services and how the modularisation of services can influence the design and execution of operations strategies. The notion of modularity has gain momentum in the design and architecture of service offerings, as a successful strategy to improve service delivery costs and enhance customer value (Pekkarinen and Ulkuniemi, 2008, Voss and Hsuan, 2009)

Design/methodology/approach

A conceptual (mathematical) model is developed first for determining the extent of service modularity and the effect of the modularisation of professional services on supply chain costs. A series of 10 case studies are then conducted in legal services firms in the UK to identify the scope for their modularisation and the implications for their operations strategies. The focus of the analysis is on sourcing strategy decisions, rather than the entire gamut of operations process for the design and delivery of services.

Findings

The case studies show how legal services can be decomposed into customisable and standardised processes/modules. An Operations Strategy framework is developed for legal services firms, including 'legal service specific performance criteria' and practical operations strategy decisions. This framework is piloted with one law firm. An analytical model is proposed for classifying different legal services based on their degree of required customisation and assessing the extent to which the delivery of these services is standardised (Bask et al., 2010). The model is tested in the 10 participating legal firms, showing that 7 out of 10 firms deliver services in a way that is 'under-standardised' (or 'over-customised) relative to the degree of customisation required.

Value

The findings of the study show that (service) process modularity presents significant opportunities for the development of modular professional services at either the level of the design of the service offering, service operations, or service organisation. Preliminary findings show that for litigation services, firms that deliver services in an optimally modularized standardised manner could record operating profit percentages that are 30% higher than those firms that delivered services in an 'under-standardised' manner.

Research limitations/implications

As the study is exploratory in nature, there is the need to test the generalizability of its findings with the use of a large survey, or a longitudinal study that can observe the performance effects of the design and delivery of modularised services

Practical implications

Preliminary findings show that for litigation services, firms that deliver services in an optimally modularized standardised manner could record operating profit percentages that are 30% higher than those firms that delivered services in an 'under-standardised' manner.

INTRODUCTION

One of the most important challenges for service organisations is their ability to respond to customer demand rapidly with flexible systems that provide a personalised experience. The cost implication for this level of customisation however is prohibitive for many service organisations. A very successful strategy for providing increased customisation and personalisation, while obtaining the benefits of cost reduction through standardisation and reduced complexity, has been the use of flexible modules and common parts and interfaces for the design and creation of products (Baldwin and Clark 2000).

The design and production of modular systems is not a new concept (IBM has used in 1964 shared components and peripherals in their 360 system which allowed them to reduce the complexity in the architecture of their products while also increasing flexibility (Baldwin and Clark 1997). Most industries have some sort of modular architecture (Shilling 2000), which has been applied to the analysis of products, organisations and services (Worren *et al.* 2002; Baldwin and Clark (1997).

Although the concept of modularity has been extensively used in design and production of tangible goods, research in the use of modularity in services and in particular in professional services has been scarce. This study contributes to the growing body of literature of service science that looks at the creation of models and strategies for service processes and adaptation of well-known concepts and practices for service firms. In particular the concept of modularity is explored in the design and delivery of legal services of law firms and how the modularisation of services can be manifested in the design and execution of operations strategies.

Law firms are interesting loci to explore the potential of the design of modular professional services systems. They currently facing a number of challenges brought about by tough economic conditions, a highly competitive market, regulatory changes, reduced barriers to entry and rapidly changing social and technological trends and there is an ongoing call for the development of systems and process that can achieve both cost effectiveness as well as customization (Susskind).

Three main research questions are explored for the development of service operations strategies based on the design and delivery of modular service systems:

RQ1. What are the key components of a legal-specific operations strategy matrix?

RQ2. How are different types of legal services currently delivered?

RQ3. How can modularity be applied to improve legal service delivery and develop new operations strategies for law firms

The paper is outlined as follows. The 2nd section reviews the growing literatures of modularity and service modularity to generate insights for the development of a service operations management framework based on modular systems. The 3rd section presents the methodology of the empirical research, followed by a detailed presentation of its findings. The 4th section analyses the findings in light of the research questions and critically reflects on how service operations strategies can be developed for modular service systems. The study concludes with a presentation of its main findings, the implications for theory and practice, the limitations of the study as well as an agenda for future research.

LITERATURE REVIEW

The multiplicity of theoretical and practical applications and the difficulty to separate the definition of a module from the benefits sought by modular business systems, has generated ambiguity and vagueness for an explicit definition of modularity (Gershenson *et al.*, 2003; Holttä-Otta, 2005; Campagnolo and Camuffo, 2010). Several definitions have been proposed that emphasize the a modularity is a business system design philosophy of structures that are composed by components

which can be separated and recombined to create a variety of different products/configurations without losing the system's functionality (Baldwin and Clark, 1997; Schilling, 2000). The modular design philosophy is opposite to the integral architecture of product design, yet modularity and integratedness can coexist within the same architecture with loosely coupled but yet related business divisions (Galunic and Eisenhardt, 2001). Common characteristics of modularity include:

- The development of highly standardised and low-cost components with specified and standardised interfaces which can be mixed and matched readily and with commonality of use across multiple products
 - A loosely-coupled architecture between its components and interfaces, enabling disaggregation and recombination
 - The provision of a platform or infrastructure which facilitates network user interactions.
- The design and development of stand-alone component modules lies at the heart of the modular design philosophy, to make sure that service processes can actually be separated, delivered independently and re-combined without negative impact.

A modular system architecture is about decomposing systems and the selection and linkage between components which should not compromise the systems integrity. Modular architecture designs enable companies to create the amount of product variety which is expected by customers Mikkola (2007). The more modular the architecture is, the easier it is to implement mass customisation. Ulrich (1995) posits that architecture design allocates functions to components and specifies the interfaces between those components. Although architectural decisions are linked to the overall organisational performance, they also influence R&D issues such as ease of product change.

Product platforms have been argued to range from industry and product specific (Sanderson and Uzumeri 1995) to being general and abstract. However, the meaning of platforms differs in scope. Meyer and Utterback (1993), argue that a platform comprises of subsystems and interfaces which are common to the whole product family. Platforms can create value by sharing service modules and platform planning allows companies to improve service quality and decrease costs because there are fewer service components to monitor and improve.

Application of modularity in services

The notion of modularity has been applied successfully in industries that produce tangible goods. The strategy of mass customization and modular design has been limited in a service industries, despite the growing awareness that modularity could be a powerful approach to enable the low-cost delivery of services that require high degrees of customization (Bask et al, 2010, Pekkarinen and Ulkuniemi, 2008, Meyer and De Tore, 1999, 2000; [Böhmman and Krcmar, 2006](#)). The emergence of the field of service science has been instrumental in driving the research agenda in this field. Baldwin and Clark (1997) argue for example that services in the financial industry can be modularised, as they are easy to analyse and split up, resulting in innovation. Securities can be split up by designers which can then be reconfigured into derivative financial products. Pekkarinen and Ulkuniemi (2008) refer to service modularity as way to manage heterogeneity in demand. They argue that a modular service would also require a modular processes as well as organizational architectures.

Most of the studies in service design use concepts applied from product family design and mass customisation. There is a dearth of inquiry however that investigates the inter-relationships and the design implications of service functions, service processes and the service supply chain, for the development of appropriate service operations strategies. .

Analysis of Service Modularity

Drawing on the work of Bask et al. (2011) and Rahikka et al. (2011), service modularity can be considered at three levels:

- *Modular service offerings* - pre-packaged bundles that customers can choose from.

- *Modular processes* – processes that are decomposed into standardised and customised service processes (modules), delivered independently by appropriately skilled resources and then recombined into customisable combinations to achieve maximum flexibility.
- *Modular organisations* – a loosely-coupled organisation where there is flexibility to allocate personnel around the organisation and / or use resources from outside the boundaries of the firm.

Bask et al (2011) develop a framework in which different customer service offerings, service production processes, and service production networks could be analysed in terms of both modularity and customisation. They develop 2x2 matrices that are dimensioned by 'degree of modularity' and 'degree of customisation' across the three levels of modularity. Figure 1 shows the modularity classification of service offerings. The classification these types of services could have a significant impact on the potential options for the type of channel-delivery system.

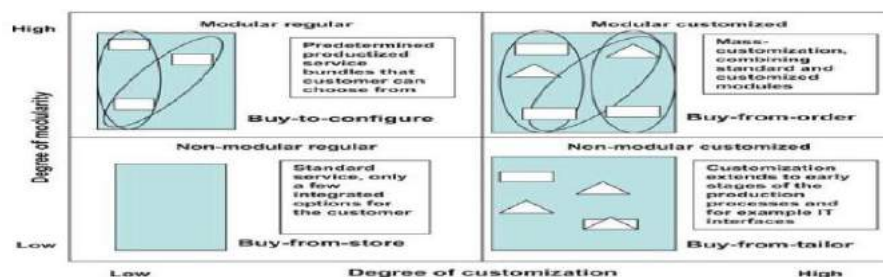


Figure 1 – Modularity at the level of Service Offering (Bask et al, 2011)

The organisational level is linked to supply chain organisational decisions to assist the level of outsourcing. It has been argued that modularity facilitates outsourcing (Sako, 2003). Research in modularity has shown that it can multiply organisation design options through configuration and reconfiguration of independent modules (Baldwin and Clark, 2000). Organisational modularity for example could help firms to realise economy of scale benefits from centralising standardised modular processes into shared service centres, or even virtual working environments. The literature review illustrates that modularity and, more specifically, service modularity is a promising area that could help to address the challenge of delivering highly customisable services efficiently.

Studies in service modularity has recently gained momentum, however the operationalization of modularity in professional service contexts and the development of operations strategies that can provide a decision making framework for service companies has been limited. In this paper the principles of modularity are applied to legal services firms to explore how they can be practically implemented to assist the development of operations strategies. The focus of the analysis is on the effect of modularity on one aspect of the newly developed legal services operations strategy framework; the outsourcing strategy.

METHODOLOGY

In order to answer the three research questions, data has been collected via a series of semi-structured interviews with managers and leaders of 10 UK law firms, which provide a wide range of legal services. Data collection has been predominantly qualitative rather than quantitative. This data collection and analysis process has followed an inductive, exploratory approach. 10 semi-structured interviews were initially carried out which focused on the current state of law firm's operations strategy and approach to legal service delivery. Following these initial interviews, two interviewees agreed to a further follow-up interview which focused more on the extent to which modularity is currently used and the extent to which it could be in the future. 10 law firms were interviewed (summarised below in Table 1). Details has been kept confidential. In order for the findings to be representative of a wide variety of law firms, interviews were conducted with senior partners and leaders of firms ranging in size from £15million to over £1billion of turnover. The interviewees were key people responsible for making the strategic operations decisions of a firm:

managing partners (MPs), chief executive officers (CEOs), chief operating officers (COOs), and finance directors (FDs).

The structure of each initial interview covered two major areas: (i) the key strategic decisions around the firm's operations (i.e. operations strategy decision areas) and (ii) how legal services are currently designed and delivered (the extent of their customisation, or modularity). A second follow-up interview was conducted with Firm A and Firm C specifically to investigate service modularity principles in law firms. These second sessions also included a process analysis workshop to decompose a legal process into component parts. Separate data analysis was undertaken to address each of the three research questions.

FINDINGS AND DISCUSSION

Development of an operations strategy framework for law firms

A theoretical *outline of a legal services operations framework* is provided in Figure 2:

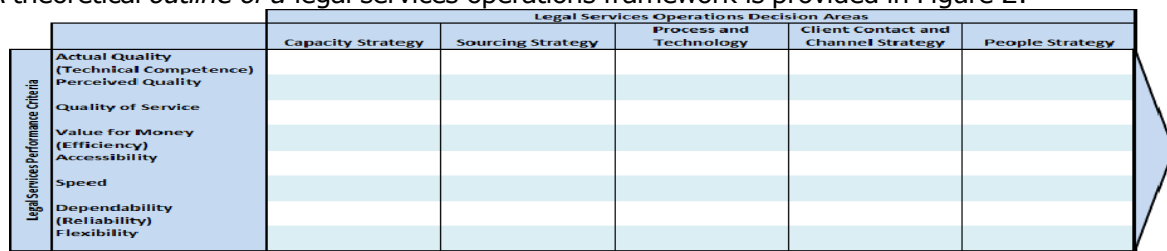


Figure 2 – Operations strategy framework for legal services (based Slack and Lewis, 2010)

The project interviews collected data on the detailed operations strategy decisions that each law firm faced. Analysis of the data in this phase followed more of an iterative process. Notes were transcribed to identify any inductive patterns in the data. Figure 3 below summarises the data in order to illustrate the key trends i.e. the percentage of responses against a sample of key operations strategy decisions.

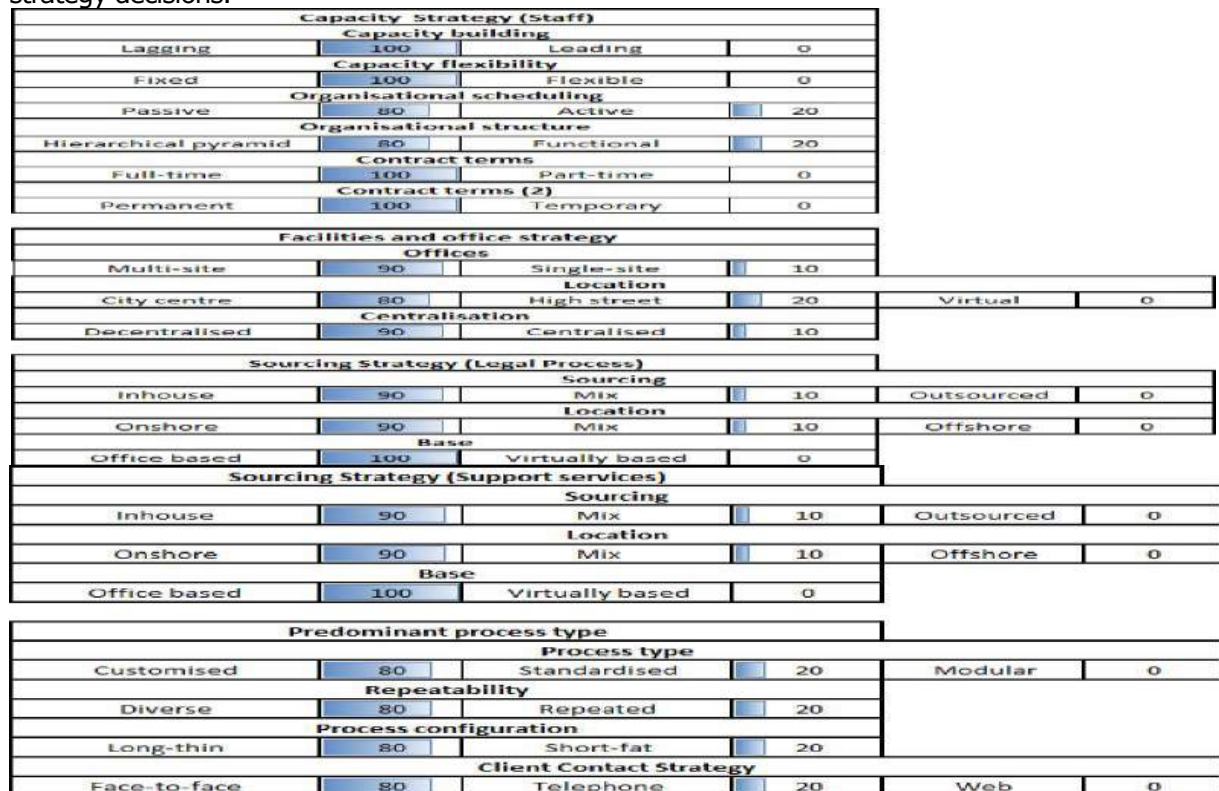


Figure 3 - The percentage of responses from project interviews to a sample of key decisions

Even with such a range of different sizes and types of firms, figure 3 shows the predominance of certain common operations strategy decisions. The detailed performance criteria and detailed

operations strategy decisions enabled the matrix to be refined and developed. As a follow-up to the initial project fieldwork, the framework was successfully piloted as a diagnostic tool with Law Firm C. It was demonstrated that the matrix can be used as effective diagnostic tool to identify issues in relation to particular performance objectives and to trace back the root cause to particular operations strategy decision areas. These findings were independently discussed with law firm management and confirmed.

How are different types of legal services currently delivered?

Each firm's predominant service offering was categorised according to the customisation table (Figure 3). In order to identify patterns in the data, each firm's service delivery approach was plotted onto an Excel template according to the classification key. Subsequently, the data was consolidated and summarised onto the customisation / standardisation matrix (developed in the literature review based on the work of Kellogg and Nie (1995)) in Figure 4. Figure 4 also includes the Operating Profit % (OP) of each firm (identified from published LLP accounts).

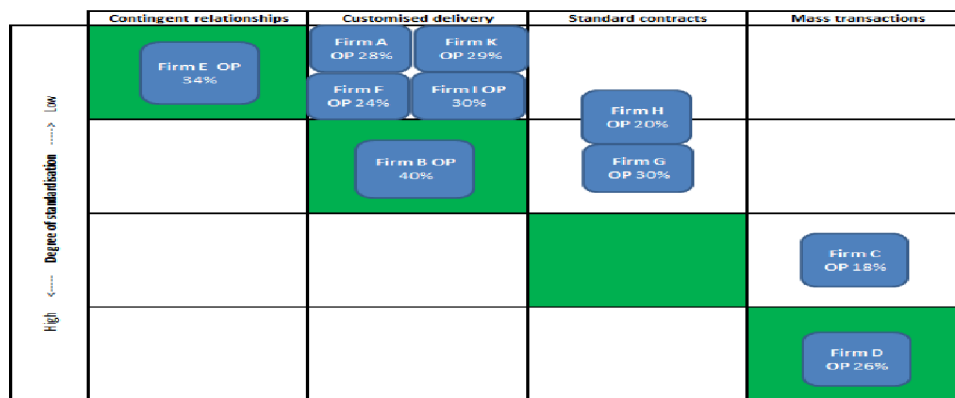


Figure 4 - Analysis of how firms deliver different types of legal services

The analysis shows that 7 of the 10 sampled law firms appear to deliver services in a manner that is "over-customised" (or "under-standardised") compared to the levels of customisation required from clients i.e. they are "above the diagonal" on the Customisation / Standardisation model. The results are summarised on Figure 5. The results from the sample of 10 firms interviewed, suggest that law firms are currently overlooking opportunities for standardisation.

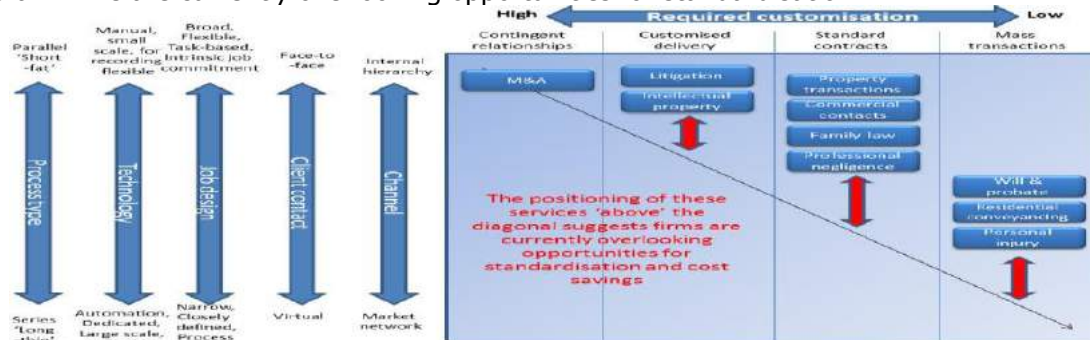


Figure 5 – Illustration of current practice of legal service delivery

Despite varied levels of required customisation, (with the exception of mass transactions) almost all legal services are still delivered as non-standardised "professional services" with non-continuous process flows. Typically only small scale, flexible technology is used and often as a means of recording information rather than as a means of automation. The model argues that efficiency, cost and productivity "quick-win" improvements could be achieved simply by standardising services so that they are positioned "on the diagonal" (Kellogg and Nie, 1995).

The Operations Strategy literature advocates that the efficiency ratio (Operating Profit %) is influenced by a firm's 'Process and Technology Strategy' (Slack and Lewis, 2010). Whilst it is difficult to surmise statistically significant conclusions from such a small sample, it is noted that

the average Operating Profit % of the 3 firms whose service delivery processes sit 'on the diagonal' was 30% higher than those firms where service delivery sat 'above the diagonal' (Avg. of firms above the diagonal = 25.6%, Avg. of firms on the diagonal = 33.3%).

How can modularity be applied to law firms?

Modular Legal Service Offerings: Responses to interviews were analysed against modularity principles and classified accordingly. Data indicated that not one of the 10 sampled law firms currently offer modular service offerings. However, one interviewee did indicate that they were aware of two relatively new entrants to the market that have begun to offer modular legal services to consumers. The results of the interviews and subsequent internet searches were plotted onto Bask's Modularity and Customisation matrix (Figure 6).

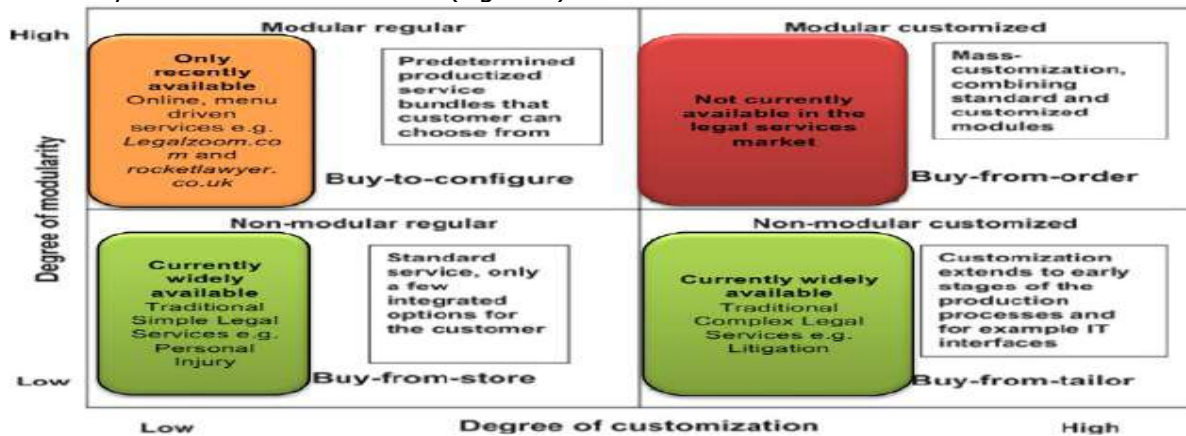


Figure 6 - Prevalence of modular legal service offerings

Figure 6 illustrates that 'non-modular regular' (e.g. commoditised legal services) and 'non-modular customised' (e.g. traditional legal services) have been widely available for a number of years. In the "modular regular" service category, innovative new entrants to the legal services market have started to deploy online, menu driven modular offerings for legal services that don't require a high degree of customisation. However, at this stage, no 'modular customised' legal service offerings have been identified, either through project interviews or an internet search. The next section considers how modularity could facilitate the 'splitting up' (or decomposition) of legal processes such that the opportunities presented by social and technological innovation can be accessed to significantly benefit law firms and their clients.

Development of Modular Legal Processes

By analysing the data collected from project interviews (see below), it can be seen that not one of the 10 firms interviewed is currently delivering services via modular legal processes. Bask et al's (2010) matrix has been completed to show the extent to which modularity is currently applied to legal processes based on interviews and process analyses.

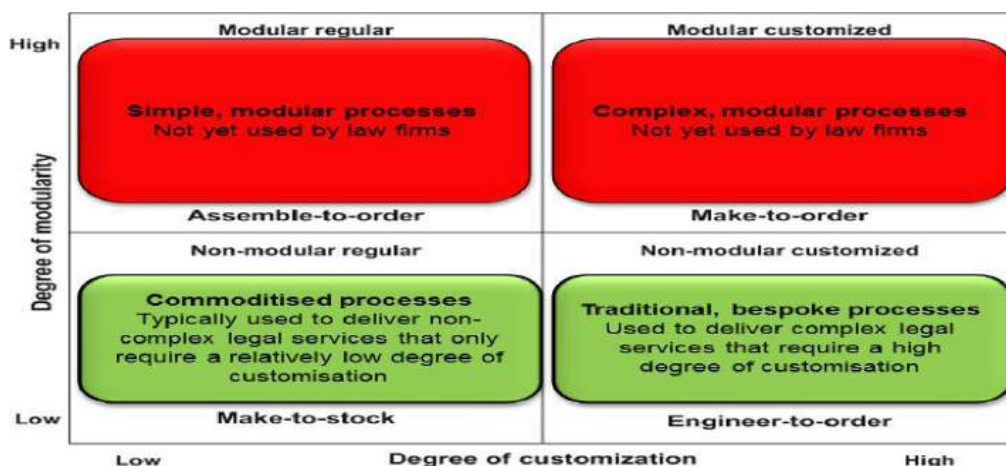


Figure 7 – Prevalence of modular legal service processes (based on Bask et al, 2011)

The model illustrates that modular processes have not yet been widely embraced in the legal services industry. The decomposition of legal services into their component parts can enable companies to deliver services with modular processes (Bask et al., 2010). Following the initial interviews, additional sessions were arranged with Firm A and Firm C to investigate modularity further and explore whether it would be possible to decompose legal processes in component parts in order to facilitate modular delivery.

With the use value chain analysis can legal process have been decomposed and then their component parts were classified into either standardised or customised groups. During the follow-up sessions with Firm C, a workshop session was held to complete a detailed process map of a simple legal process. Each of the process tasks and components was assessed independently to identify whether it could be delivered in a standardised manner or whether it needed to retain a degree of customisability. A summary of the output from the workshop is included in Figure 8.



Figure 8 – Decomposition of a simple legal process

Figure 12 illustrates that there are considerable opportunities to standardise components of a simple legal process. This suggests that modularity could be applied to simple legal processes. Following these promising results, the next challenge was to assess whether this exercise could be replicated for a complex legal service. Firm A currently delivers legal services which have been classified as 'Customised Delivery'. Figure 13 shows how the whole of the Litigation process is currently delivered by Firm A in a non-standardised manner.

Figure 9 illustrates that by decomposing a process into component parts and assessing the level of customisation required, modular processes can deliver each component in an appropriately standardised manner, resulting in an increase in standardisation of overall service delivery.



Figure 9 – Decomposition of a litigation process into modular components that are delivered at an appropriate levels of standardisation

The modularity literature suggested that "off the diagonal" improvements with modularity i.e. delivering services with high-levels of customisation in an efficient and standardised manner (Bask, 2011). The results from the disaggregation of the two legal processes above suggest this is possible

for legal service delivery. If these results could be applied across the industry, then it may be possible to deliver customised legal services in a highly standardised way (Figure 10).

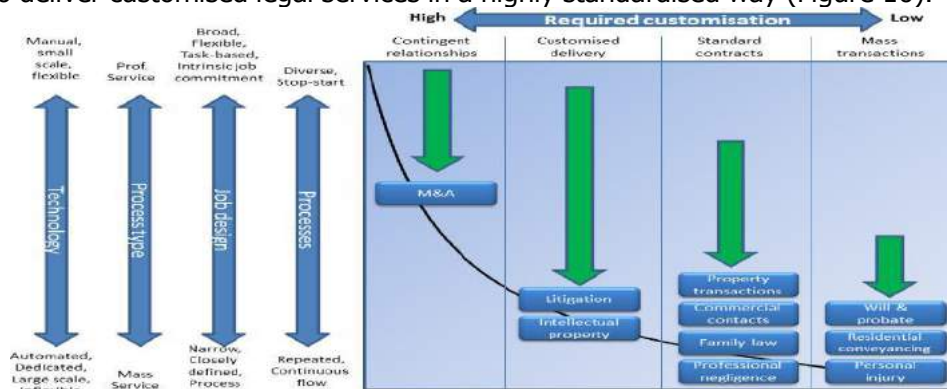


Figure 10 – Repositioning legal service delivery to achieve “off the diagonal” improvements

Development of Modular Legal Service Organisations

Based on the data collected from project interviews, there appears to be only a limited degree to which these modularity principles have been embraced by law firms. Similarly, the extent to which law firms outsource services is also limited. Of the 10 firms interviewed, one firm outsources any of legal work to another business (although this firm is a wholly owned subsidiary of the outsourcing firm). Figure 11 shows how a law firm by operating in a modular manner could move the decentralised completion of standardised components by fee earners to a centralised shared-service centre (or a “Legal Process Delivery Centre”).

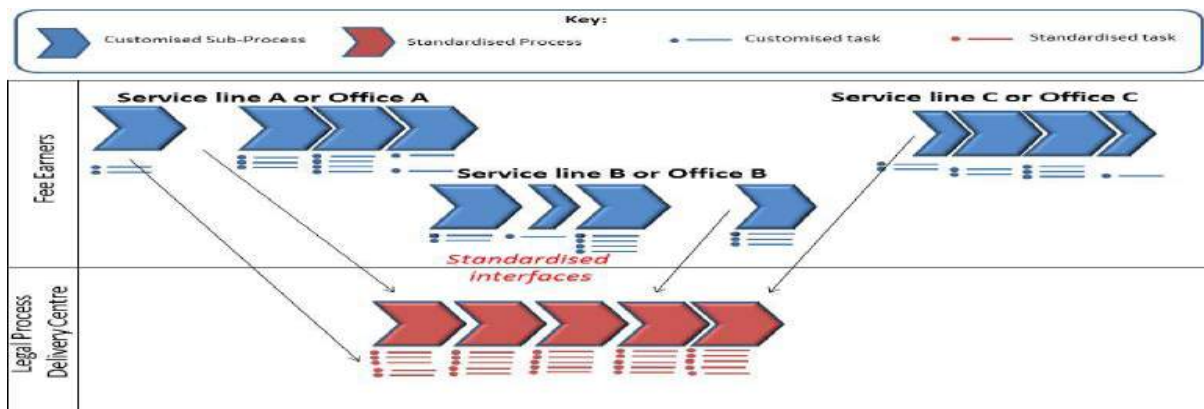


Figure 11 – Illustration of centralisation of processes to a “Legal Process Delivery Centre”

The ability to standardise and centralise legal process delivery presents considerable cost saving opportunities, particularly since simplified, standardised task and sub-processes do not necessarily need to be delivered by highly skilled and expensive lawyers. It is important to note that no attempt has been made to quantify the potential economies of scale benefits associated with such a centralisation move, so any net saving is likely to be understated. Despite all of these benefits, the data suggests that outsourcing has not been widely embraced yet.

CONCLUSIONS

This purpose of this study has been to explore how modularity can assist law firms to operate and deliver legal services. The project fieldwork has produced insights about the status quo which have been integrated with a comprehensive review of academic literature to develop new concepts and potential approaches to future operations strategies and legal service delivery processes. An operations strategic framework for law firms has been developed. From an academic viewpoint, this has provided greater clarity over the key performance criteria and operations strategy decisions for a service business (particularly a law firm) over and above the generic criteria put forward by Slack and Lewis. It also provides a theoretical framework against which further research in the legal industry can be conducted.

A conceptual model has been developed to categorise different types of legal services based on their required degree of customisation and also the way in which these services are delivered based on the degree of their standardisation. This model can be used to analyse how different types of legal services are delivered to identify opportunities for efficiency and profitability improvements. The model suggests that law firms are over-customising (or under-standardising) legal service delivery. The project work also provides empirical evidence that suggests a relationship between over-customisation and a reduction in operating profit (used as an indicator of efficiency).

Data from this project suggests that modularity has not been widely embraced by the legal industry at either the level of service offering, process or organisational form. Innovative new entrants to the legal market have developed modular, simple legal service offerings to great effect and have managed to demonstrate impressive year-on-year sales and profitability growth. At this stage, no firms were identified that were offering complex legal services in a modular way, presenting an opportunity for an innovative firm to seize 'first-mover' advantage. Project data also showed that despite limitations with the existing types of legal processes (i.e. 'bespoke' and 'commoditised'), not one of the firms sampled is currently delivers legal services via modular processes. This project illustrates how modular legal processes can be developed by decomposing legal services into customisable and standardised modules. The subsequent benefits of this are that each independent module can then be delivered in an appropriately standardised way by appropriately skilled resources. The project demonstrates how a complex legal service (in this example; Litigation) can then be delivered in a more standardised and (as suggested by the previous research in this paper) more efficient manner. Process modularity also presents significant opportunities for the development of modular law firms. Interviews suggested that outsourcing and offshoring was not being pursued by most firms for a number of reasons being cited including; cost, risk, process and institutional factors. Despite the unpopularity of outsourcing, opportunities do exist for the creation of centralised legal process delivery centres. A conceptual sourcing model was developed to illustrate the perceptions of law firms of different sourcing mechanisms in terms of both risk and cost. Although modularity principles have not been widely deployed in the legal industry yet, the concepts developed in this project have illustrated how modular offerings, processes and firms could improve growth, efficiency and profitability of law firms.

The sample size of just 10 UK-based firms limits the extent to which the concepts and theories generated in this research can be generalised to all firms. Finally, it is possible that the qualitative nature of data collection and combination of inductive and A Priori data analysis could also introduce some bias into the process. In order to improve the accuracy of results, it is recommended that future quantitative research be undertaken on a larger sample of law firms.

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Section 7: Supply Chain Costs

THE STUDY OF SMES' GLOBAL LOGISTICS MANAGEMENT SYSTEM IN TAIWAN

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Abstract

The research explores the key factors of global logistic system affecting the performance of global market including good cross cultural management system, IT system, good logistics partners, local distribution channel, well understanding local customs regulation and policies of political and labor laws. An empirically executable and workable system has been approved to have 15% cost reduction including logistics cost and products cost also saving delivery time more than 10% through an integrated information system. The research is limited to survey only electronic parts firms and would like to recommend extend more industries and firms to survey. Any firms wants to apply the proposed global logistics management system is necessary to adjust based on the findings of research.

The global logistics management system call IDC is a workable system for Taiwanese enterprises in the developing countries. Specially, low inventory and cost reduction for the manufacturing firms is the core value.

Key Words: Small & Medium Enterprise (SME), Global Marketing Logistics, Industrial Distribution Center (IDC),

1. Introduction

The corporation between private sectors and government will make it successful easier. For better competitiveness, information technology, internet, mobility, cloud technology will play an important role in the global marketing. SMEs do not have competitiveness since global marketing is the expensive and complicated such as very expensive international exhibition and business trip. It is not easy to have satisfied performance in a short time. How to integrate manufacturing capabilities, low cost logistics system, and smart IT system will be the key issues between government and enterprises.

1.1 Purposes of Research

Facing the problems of global marketing, globalization, cost reduction, and no brand, to establish a global channel system will be the only solution to promote and upgrade the competence of Taiwanese enterprises. This research will try to find a

solution to assist Taiwanese enterprises to survive. This research has three objectives as the follows: 1. The key factors of logistic service for good performance in the global marketing. 2. Trying to find the workable and cost effective collaboration management for SMEs.

1.2 Research Method

A Case Method being used in the research which is defined as "the case method is a philosophy applying to both education and research that is built upon the creation and analysis of complex real world examples. What main features of case method research are explained as the follows: (T. Grandon Gill, 2011) A. Case method research tends to be exploratory in its goals. B. Case method research relies heavily on triangulation of data sources. C. Case method research often involves a researcher actively participating in the process being investigated. D. Case method research conclusions are constructed by the researchers involved. E. The intended outcome of case method research is more likely to be a better explanation of a process than a generalizable "truth". The research is to understand the possibility of a practical operating model. The research method is to use a real case and to test its practical operations then analyze its possibilities and benefits. The research flow consists of Literature review and the confirmation of research method, Finding the surveying firms and designing the questionnaires, Data analysis and result discussion, Structuring a system and test run, To analyze and discuss the benefits and possibility of system, Conclusions.

2. Literature Review

2.1 The Characteristics of Global Marketing

SMEs must have a powerful manufacturing capability and high quality products and effective logistics system while facing the global competition in the global environment. The characteristics of global marketing involve A. The conflict of multi-culture, B. Multi-race, C. Different language, D. Unbalanced education, E. Geographical constraint, F. Different economic system, G. Different political system, H. Owned brand. (Keegan and Green, 2002)

2.2 The Strengths and Weakness Analysis of Developing Global Marketing In Taiwan

OEM and ODM are the strengths of Taiwan enterprise in the past years. Recently, Taiwanese enterprises are getting less competitive with enterprises in other developing countries since her higher labor cost. As a result, Taiwanese enterprises move to China and other developing countries for her survival. For future developing, enterprises and government made an effort to develop global marketing on the basis their experience of corporation with international companies such as HP and Dell. Based on Taiwan government published magazine of economy in 2004, the

strengths and weaknesses are exploited. The Strengths of Taiwanese enterprises include High quality human resource, Well-educated, High quality products, efficient management capability, Well-used information technology, and mobile equipment, Good internet and intranet environment, R&D capability. The Weakness of Taiwanese enterprises have. Less global marketing experience, No owned brand, Lacks of the spirit of cooperation, Focusing near-sighted benefits, Less globalized experience, High logistics cost, approximate average 11%, Customs & legal constraint.

2.3 Global Marketing Logistics Management

According to John T. Mentzer, Matthew B. Myers, Mee-Shew Cheung (2004) researched, two questions are required while doing research on the global marketing logistics which are "1. What logistics service factors account for differences in business customer satisfaction across national borders? In other words, what value differences exist for specific logistics functions across customers? 2. How do these differences reflect distinct segments in the global logistics services market?"¹ Global Marketing Logistics accompanies the entire marketing process continuously from planning to creation, development and asset management, on through to advertising production and efficient distribution. All the services consist of consultancy, implementation support, international vendor management and more. The key process management are Creation-create content efficiently, production- automate media production, and distribution-distribute campaigns locally. International Marketing and Logistics Management present innovative ideas and understanding the challenges confronting global business. Covering the breadth of international business, articles discuss human management, marketing, leadership, creativity, entrepreneurship. The economic, political, legal, socio-cultural, and technological issues related to international business are discussed. Some related issues are Globalization strategies, Global marketing, Cross cultural management, Global finance and accounting, Leadership and strategic management, International human resources, Sustainability and ethics, Emerging market opportunities, International consumer markets, Mergers and acquisitions, Global electronic commerce, International information technology and systems, Global supply chain management, International risk management.

2.4 Key factors managing marketing logistics

Karen E. James (2011) mentioned that interrelated aspects associated with

¹ John T. Mentzer, Matthew B. Myers, Mee-Shew Cheung (2004), Global market segmentation for logistics services, *Industrial Marketing Management* 33 (2004)

market logistics have physical distribution, supply chain management, value network, demand chain planning, market logistics, and integrated logistics system(ILS). The objectives of market logistics involve trade-offs between cost and customers service, maximizing profit, not sale is key, a total system basis should be considered, design a system that will minimize the costs of achieving objectives should be the outcome. Market logistics decision consists of order processing, warehousing including storage, distribution, and automated warehouses, inventory such as determine reorder point, relevant cost comparison, and optimal order quantity, and transportation emphasizing on containerization, private vs. contract carriers. Lessons of market logistics are a senior V.P. is needed as a single contact, senior V.P. must maintain close control, and software and system are essential for competitively superior logistics performance. Peck and Christopher identified (2003) that three key issues and factors of managing marketing are important including Managing processes, not just functions, any processes of tasks in organization that is very important for all staffs. Good methods of managing processes that could have a lot of benefit, such as create customer value. An organization should always put self in customers' position. Then they could be easy to understand what customer needs or wants. Also, processes require functional excellence to support them as well. B. Managing supply and demand, not just products: a company needs to understand and manage their supply and people's demand. Knowledge sharing is very important in this stage.

3. An Effective Global Marketing Logistics Management System

SMEs are hard to approach if government and embassy do not assist while structuring global marketing logistics management system. Specially, banks and government are requested to assist her people to investigate the credit of customers and partners. The key issues of global marketing logistics management system are the cross culture issue, the political and legal issue, Information sharing issues, Technology, service, and maintenance issues, racial and social responsibility issues.

4. Case Research of Structuring of Global Marketing Logistics Management System

Questions for the top managements and questionnaires for operational management are primary data and reviewing literatures as a secondary data. The statistical method and correlation regression will be used in SPSS software. The case companies are small and medium whose business is electronic parts for Taiwan local market and international market will be described as the follows.

4.1 Hypotheses

To find the key factors of structuring global marketing logistics management system in this research and understand the relationship between global marketing logistics management system and corporation performance.

H1: good cross culture management is positively related with structuring global logistics and channel system. H2: global information management system is positively related with structuring global logistics and channel system. H3: logistics partner is positively related with structuring global logistics and channel system

H4: localization of distribution channel is positively related with structuring global logistics and channel system. H5: political and legal system is positively related with structuring global logistics and channel system. H6: structuring global logistics and channel system is positively with business performance

4.2 General Descriptions of Six Companies

Six companies were selected as case study to do research on the basis of Capital, sales revenue, staffs, and market regions also meeting the SME's standard of Taiwan government is described as the follows: Capital: USD300,000 ~ 1,300,000, Sales Revenue: USD 1,500,000 ~3,000,000, Staffs: 10~50, Market: more than 3 nations. Concerning Data Analysis and Result Discussion: Data collection and analysis of the interviewing with top managements of SMEs' electronic parts companies, the result will be compiled as the Table 4-1. Data collection and analysis of operational level employees of SMEs 120 copies of questionnaires were distributed to selected companies' operational employees and collected 75 copies. Then using SPSS to run statistic then have the result as the follows: Reliability Analysis: Shown in the Table 4-2, table 4-2 shows the reliability of this research, Cuieford(1965) stated that if Cronbach $\alpha < 0.35$ means low reliability then not acceptable. If Cronbach $\alpha > 0.7$ means high reliability and Cronbach $0.35 < \alpha < 0.7$ means acceptable. Table 2 shows all the Cronbach $\alpha > 0.8$ means highly acceptable. According to the descriptive analysis, all the surveyed companies have their international business and internationalization including trade business, agent, branch office, alliances. Most of interviewees have international business and internationalization experience. Descriptive Statistics: Table 4-3. Correlation Regression Analysis: Based on the analysis Result then examine the hypotheses as the follows, H1: 「good cross culture management is positively related with structuring global logistics and channel system」, Result of analysis: Pearson value=0.301, α value=0.01 means highly positively relationship. H2: 「global information management system is positively related with structuring global logistics and channel system」, Result of analysis: Pearson value=0.381, α value=0.008 means highly positively relationship. H3: 「logistics partner is positively related with structuring global logistics and channel system」, Result of

analysis: Pearson value=0.356 , α value=0.009 means highly positively relationship. H4: localization of distribution channel is positively related with structuring global logistics and channel system, Result of analysis: Pearson value=0.111 , α value=0.193 means not relationship. H5: political and legal system is positively related with structuring global logistics and channel system, Result of analysis: Pearson value=0.366 , α value=0.0085 means highly positively relationship. H6: structuring global logistics and channel system is positively with business performance, Result of analysis: Pearson value=0.357 , α value=0.0075 means highly positively relationship.

5. Result of Analysis and Proposal of Global Logistics & Channel System

Key factors of influencing on structuring global marketing logistics management system consists of good cross cultural management system, IT system, good logistics partners, local distribution channel, well understanding local customs regulation and policies of political and labor laws. According to the survey and Griffin & Pustay (2004)research, the characteristics of workable global marketing logistics management system are Integrated logistics service, global logistics system base on manufacturing core competence, Quick and convenient financial service, paperless, information sharing, and EDI transaction,

structuring global logistics and channel system	Description
a. How many years you have any international business experience?	All six companies had more than 5 years international business operation experience.
b. What kinds of business you do in the international market?	Electronic parts and semi-finished parts
c. Do you have structured global logistics and channel system in your business?	All companies did not structure global logistics and channel system, but most of top managements identified global logistics and channel system is beneficial for their business
d. What kinds of difficulties and problems while structuring global logistics and channel system?	International market: understanding cross culture, IT , contract negotiation issues, localization, hard to understand bribery policies and commission regulation, legal concept
e. According to your experience, what kinds of difference between structuring global logistics and channel system and traditional operations?	Tracking delivery, cost effective, knowledge sharing, demand and supply forecast

f. What benefits you have when you structured global logistics and channel system?	cost down, delivery on time, 24 hours service, low inventory
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Table 4-1: The Descriptions of Interviewing With Top Managements

Variabls	Cronbach a value
structuring global logistics and channel system	0.89
H1:good cross culture management	0.83
H2:global information management system	0.91
H3:logistics partner	0.81
H4: localization of distribution channel is positively related with structuring global logistics and channel system	0.85
H5:political and legal system	0.89
H6: structuring global logistics and channel system is positively with business	0.87

Table 4-2: Cronbacha value

Profit sharing, Quick response, on time delivery, and convenient service, Professional corporation. customers' value based on their policy building long relationship with all partners. JIT plays a role to do investigation what necessities their partners need. JIT does efforts to do research on the culture and legal issues before kick off their foreign markets.

Items	Statistics
Age	25~35: 53%, 35~50: 43%, 50~:2%
Education	Undergraduate: 65%, Graduate: 35%
Position	Staff: 65%, Section Manager: 15%, Manager: 15%, VP: 5%
International Business Experience	Yes: 96% (international trade 51%, international exhibition25%, international negation11%, market development and stay more than six month 9%), No: 4%
Foreign Language	Japanese: 28%, English: 63%, German: 5%, others:4%
What nations doing business (Multi answer)	Japan 25%, Vietnam 32%, China 61%, Malaysia 18%, Singapore 16%, USA 48%, Europe 37%, Middle East 23%, others 24%

Table 4-3: Result of Descriptive Statistics

6. Comments and Conclusions

All the working levels and top management totally agreed that they have the following benefits when they structured the system as the follows: Saving time more 15% than traditional trading model, On time delivery, Tracking cargo anytime, Saving 15% logistics cost since more negotiation power, Down more than 15% product cost since more suppliers. To structure an integrated information system to solve products flow, financial flow, logistics flow, and information flow is important. On the basis of mutual trust, all the parties must come to agree on standard operating procedures, contracts, sharing information.

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A THEORETICAL FRAMEWORK FOR UNDERSTANDING THE NATURE OF VALUE IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT

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Abstract

The aim of this paper is to extend our discussions of value at previous ISL conferences by providing a framework that will guide actors in logistics and supply chains in moving towards an understanding of how value may be conceptualised and implemented? In this theoretical paper we consider whether an essence of value exists and if so what its necessary conditions might be? Drawing on Wittgenstein's philosophy we argue that there is no essence of value (Wittgenstein, 2000), instead value may be conceived in terms of family membership. We propose a three-stage framework that provides a means of understanding the nature of value through the lens of family resemblances. Conceptualising value in terms of family resemblances clarifies the lack of theoretical and definitional rigour, and the large variety of linguistic usages that currently exist. The second stage of the model provides a means of implementing the findings based on an experiential approach that considers the qualitatively different ways in which actors in logistics and supply chains experience value. The third stage of the model provides guidance for collecting and analysing data using a phenomenographic approach (Marton, 1986).

1. INTRODUCTION

At ISL in 2012 we presented an inaugural paper in which we argued that the term 'value' as used in logistics and supply chain management (LSCM) lacked definitional rigour, based on two units of analysis: the official dictionaries of UK professional bodies and key textbooks (Fisher *et al.*, 2012). At last year's conference we extended our 2012 paper to include a comprehensive content analysis of peer-reviewed articles on the topic of 'value' within Purchasing and LSCM journals (Francis *et al.*, 2013). The aim of this paper is to continue our previous discussions by providing a framework that will guide actors in logistics and supply chains in moving towards an understanding of how value may be conceptualised and implemented.

This paper represents the third stage of our programme of research. It is a theoretical paper in which we consider whether an essence of value exists and if so what its necessary conditions might be? Drawing on Wittgenstein's philosophy we argue that there is no essence of value (Wittgenstein, 2000). Instead value may be conceived in terms of family membership. We propose a three-stage framework that provides a means of understanding the nature of value through the lens of family resemblances together with a methodology and method to guide practice.

2. LITERATURE REVIEW

Value has been studied extensively for more than two thousand years. During this time research has focused on the theory of value through to its application in disciplines such as Sociology and Economics, and more recently in the service paradigm. What is clear is that there is no agreement over what value means (Zeithaml 1988). There does not appear to be an essence, something that is

common to all instances of value. Instead, what is evident is that value means different things to different people.

Since Vargo and Lusch's (2004) article proposing an evolution towards a new service dominant logic of marketing (SD logic), value has achieved a new prominence. The importance of value is particularly evident in the field of LSCM where much research effort has been invested (e.g. Hammervoll *et al.*, 2014; Maas *et al.*, 2014). The importance of value has also been identified by Ostrom *et al.* (2010) who suggest that measuring and optimising value is a key area for research, although the focus is on measurement and metrics rather than on understanding what value actually means. In other research Holbrook (1996) argues for an understanding of the interactive and relativistic characteristics of the customer. It is this theme of *experience* in understanding value and the value creation process that is proposed by Ojasalo (2010) who argues that customer experiences result from situations where the customer defines and creates value. Customer experiences and perceptions are essential to value determination and value is co-created by learning together. Other researchers (e.g. Flint 2006; Chen *et al.*, 2012; Helkkula *et al.*, 2012; Mele and Polese 2011) also discuss the importance of experience in value creation and co-creation, while arguing that value is phenomenologically based. Grönroos and Voima (2013), Kohli (2006) and Vargo and Lusch (2006) suggest a need for new approaches, while Payne *et al.*, (2008) likewise call for research into understanding what customers actually do when they co-create value. In other research Flint (2006) suggests that symbolic interactionism may be an appropriate research approach while Edvardsson *et al.*'s (2011) suggest social construction as a way of making sense of value creation.

While much research effort has focused on the creation and co-creation of value, and the actions of producers and consumers, there is little research directed towards understanding the underlying nature of value itself (Grönroos 2011; Grönroos and Voima 2013). This is the gap in academic literature and knowledge that this research aims to address through the research question: *How can the nature of value be understood in logistics and supply chain management?* In addressing the research question the paper provides a response to the call for further research, in particular the *experiential* view of understanding phenomena, that is explored in this paper through Wittgenstein's (2000) philosophy.

3. CONCEPTIONS OF VALUE

Through analogy, and using a discussion about what he terms "a game", Wittgenstein (2000) provides a means of conceptualising the nature of value. In arguing that there is no common essence to what we call a game he suggests that one should first study or *look at* a phenomenon before thinking about it, suggesting an *experiential* approach to understanding. He proposes that understanding can only occur through a sequence of *look-think-act*. When thinking is the first step in the mental model used to achieve understanding, as in most interpretive research, this typically leads to a search for essences, which is often a non-productive approach to understanding. Wittgenstein suggests that instead of searching for an essence the focus should be on *differences* as a means of understanding. We should consider phenomena as members (or otherwise) of a family based on family resemblances. In the same way that Wittgenstein expresses "game" as a belonging to a family, we argue that there is no essence of value and it should be understood as forming a family, which is consistent with Najder's (1975) contention that as value is a concept there is not likely to be a single wholly satisfactory answer (i.e. essence) to its meaning. Conceptualising value as a family addresses the ontological tension that arises from attempting to regard it as being phenomenologically determined (Vargo and Lusch 2006, 2008) yet qualitatively different based on the experiences of actors (Ojasalo 2010).

Regarding value as a forming a family is the first stage in our proposed framework. The implications of applying Wittgenstein's philosophy of family resemblances to research into the nature of value in LSCM are that the nature of value can now be conceived as being wholly experiential. This means that the nature of value may differ between people, time and context, or some aspects of it may be the same. In order to guide research into how value may be understood in terms of family resemblances a different approach to the usual search for essences based on phenomenology is needed.

Using Wittgenstein's philosophy of family resemblances to address how value may be conceived requires a different research approach to phenomenology. Phenomenography is an alternative approach that accommodates family resemblances by focusing on the qualitatively *different* ways in which people experience, conceptualise, perceive and understand phenomena in their lifeworld (Marton 1986). Phenomenography was originally developed in the 1980s by Marton (1986) for educational research in Sweden. It is an empirical, interpretive approach with an ontology and epistemology based on knowledge, and an ideographic methodology (Bowden 2000; Burrell and Morgan 1979). Phenomenography is a qualitative approach in which data are usually collected by means of interviews and observation (Sandberg 2000). Once data collection has been completed (based on experience from previous studies between 15 and 20 interviews are usually conducted) data are analysed *en bloc* rather than on an individual basis as in other qualitative approaches such as grounded theory (Strauss and Corbin 1990, 1998). Analysis mainly consists of answering *what* and *how* questions (Sandberg 2000). Originally developed in the 1980s by Marton (1986) for educational research in Sweden, phenomenography is increasingly being used in business research, for example in a study of human competence at work (Sandberg 2000) and in understanding quality improvement processes (Kobayashi 2009). By accommodating the different ways in which the nature of value may be conceived phenomenography provides a methodology and method for implementing the concept of family resemblances empirically. Adopting phenomenography as a research approach is the second part of the proposed framework.

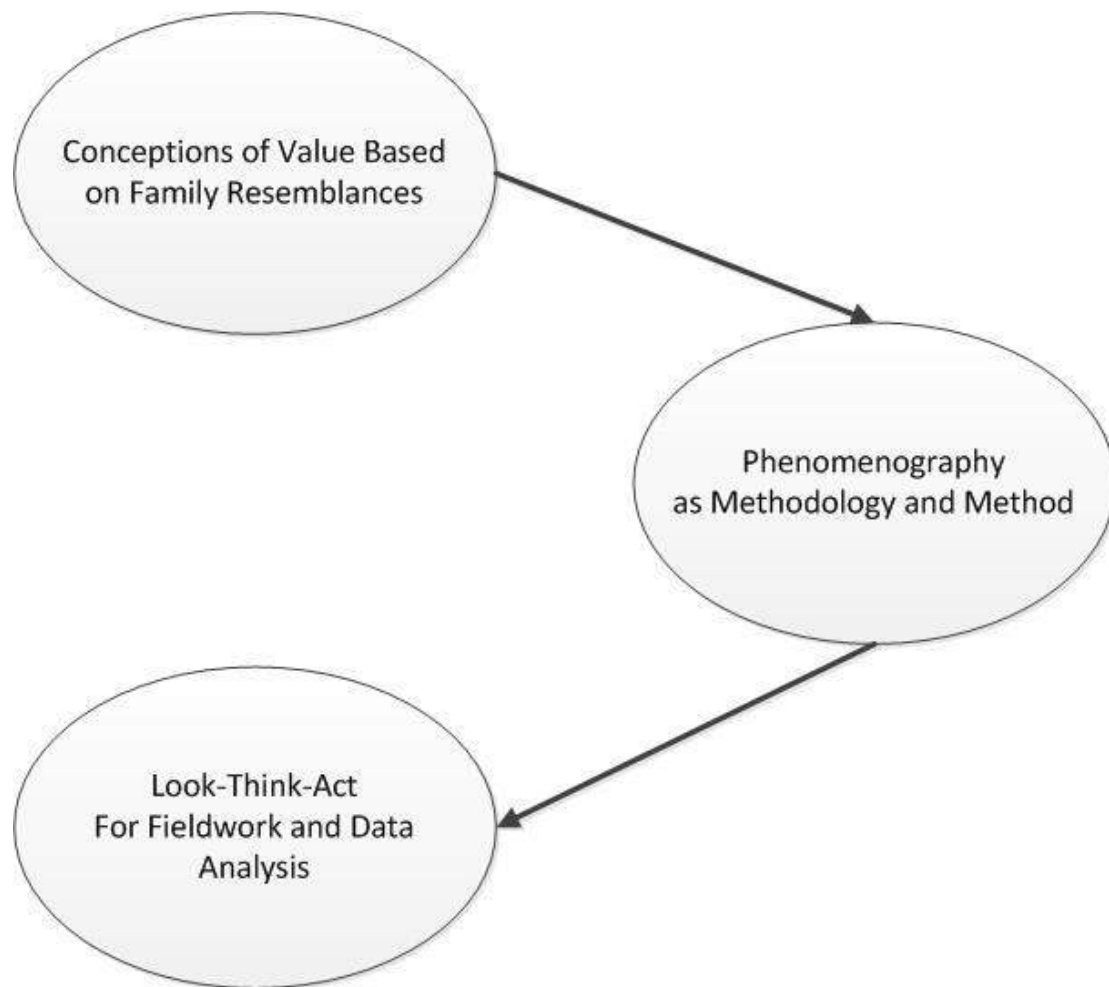


Figure 1 A Three-Stage Framework for Reconceptualising Value

When discussing family resemblances Wittgenstein (2000) advocates that in investigating a phenomenon we should first *look and see* as seeing demands consideration of what is open to view. Seeing is grounded in the shared world connecting people and other aspects of the world and involves differences (Genova 1995). Second, we should *think*, as thinking tends to focus on identities and essences (Genova 1995). Finally, we should *act*. Wittgenstein is advocating an *experiential* way of understanding based on look-think-act. Usually, the first step when considering a phenomenon is an attempt to theorise in an instinctive search for essences. Wittgenstein (2000) argues that in thinking we convince ourselves that the ideal must be found in reality, yet we have not yet seen how it occurs. Thinking means we lose sight of the “disorder of things” (Genova 1995). On the other hand looking and seeing shows the family resemblances between concepts, “the connections that criss-cross the conceptual domain” discovering differences not essences. Looking resists the temptation to get involved with theoretical possibilities and enables us to see particulars, based on differences (Genova 1995).

Look-think-act provides researchers with a means of conducting field work and guiding data analysis in a way that follows the phenomenographical process. It is

the third stage in the three-stage framework for reconceptualising value, which is shown at Figure 1.

4. DISCUSSION

Providing a basis for establishing that there is no essence of value is a contribution to research in LSCM that informs academic literature. In past research the simultaneous search for an essence along with an assertion that value is experientially created has led to ontological tension. The current focus on value in LSCM research will be informed by understanding *what* the nature of value is and *how* it may be understood in a given context. Understanding the nature of value through the experiences of actors is a precursor to understanding how it is created. In proposing that value may be understood in terms of family resemblances we provide a new approach to the conceptualisation of value in LSCM. We also advocate using phenomenography as a suitable methodology and method to guide research into value as a family. Using the framework to guide a phenomenographic study will enable researchers and practitioners to understand the nature of value experienced by actors. Understanding value in this way is particularly important in supply chains given their complex, relational nature.

We envisage that identifying the value(s) experienced by actors in logistics and supply chains will enable a determination to be made about whether value is created or co-created at a particular point in the interaction. Use of the framework to identify how individuals experience value will enable researchers to clearly identify whether value is created individually or co-created. By proposing a framework that researchers can use to understand the nature of value in empirical studies our research addresses the research question: *How can the nature of value be understood in logistics and supply chains?* The proposition that value should be conceived through the lens of family resemblances rather than the search for an essence, along with the concomitant use of phenomenography represents a novel approach within LSCM research. Making sense of the nature of value can only occur through the qualitatively different ways actors interpret experiences in their lifeworld. The third stage of the framework (*look, think, act*) enhances the phenomenographical approach by ensuring there is a focus on the phenomenon itself, rather than embarking on premature theorisation.

In addition to providing a solution to the ontological tension caused by attempting to understand the ways in which actors experience value through an inappropriate approach (phenomenology), our research has practical importance. Use of the framework will enable empirical studies of the nature of value in LSCM contexts to be conducted soundly and relatively quickly (15-20 interviews analysed *en bloc*) compared with other qualitative approaches. Also, the framework offers opportunities to enhance understanding of the nature of value by providing a more inclusive and holistic set of values based on the experiences of individuals.

Achieving a holistic understanding of the nature of value through use of the framework has important implications for research and practice. Researchers will be able to rely on a sound methodology and method in pursuing the further research into the nature of value. The implications for managers include the ability to plan and deliver business outcomes that are more closely aligned with customer values. Understanding what actors in LSCM networks value, as determined by application of the framework, has clear implications for management.

4.1 Potential for Further Research

The proposed framework offers an empirical research approach that advances knowledge through an understanding of the nature of value. The framework provides a sound basis for discussing value creation and co-creation grounded in a clear understanding of the nature of value in different contexts. A starting point in understanding the nature of value, through the lens of family resemblances using phenomenography as methodology and method, is to understand the key family characteristics of value. Following the way that Wittgenstein speaks of gait, color of eyes, facial characteristics etcetera as characteristics of human family membership, identifying the characteristics of membership of the family of value in particular contexts is needed. The proposed framework supports an approach to empirical research that can advance LSCM through a new understanding of the nature of value. The framework provides a sound basis for discussing value creation and co-creation grounded in a clear understanding of the nature of value in different contexts. Logistics and supply chain practice should change to reflect the experiential approach to understanding value proposed by our model.

5. CONCLUSION

This article has reviewed the nature of value from its philosophical origins to its use in LSCM research. What is clear from the review is that there is no universal way in which value is understood or defined. Framing value as being phenomenologically determined (e.g. Vargo and Lusch 2006; Helkkula *et al.*, 2012) has been a constraint to research, particularly when coupled with a contradictory proposition that value is experientially and individually determined by actors. Wittgenstein argues that the reason concepts like value are not understood is that they have no essence or necessary conditions. Following the logic of Wittgenstein's philosophy we view value as a member of a family rather than a phenomenon that has an essence.

We propose a three-stage framework. During the first stage value is viewed as being a member of a family, where value in one context may have similarities or differences to value in a different context, but cannot be expressed in terms of necessary conditions or an essence. The second stage proposes phenomenography as an appropriate research approach that accommodates the experiential, individual ways in which actors conceive value. The third stage supplements the phenomenographic method by providing a means of implementation that will enable researchers and practitioners to engage with the research process effectively.

Our framework provides a means of understanding more effectively the nature of value in LSCM through the qualitatively different lived experiences of individuals. Understanding the nature of value is a precursor to understanding how value is created. The framework is consistent with the move towards qualitative research as a means of understanding the nature of value and builds on Flint's (2006) suggestion of symbolic interactionism and Edvardsson *et al.*'s (2011) suggestion of social construction as a way of making sense of value creation. Our research therefore contributes to the body of academic literature in LSCM and promises to facilitate improved understanding of the value creation process for both academics and practitioners.

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PURCHASING AND LOGISTICS PARADOXES IN RETAIL ORGANISATIONS

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ABSTRACT

Organising global purchasing and logistics activities requires an act of balance between different strategies and goals inherent in the organisation, i.e. there are paradoxes that need to be managed. The purpose of this paper is to explore purchasing- and logistics-related paradoxes in retail organisations. It presents some of the major paradoxes extracted from a systematic literature review of global sourcing literature. In addition, as a means to further illustrate the paradoxes, the paper presents a case study at a Swedish fashion retailer.

INTRODUCTION

Global sourcing has become a strategic matter for many retail companies as a means to deliver superior value that can be sustained over time (Ganesan et al., 2009). This research acknowledges that organising global purchasing and logistics requires an act of balance between different strategies and goals inherent in the organisation, i.e. there are paradoxes that need to be managed. For instance, regarding supplier selection, total costs must be balanced against required customer service (Bygballe et al., 2012; Cho & Kang, 2001), but also to other non-financial factors such as Corporate Social Responsibility (CSR) performance.

The purpose of this paper is to explore purchasing- and logistics-related paradoxes in retail organisations. It presents some of the major paradoxes extracted from a systematic literature review of global sourcing literature. In addition, as a means to further illustrate the paradoxes, the paper presents a case study at a Swedish fashion retailer.

The research applies a paradox perspective that seeks to explore how organisations can apply to competing demands simultaneously (Smith & Lewis, 2011). More specifically, the paper identifies some of the key contemporary paradoxes present in the areas of (1) selection of sourcing region and actual supplier, (2) the design of the physical flow of goods from supplier to end customer, and (3) the design of the purchasing organisation including tasks, responsibilities, and interface to other company functions. The organisational design is here understood to comprise "the process of assessing and selecting the structure and formal system of communication, division of labour, coordination, control, authority and responsibility required to achieve and organization's goals" (Trent & Monczka, 2005, p. 29).

Paradox theory, which is a relatively new theoretical field developed in organisational research, defines a paradox as "*contradictory yet interrelated elements that exist simultaneously and persist over time*" (Smith & Lewis, 2011, pp. 382). This definition emphasises that the underlying logic for each element may seem rational when dealt with them separately, but appears to be inconsistent when juxtaposed against each other (Sandberg, 2013). Smith & Lewis (2011) identify four categories of paradoxes that are applied in this paper as a means to structure our analysis of paradoxes discussed in the reviewed literature (Smith & Lewis, 2011, pp. 383):

1. Learning (knowledge): Efforts to adjust, renew, change, and innovate foster tensions between building upon and destroying the past to create the future
2. Belonging (identity/interpersonal relationships): Identity fosters tensions between the individual and the collective and between competing values, roles, and memberships
3. Organising (processes): Structuring and leading foster collaboration and competition, empowerment and direction, and control and flexibility
4. Performing (goals): Plurality fosters multiple and competing goal as stakeholders seek divergent organisational success

METHODOLOGY

The paradoxes presented in this paper are based on a systematic literature review inspired by the stages presented by Tranfield et al. (2003). Eight search strings with "retail" combined with other key words such as global sourcing, international purchasing and logistics generated in total 175 unique matches, of which 47 were found relevant after reading through abstracts. After reading the articles through another 6 were deleted, major reason for deletion was the absence of focus on retaining in the article. Only peer reviewed, academic articles from Business Source Premier were selected. For each article, the purpose, key content (topic), use of empirical data, paradoxes discussed (if any) were highlighted in an excel file (due to space limitation, this paper presents an excerpt from the review findings).

Based on Smith and Lewis' (2011) framework on paradox categories, paradoxes were extracted from the literature (due to space limitation, this paper does not present an exhaustive list of all paradoxes found). In addition to the literature review, a case study has been conducted at a Swedish fashion retailer. For the purpose of this paper, the case study helps to illustrate, exemplify and further develop the paradoxes. The case company has a history with strong supplier relationships in certain sourcing areas (three regions in India), while at the same time striving for new knowledge and quality of the products. The case company has consciously struggled with their global sourcing strategy for a long time. Their consciousness and awareness of the challenges of being a fashion retailer with true global sourcing as one their main priorities, makes the case company particularly suitable as an illustrative showcase of this study.

GLOBAL SOURCING IN RETAIL COMPANIES

Global sourcing is defined as "an advanced approach to sourcing and supply management that involves integrating and coordinating common materials, processes, designs, technologies and suppliers across worldwide buying, design and operating locations" (Trent & Monczka, 2005, p 24). Trent & Monczka (2005) compare global sourcing to the term "international purchasing" and argues global sourcing to be associated with integration and coordination of sourcing activities, whereas international purchasing is limited to the direct purchasing transactions. For the purpose of this research, we subscribe to Trent & Monczka's (2005) view of the terms. Commonly discussed benefits related to global sourcing are improvements of product assortments and customer satisfaction, as well as lower costs (Jonsson & Tolstoy, 2014). In particular, lower unit price has been a driver for western companies, retailers included, to get involved in sourcing from emerging supplier regions (Bygballe et al., 2012; Gibbon, 2002). Below we focus our discussion on three topics of global sourcing that were introduced in the introduction section.

Selection of sourcing area and supplier

Being one of the dominating themes in global sourcing literature, the selection of sourcing area has been widely acknowledged, also in retail settings (Gibbon, 2002;

Jonsson & Tolstoy, 2014). Not surprisingly, total costs, service performance, and lead times are the dominating selection criteria discussed in literature. From a logistics point of view, it is a well established argument that total costs, rather than price, should be evaluated. "Hidden costs" and "inflexibility costs" (costs related to a company's ability to cope with uncertainty) must be taken into account (Cho & Kang, 2001).

Performance in the supply chain can not solely be evaluated from a pure financial perspective, neither a logistics perspective focusing on service and lead time is enough. Environmental and sustainability issues must also be brought into the calculation (Brito et al., 2008). Brito et al. (2008) points out that European fashion supply chains can not compete anymore on cost, and it is therefore necessary to adopt a differentiation or focus strategy in order to stay competitive. In these strategies, environmental issues, as well as CSR concerns, becomes crucial.

CSR issues have in recent years emerged in literature (Jonsson & Tolstoy, 2014; Robinson, 2010). It is clear that due to market considerations such as brand image and customer attitudes, CSR and environment issues nowadays plays a decisive role for many retailers in their selection of sourcing area and supplier (Ganesan et al., 2009; Mamic, 2005). CSR concerns "the moral, ethical and social consequences in supplier countries of global business operations" (Perry & Towers, 2013, p. 480) including wages, working hours and working conditions (Perry & Towers, 2013). As an important foundation to ensure proper CSR conditions, the implementation of Code of Conducts has been suggested (Mamic, 2005). A code of conduct "sets guidelines on a range of issues including child labour, forced labour, wages and benefits, working hours, disciplinary practices, the right to freedom of association, health and safety, and environmental practices" (Mamic, 2005, p. 81)

Recent literature takes a dynamic view on sourcing, pointing out that the most appropriate sourcing region may shift over time (e.g. Toklati, 2008). The ability to exploit local opportunities in the region and at the supplier is decisive for competitiveness. The changing competitive landscape regarding supplier markets has been captured in what has been labelled "industrial upgrading" (Gereffi, 2009) in the apparel industry. This industry has experienced a development in many countries from what used to be considered low cost countries with limited technological capabilities to more western-like skills and technology, but also costs (e.g. higher wages). Companies looking for low cost production areas has consequently moved their production to new emerging, low cost supplier regions such as countries in Africa. Meanwhile, in the fashion industry the more advanced production stays in the newly developed countries (e.g. India and Turkey).

Design of physical flow of goods

The design of the physical flow of goods in a global retail supply chain has so far been little acknowledged in research, although logistics is to be considered a major challenge of global sourcing (Cho & Kang, 2001). An exception is Bygballe et al. (2012) who outlines four general retail supply chain structures from Asian suppliers to retail stores in Norway. These are (1) Deliveries between individual producers and retail stores, (2) Consolidation of shipments in the customer country, (3) Consolidation of shipments in the supplier country, and (4) Consolidation in both countries. The authors further discuss the need for balance between total costs and customer service and the benefits of each supply chain structure. Lyu et al. (2010) presents a similar division, but add the information flow dimension. Three possible distribution structures from manufacturer, via retailer head quarters/central warehouse and individual stores are discussed. Pros and cons are presented based on whether the physical flow of goods is taken via the retailer centrally or directly from manufacturer to stores, and how the information flow is designed.

The supply chain structure could also be designed with double sourcing, meaning that two suppliers are engaged for the same products with one flexible supplier close to the

retailers market and one situated in a low cost country far away from the retailer. Double sourcing facilitates a strategy for exploiting low cost suppliers that are less flexible and requires long lead times, with more costly, but flexible suppliers with shorter lead times.

Purchasing organisation

Global sourcing requires coordination and management of complex supply chains. As a result, many retail purchasing organisations have changed and become more centralised, e.g. in the form of a new, central supply chain function with advanced technical support to purchasing (Gibbon, 2002). Relatedly, Trent & Monczka (2005) stress the importance of strong leadership in the purchasing organisation, with accountability for global results, and an extensive reliance on cross-functional teams for the realisation of advanced sourcing strategies.

The organisation is to a high extent related to the question of how the physical flow of goods is designed and who is having the control of it. An overarching issue for the purchasing organisation is therefore to what extent the supply chain is vertically integrated. There exists a number of different opportunities for the retail supply chain structure between the extremes of a pure "market mode" where an external part handles all tasks of purchasing and management of supply for the retailer on the one side, and a wholly owned manufacturing subsidiary on the other. For instance, Toklati (2008) divides fast fashion retailers into "retailers with no manufacturing competencies of their own" (e.g. Gap, H&M, and Mango) and "retailers with factories" (e.g. Benetton and Zara).

Apart from a question of "government mode", the degree of collaboration is also discussed in literature. The retailer's purchasing organisation is not to be considered an isolated, internal challenge and the actual design of the purchasing organisation is highly dependent on the supplier relationship. (Bygballe et al., 2012). Gibbon (2002) means that the purchasing organisation also depends on the capabilities at the suppliers. Overall, the requirements and needs of the retailer must be matched with appropriate capabilities at the supplier (Jonsson & Tolstoy, 2014). Supplier capabilities and ability to meet retailer requirements are also influenced by number of suppliers in the network (Gibbon, 2002). Learning and inter-organisational integration is expected to be improved with fewer suppliers (e.g. Bygballe et al., 2012).

The design of the purchasing organisation is also influenced by strategies for supply chain risk mitigation. The organisation could here be considered an important tool for management of risks associated with logistics and purchasing activities. Commonly discussed strategies include multiple sourcing and improved integration and coordination with suppliers.

ABOUT THE CASE COMPANY

The case company is a Swedish retailer that provides fashion for women and furniture inspired by an oriental style. The company operates 98 stores with in total about 700 employees in Sweden, Denmark, Norway and Iceland and has a turnover of approximately 100 Million Euro. About 55-60 people work at the headquarters in Stockholm, Sweden, of which the purchasing department has about 30 employees, including 6 purchasers, purchase assistants, quality managers, etc.

Still a family owned company, the case company relies heavily on strong relationships to a number of Indian suppliers. Already 50 years ago the Swedish owner family established a relationship to an Indian business family, still an important partner for the company, now in the second generation. Today the company has about 35 people employed in India in two production offices and a distribution central in Mumbai, from which all Indian goods are sent through further on to the central warehouse in Sweden. In order to push as much administration and goods handling as possible backwards in the supply chain, goods coming from India are to a great extent packaged to individual stores already in India. Overall, the two production offices are considered the extended arm of the

Swedish purchasing department, taking care of daily local, operational contacts with suppliers including quality control, deliveries and administration. It has also become an important partner for price negotiations, supplier-development and evaluation.

The entire business concept for the company is to offer products inspired from the orient, in particular India. However, except for Indian suppliers, that represent about 60% of total supply, the company has in recent years extended their sourcing from China (stands for about 30% of the total supply) and European countries (in particular Turkey). The expansion of sourcing regions is mainly due to increased awareness of quality demands and decreased lead times, but also price.

FINDINGS

Retailers' adoption of global sourcing renders several challenging paradoxes to be handled. Although seldom explicitly stated in present literature, a number of paradoxes could be suggested based on the literature presented in the previous section of this paper.

Learning

Learning paradoxes in a global sourcing setting mainly involves the balance between maintaining learning inside collaborative, long term relationships, and accessing new knowledge and innovation in new relationships (Jonsson & Tolstoy, 2014). Global sourcing literature, in particular logistics-related articles, has for a long time advocated long term, stable relationships that are expected to foster collaboration and continuous improvements (Brito et al., 2008). For instance, collaboration and SCM practices are expected to improve CSR performance as well as sustainability issues beyond traditional control activities (Perry & Towers, 2013; Brito et al., 2008; Mamic, 2005). Long term collaborative relationships enable improved dialogue and learning rather than formal control activities, which means less risk taking and a possibility for true joint learning concerning development of logistics and purchasing activities. On the other hand, the needs of global sourcing practices are considered dynamic and for instance appropriate sourcing region may change over time (e.g. Toklati, 2008; Gibbon, 2002), thus render a shift of the supplier base. Relentlessly changing market requirements changes the needs of the retailer in turn, which drives a change in the selection of sourcing region and suppliers.

The case company: Long term relationships, but not too long

Learning and joint development through long term relationships is strongly anchored in the case company's strategy, having supplier relationships in India reaching more than 50 years back in time. These relationships are seen as drivers for improved knowledge about the partner's business and willingness to make investments. As an example, in the area of CSR and sustainability, long term trust-based relationships with ten Indian fashion manufacturers have resulted in new production units with efficient water cleaning facilities. The case company proudly present these Indian relationships and considers them to be strategically important and part of the company's success.

However, on the other hand, the case company has experienced the risks of increased production costs and lack of innovation as a result of less competition. The company claims individual supplier relationships should be regularly scrutinised as a means to avoid quality- and capacity related problems, as well as risk for corruption behaviour. In addition, learning from new suppliers could be regarded an important source for innovation and drives the development of the case company, as well as older, existing supplier relationships.

Belonging

Paradoxes related to belonging discussed in global sourcing literature seem to be mainly driven by challenges related to cultural differences. A global supply chain, in comparison to a domestic one, naturally creates more tensions in buyer-supplier relationships as

there are larger cultural differences as well as regulations that need to be tackled (Cho & Kang, 2001).

The case company: Purchasing offices: coming closer to the suppliers or extending the supply chain?

An extension of the supply chain together with communication barriers (e.g. time differences) means that intermediaries such as local buying offices (as in the case company) play an important role in the supply chain. From the head quarters' point of view, local purchasing offices in India serve as an extended arm of the head quarters, involved in suppliers' production, price negotiations, logistics operations, etc. The interviewees (placed on the head quarters in Sweden) consider the local purchasing offices as a means to come closer to the suppliers, enabling local presence and in-depth understanding of supplier conditions. Conversely, giving more responsibility and control to the local purchasing offices also increases the distance to the headquarters. The case company stresses the importance of transparency in the supply chain in order to avoid extension of the supply chain. To involve the local purchasing offices, for instance by informing them about sales figures and margins in Sweden, is necessary in order to avoid the purchasing offices being an extra layer in the supply chain.

The case company: Individual suppliers vs supplier group

Whether an individual supplier is preferable or not does not only depend on parameters such as costs, service, CSR performance, etc., but also on other suppliers in the product category. For the case company the most important and overarching criterion for selection of a new supplier is their production skills and knowledge about their products, and appropriate CSR policy. These criteria are followed by other criteria such as price and production capacity. However, these factors showing the performance of the potential supplier are sometimes overruled by the characteristics of the existing supplier base in the product category. A mixture of different types of suppliers is searched for, thus affecting the selection of the new supplier. The supplier base should together be able to deliver low cost as well as shorter lead times and innovation for design.

Organising

Organising global sourcing means organising a global supply chain that includes several challenges related to for instance logistics issues in the physical flow of goods and supplier relationships (Ganesan et al., 2009). One issue of particular interest for organising the supply chain is the use of intermediaries. As discussed above, a global supply chain increases the complexity of the supply chain and the need for appropriate coordination mechanisms becomes evident. Gibbon (2002) states that this is a reason for why many retailers are relying on fewer suppliers; fewer suppliers are expected to decrease supply chain complexity. On the other hand, paradoxically, the use of intermediaries are expected to increase due to the same reason; intermediaries are anticipated to coordinate and take care of a greater part of the supply chain and thereby decrease the retailers' need for coordination.

The case company: Purchasing offices: increasing or decreasing control of the supplier?

Interviewees witness that the case company's use of local purchasing offices in India improves and facilitates close contact with suppliers and offers control of production processes and CSR questions. As an extended arm of the head quarters, the local purchasing offices become responsible for operational, daily contacts concerning quality, production processes, logistics, etc. A purchasing office however also clearly adds an intermediary in the supply chain, and the head quarters get less direct control of operational issues at the suppliers. To work as a united company, with one message and one strategy, communication and information sharing in the supply chain becomes more demanding.

Performing

Global sourcing activities render many paradoxes related to performing. The most paramount ones that have for a long time been discussed in logistics literature are the trade-offs between different logistics costs, particularly between transportation and inventory, and between total costs and service (Bygballe et al., 2012). Overall, to manage paradoxes concerned with the physical flow of goods potential benefits from lowered costs must be gained while at the same time sufficient customer service must be achieved.

The case company: Traditional logistics parameters vs CSR

The traditional paradox between costs and services has in recent years been extended to also include parameters in the form of CSR and environmental issues, which further complicates the situation and renders more paradoxes to be dealt with. The case company has a relatively long history of acknowledging the need for CSR performance and has therefore been aware of this extended paradox for a long time. A few years ago for instance, case company actively decided to not source from Bangladesh. Despite lowered prices and total costs, and unchanged service level, the company felt uncomfortable with the CSR questions. Since the company did not have full control of these concerns, the company terminated the negotiations.

The case company: product range vs supplier base

With strong relationships to regions in India, the company strives to source as much as possible from India. Despite this the company “only” manages to source about 60% from India. Against the offering from the supplier base in India stands market considerations and having an attractive product range. Simply put, the supplier base in India is not able to offer the products needed for the company’s market position and therefore other sourcing regions are needed. Product range decisions are hence not limited to a certain supplier region, and a customer focus outmanoeuvres the selection of supplier region.

The case company: Order timing – late vs early order commitments

Retailers often prefer late ordering as a means to avoid demand uncertainty and inventory speculation, in particular in seasonal products. At the same time, suppliers prefer longer lead times in order to better optimise and even out production capacities. The order timing therefore becomes an act of balance between avoidance of surplus inventory at the retailer and the supplier’s smooth production operations. In fact, this paradox is a strong argument for increasing the domestic supply. With significantly lower lead times the order timing issue becomes easier to tackle. The case company is aware of this paradox and has therefore increased their efforts to provide better forecasts to their main suppliers in recent years. The long lead times, causing uncertainty in demands, are also a major reason for why the company source products from Europe (in particular Turkey).

CONCLUSIONS

Research on the organisation of logistics and purchasing activities in retail companies is still in its infancy (Bygballe et al., 2012; Sandberg, 2013). As a means to capture some of the challenges of organising global sourcing, this explorative paper unravels contemporary purchasing- and logistics-related paradoxes in retail organisations. Although a paradox perspective has been discussed in organisation theory since the 1980s, its application in a purchasing and logistics context is relatively new. For logistics scholars, the paradox theory could be seen as a valuable continuation and development of the more well-known contingency theory. It offers a new theoretical lens through which an organisation could be better explored, described and understood (Sandberg, 2013).

The case study presented in the paper indicates the paradox theory as a useful, understandable platform for a discussion between academics and practitioners. Interviews based on the paradox perspective enables a discussion on the complexity of real world challenges meanwhile a focus on a particular topic could be held.

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A NETWORK PERSPECTIVE OF SUPPLY CHAIN COLLABORATION

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ABSTRACT

Social network perspective of interorganizational relations (IOR) focuses on the effect of organizations' external relationships (at both individual and organizational levels) in collaboration. It presumes that effectively managing such relationships is vital to gaining collaborative synergies. However, the perspective still remains far from becoming a standalone theory of IOR as it has failed to address the cross level challenges and opportunities of this inherently multilevel phenomenon. Our research therefore attempts, to arrive at a unified social network theory of IOR inductively, by using case study methodology in a third party logistics context.

INTRODUCTION

Social network perspective to interorganizational relations (IOR) is highly recognized as a distinct theory that examines how organizations access resources and capabilities through their networks of relationships (Gilgor & Autry, 2012; Skjoett-Larsen, 1999; Zaheer, Gözübüyük, & Milanov, 2010). It presumes that interorganizational collaboration arises in the context of relationships and unfolds through ongoing interaction. However, the perspective still suffers from becoming a standalone theory of IOR (Kilduff & Brass, 2010) due to the field's fragmentation, with two distinct approaches: the micro (individual level) and macro (organizational level), existing without a joint agenda (Ibarra, Kilduff, & Tsai, 2005). Further research is therefore warranted to integrate the two approaches to examine the simultaneous effect of individual and organizational networks in collaboration (Carpenter, Li, & Jiang, 2012; Zaheer et al., 2010). The purpose of this study is to first carry out a review of the two perspectives, micro and macro, and then to arrive at a unified social network theory of IOR inductively, using empirical data collected in a third party logistics context.

SOCIAL NETWORK PARADIGM IN INTERORGANIZATIONAL RESEARCH

Social network studies originally stemmed from sociology literature that explores different forms of relationships among individuals (e.g. social groups and cliques). Recently, it has been extended to include organizations which can also be interconnected with other organizations through an array of social and economic relationships (Gulati, 1998). Accordingly, the social network approach in organizational theory distinguishes itself from other approaches such as transaction cost economics, by studying the relationships among social actors (Balkundi & Kilduff, 2005; Brass et al., 2004). Reviews (Betts & Stouder, 2004; Carpenter et al., 2012; Galaskiewicz, 2011; Kilduff & Brass, 2010; Oliver & Ebers, 1998) reveal of two distinct paradigms, micro (individual) and macro (organizational), existing in the field of interorganizational network research. Micro perspective views actors as individuals and presumes that IOR are embedded in interpersonal networks (IP networks). It affirms that relationships among firms are dependent on social parameters such as trust and affect, and disregards of any economic controls that may exist at the organizational level. The macro perspective on the other hand, views actors as organizations and presumes that IOR are embedded in interorganizational networks (IO networks). It considers organizations as economic actors that possess the ability to make independent decisions in their own best interests (Child, 1997; Kim, Choi, Yan, & Dooley, 2011). Different exchange conditions such as uncertainty, asset specificity and frequency (Jones, Hesterly, & Borgatti, 1997) are thus viewed as factors that result in creating different forms of IOR between individual organizations (Powell, 1990; Provan, Fish, & Sydow, 2007) disregarding any social control that may arise at individual level. This distinction of the two perspectives is clearly evident in the work of Heide and Wathne's (2006) where they stated that *"in branches of the new institutional economics literature decision makers' assumed principle of action is utility maximization sometimes to the point of "self-interest seeking with guile"[...] which have the presumed ability to manage parties' inherent "calculative" orientations. In contrast other streams of literature particularly in sociology have been overly critical of such "under socialized" view of exchange arguing that relationship behaviour follows from rules or "heuristics" [...] applied regardless of their economic consequences"* (p. 90). In the following sub-sections we further explore the two approaches.

Interorganizational Networks (IO)

The main focus of the macro perspective has been on gaining synergetic benefits through alternative organizational configurations. While some (e.g. Brass, 2004, Gulati, 1998) have referred to IO networks as forms of cooperation such as joint ventures, strategic alliances, collaborations, and consortia, others (e.g. Powell, 1990) have adopted a 'network metaphor' to the study of IO networks by defining them as a form of economic organization separate from markets and hierarchies. However, according to Provan et al. (2007), all interpretations represent a common view of the underlying logic of social networks; the relationships that leads to connectedness. Thus, it is quite possible for a researcher to investigate 'network ties' between organizational actors and not be concerned with a network form of organizations (Betts & Stouder, 2004). IO networks in this regard, represent a dyadic relationship (Bernardes 2010), with two nodes and a link. Each node can be conceptualized as an actor, or an organization, engaged in the process of value creation (Choi & Kim, 2008). Unlike a firm's internal resources, most critical resources lie outside firm boundaries. Therefore, the actors create a link and form a dyad and engage in an exchange relationship to utilize these network resources (Gulati & Gargiulo, 1999). IO networks will hence be the first, and the foremost dyadic connection that reflects the contractual structuring in IOR. According to Gulati (1998), contractual agreements establish the key structural and precesual links between organizations. While governance structure manifests the relationship's degree of hierarchical structuring (Gulati, 1998), governance processes manifests the degree of joint action entwined in the relationship by setting the standard operating procedures.

Interpersonal Networks (IP)

As explained earlier, unlike the macro perspective, a micro perspective seeks to understand the nature of IP networks in IOR. Scholars in the micro domain view the strength of boundary spanners' interpersonal ties as significant to enhancing the degree of mutual socialization between organizations that promotes a normative environment of trust and reciprocity for collaboration (Uzzi, 1997). By using social network analysis methods (a tool used to study the interconnectedness of individuals), scholars in the micro domain have strived to unveil the nature of individual ties in collaboration. Recent reviews (e.g Betts et al., 2004) show a number of such IP networks explored in strategic alliances as: communication ties (Gilgor & Autry, 2012), friendship ties (also identified as expressive/ primary ties), workflow ties (also identified as instrumental ties) (Ibarra & Andrews, 1993), and help and advice ties (Krackhardt & Porter, 1986). Among them, work flow and friendship ties have gained significant attention in IOR literature (e.g., Gilgor & Autry, 2012; Mehra, Kilduff, & Brass, 2001). For instance, Turnbull (1979), and more recently Hallen (1992), claimed that IP network consists of both workflow and friendship ties. Workflow ties are identified as those that arise in the course of performing assigned work roles, while friendship ties are defined as those that arise from interpersonal attraction and emotions that primarily influence the personal rather than the task related sphere of social action (Lincoln & Miller, 1979).

RESEARCH METHODOLOGY

Our objective was to understand how interpersonal and interorganizational relationships foster collaboration between supply chain firms. The process of investigating the phenomenon accordingly, required generating rich descriptions of actual events in real life contexts provided by participants. As such, a qualitative and exploratory case study research design was undertaken and a greater understanding of the thoughts and experiences of managers in the context of collaboration was inductively drawn in arriving at a unified model of social interactions in collaboration. Social network perspective fundamentally presumes that organizations access resources and capabilities through their networks of inter-firm relationships, and hence are both empowered and constrained by their existing patterns of relationships (Zaheer et al., 2010). Accordingly, the perspective considers dyads (pairs) as opposed to single organizations as the basic building block to understanding IOR. Recent literature (e.g. Choi & Wu, 2009; Provan et al., 2007) however, argues that a dyadic framework ironically ignores the basic network theoretical insight; 'actors and actor-to-actor relationships are likely to be influenced by the overall set of relationships' (Mitchell, 1969). Thus, in order to gain a rich and in-depth understanding of the phenomenon, the study extended its scope beyond the basic relational context that a dyadic level study provides, to an ego-centric network by studying a series of dyadic relationships of a focal firm. We purposely selected a firm functioning in the 3PL service industry as unlike the manufacturing industry, 3PL

service industry is deemed to operationalize the relational dynamics at its highest, in becoming more responsive to the demands of the many stakeholders it caters to (Razzaque & Sheng, 1998). The focal firm is a pioneering local logistic service provider in Sri Lanka that started its operations in 2001. The customers selected are multinationals functioning in FMCG and Lubricant industries for over 20 years and the supplier is a labour contractor. As the identities of these companies must remain confidential, they are referred to as follows: Focal – 3PL, FMCG customer – FMCG, Lubricant customer - Lubricant, Labour contractor - Labour.

Once access is gained, Yin (2003) affirmed that in a single case that contains a number of subunits, it becomes the researcher's challenge to make sure the data gathering and analysis is conducted simultaneously covering subunits (network dyads) and the whole (the larger network). Thus, after gaining a brief yet overall understanding of how the 3PL functions from its group director, we obtained permission to access its partners next in order to gain an understanding of the firm's ego centric network from their perspective. We soon realized that the focal firm's (3PL's) positive self-perception within its network (partners) was not held by its partners. This perception mismatch became the leading question in the following interviews with the focal firm's key personnel. Some significant evidence that unfolded as 'past incidents' from the partners' end, fostered a rich dialog with the 3PL's employees as they contemplated on them. This unique approach that involved simultaneous questioning of the focal firm and its partners back and forth enabled us not only to be exposed to a rare experience of immersing ourselves in a true interpretive exploration on the dynamics of interorganizational collaboration, but also to significantly improve the validity of findings. Moreover, our judgments on these 'incidents' lead us to search for additional evidence by not only interviewing the key informants in the partnering organizations who were mainly functioning at the strategic level, but also the personnel directly dealing with the 3PL at the operational level. This whole process of interviewing was done consecutively for several weeks (and totalled up to 35, covering both the 3PL and partners) with the intention of keeping the informants engaged in the developing dialog. Parallel to these interviews, informal observations were also carried out. At the secondary stage of analysis, we read and re-reading the transcribed interviews and relating it to the field notes and archival data in order to discover and label variables. Key concepts identified in literature were primarily used as the basis for this process and relationships between these concepts were later sought, core categories were accordingly arrived at (Alaranta, 2006).

FINDINGS

Dyadic Case: 3PL and FMCG

The 3PL's role in the wider business agenda of FMCG is to ensure that products are available on time in full. This includes providing warehouse facilities, managing FMCG's transport facilities as well as providing value added services (VAS) for their products. At the time of the investigation, partners were gradually recovering from a damaged relationship with regard to VAS. This long held job was suddenly awarded to a competitor due to a rate issue. VAS was a successful operation to the 3PL. The Assistant Account Manager of the 3PL claimed that once he took over, the 300000 rupee per month revenue operation turned into one that now earns 5-6 million. His decision to charge its services on a full cost basis without deducting the factory overheads however, was a long held concern to his counterparties at FMCG; "*this small guy who is handling VAS is trying to maximize his stake*" (Director, Supply Chain FMCG). The sustained concerns finally triggered when he quoted an unexpectedly high price for a job that they had been doing for 3 years consecutively. FMCG decided to award the contract to the 3PL's competitor. However, FMCG later realized that the competitor lacked sufficient capacity and 50% of it was once again awarded to the 3PL in the following year. Double line arrows in Figure 1- dyadic case depict the organizational ties between the key actors with regard to VAS at the time of the incident as per data from the process maps and relationship diagrams. Further analysis of the employees' accounts on the incident revealed that most of these 'structured interactions' (i.e., organizational ties) had not been in place; instead daily collaborative efforts had been driven by the employees' own work styles (i.e., personal ties). The single line arrows in the figure depict these personal networks of the dyad.

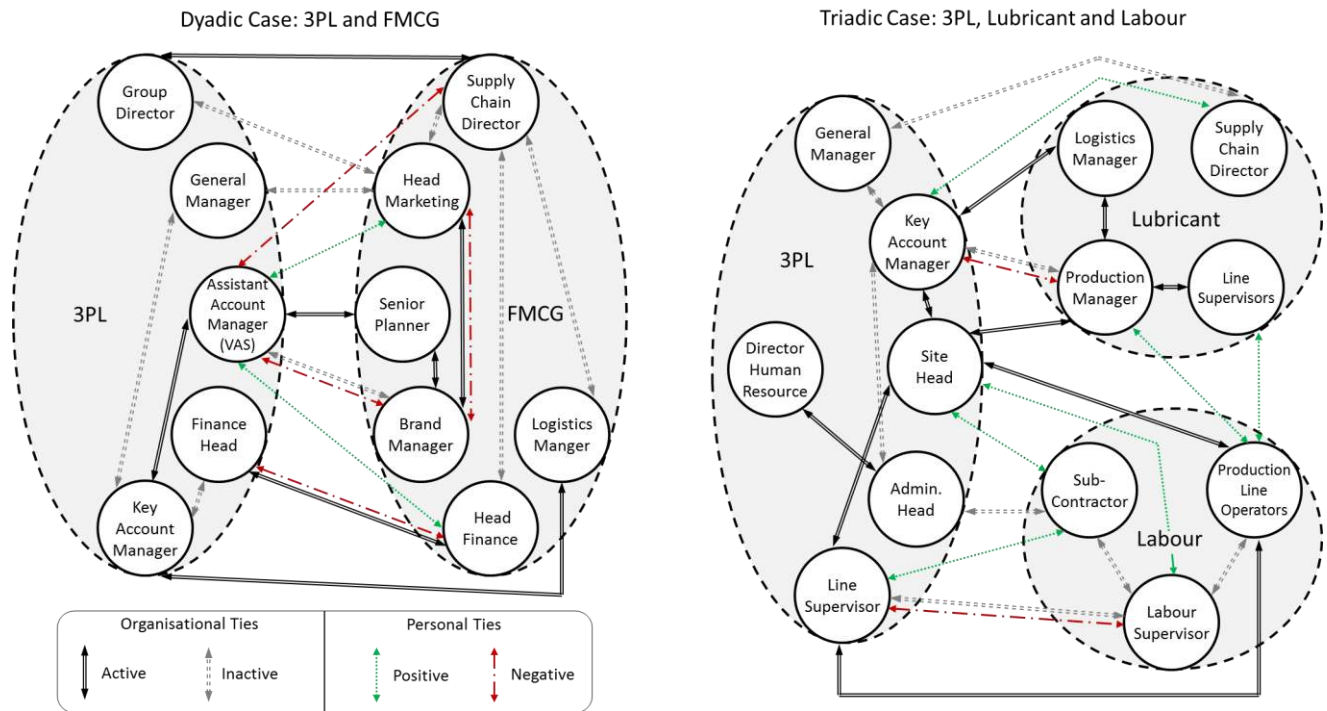


Figure 1. Case Study Organisational and Personal Networks

Triadic Case: 3PL, Lubricant and Labour

As a policy, the 3PL outsources labour for its clients’ production line operations. Accordingly, operators for Lubricant’s production line are provided by Labour. Contract between the 3PL and Labour is such that Labour provides an uninterrupted head count of 41 workers to Lubricant’s production line. At the time of the investigation, the partners were facing serious issues with a high labour turnover. The 3PL has continually failed to ensure a headcount of 41 for the last three months. Although it has imposed strict operating clauses on Labour regarding the management of production line operators, rigid processes and monitoring procedures at Lubricant has made it extremely difficult for the 3PL personnel on site to retain workers. As shown in Figure 1-triadic case, labour issue thus seemed to revolve not around the dyad; Lubricant and the 3PL, but the triad including Labour. Double line arrows in the figure depict the organisational network of the triad as per data mainly derived from the process maps and contractual agreements. Further analysis of employees’ accounts on their daily performance revealed that these ‘structured interactions’ are mostly not in place; instead, activities are driven by the employees’ own work preferences as shown by the single line arrows in the same figure.

DISCUSSION

Zaheer and Venkatraman (1995) identified IO networks as the embedding of governance structure and processes in IOR. Governance structure is the interorganizational framework within which exchange takes place and is formed through the organization of relations among members in terms of formalized roles (Gulati, 1998), while processes are designed and used to manage these roles (Doz, 1996). Analysis showed that partners maintained detailed contractual agreements with clearly stated objectives and service deliverables. It revealed a more or less stable link formed at the organizational level predominantly driven by economic motives and was observed as fundamental by participants. It also revealed that an IP network was subsequently developed to execute the IOR’s contractual obligations. Emergence of this social link is clearly evident in one of the Director Supply Chain, FMCG’s quotes where she recalled how it all began; “When we started off the operation, Arnold, (chairman, 3PL) gave me his mobile number, and said; if you ever have a problem you just call me. That’s the kind of confidence they gave us at the beginning”. As observed in previous literature (e.g. Larson, 1992; Mehra, Kilduff, & Brass, 2001; Ring & Van de Ven, 1994), Participant accounts showed that these IP networks have been developed around the boundary spanners’ role authorities and hence reflected a formally prescribed set of

interdependencies established by the division of labour in the organizations; *"At the end of the day it is the performance KPIs that matters and not how you achieved them. So, you should be able to develop some sort of a connection with whom you are working. This can only be done by showing to what extent you are willing to stretch your limits to help them"* (Junior planner, FMCG). The quote also reveals that unlike normal friendships that arise out of personal choice (Mehra et al., 2001), in IOR, there exists a special type of friendship which Price and Arnould (1999) called 'commercial friendships', emerge to wholly facilitate boundary spanning work roles.

The interwoven nature of the IP and IO networks has been amply discussed in recent literature. For instance, Borgatti and Li, (2009) affirmed that both types are vital to understand what happens in IOR. This study infers that the two cannot be separated as they carry a symbiotic effect on each other. For instance, IP networks originally stem from, and are repeatedly nurtured by the IO networks. Hence, in the absence of IO networks, functionality of IP networks would cease; *"SOPs are maintained to make people accountable for what they do"* (Junior planner, FMCG). On the other hand, the IO network's functionality is dependent on the development of an associated IP network; *"It is the process map that acts as the interfacing document between you and the customer. However, at both ends, it is a person who executes the process map"* (Director, 3PL). Nevertheless, the case also revealed that although formed as a result of the IO networks, IP networks are not entirely consistent with IO networks. This finding is contradicting to previous research (e.g. Böröcz & Southworth, 1998) that argued the structural rigidity associated with the workflow ties have created a more explicit, impersonal, and functionally specific nature in them although executed by individuals. According to Perrone, Zaheer, and McEvily, (2003) *"incumbents experience a variable level of role autonomy in their organizations that goes from passive "custodianship" of the received role to "role innovation," where they are relatively free to actively change the goals and scope of their own role"* (p. 424). It was evident that despite the comprehensive training given to boundary spanners on the tasks and related processes, they have deviated from these 'structured interactions' in their daily collaborative efforts as the partnership evolved overtime; *"I would say the processes, if you go by the paper work, what you have been given in the hard copies of it, you might see all those there. But no one seems to be following them"* (Director HR, 3PL).

The study revealed that the interwoven nature of the two networks has created a profound effect of IP networks on IO networks and vice versa in collaboration. For instance; the IP networks shown in Figure 1 have positively as well as negatively affected the relationship's IO networks. Although the site head's friendship with the Subcontractor has facilitated his relationship with the Production Manager of Lubricant, this relationship contributed to diminishing communication with the Labour Supervisor in the triadic case. Similarly in the dyadic case, while the Assistant Account Manager's informal links with the Head of Finance has significantly helped to ease tension between the two finance heads, his informal link with the Marketing Head has prevented his formal communication with the Brand Manager creating a more hostile environment around him; *"It was personal and had nothing to do with business [...] she didn't like me directly discussing prices with Ronald (Head, marketing, FMCG). She was taking it personally and was not ready to talk"* (Assistant account manager, 3PL). On the other hand, certain IO networks have also impacted the IP networks. In the triadic case, while the strong formal links maintained by the Site Head of the 3PL with the lubricant company's Production Manager has helped to ease tension between the 3PL's Key Account Manager and the Production Manager, the formal link between the Site head and the Key Account Manager has contributed to weaken the Admin Head's active involvement in the issue; *"Augustine (Head administration, 3PL) always waits to hear from Pam (key account manager, 3PL) and then sends me a mail. I have never seen him talking to Steve (Production manager, Lubricant) directly"* (Site head, 3PL). The structural link between the Supply Chain Director and Group Director in the dyadic case facilitated a cessation of hostility between the two finance heads. However, the strong formal link between the Assistant Account Manager and the Senior Planner has resulted in a negative personal link between the Assistant Account Manager and the Brand Manager.

The interwoven nature of IO and IP networks therefore suggests that unless efforts are made to mitigate the negative effects and duly recognize the positive effects of the changes in the two networks, IOR will be adversely affected. For instance in Figure 1, the friendship developed in the triadic case between the Key Account Manager and Supply Chain Director, by-passing the

Production Manager will continue to aggravate the issue unless the IO networks between the Key Account Manager and Production Manager are formally reinforced. In the dyadic case, hostility developed between the Assistant Account Manager and the Brand Manager could be eased if the weak IO network between the two were revitalized. Similarly, in the triad, if the value of the emergent relationship between the Site Head and the Sub-Contractor was institutionalized, absence of labour could be better handled. If the value of the link between the Assistant Account Manager and Head of Finance in the dyadic case was institutionalized, rate negotiations for VAS could have become more unbiased. While participant accounts reveal some evidence of efforts made to maintain a symbiosis of the two, such efforts had unfortunately not been consistent and rigorous enough, as they view them as part and partial of collaboration; *"it's a cycle. Every one year or two we have this coming up"* (3PL General Manager). This has resulted in one contract already being lost; *"If you feel that you can get more value by scanning around the market I don't see any wrong in shifting. It's like a marriage. In a marriage you don't want to try out so many times but there are instances where the marriage may not work"* (Director Supply Chain, FMCG), and another in the verge of being terminated.

Proposed model

All the interviews in this study consisted of composite descriptions about events that occurred at various points in the relationships. This temporal variety of personal stories enabled us to develop an initial causal model depicting the role of IP and IO networks in collaboration. As illustrated in Figure 2, the analysis indicates that the development of an interorganizational relationship occurs through a combination of both interpersonal and interorganizational interactions. Furthermore it was identified that the two and the corresponding elements; structural and processual ties (that form the IO network), and friendship and workflow ties (that form the IP network), are interdependent. As a result, unless conscious and continuous efforts are made to ensure a symbiotic existence of the four, parties may not be able to yield the desired outcomes. The primary question is thus "How do parties ensure a symbiotic existence?" Our empirical study demonstrates a lack of symbiosis, where some personal ties undermined the existing structural (formal) relations. Symbiosis cannot be formally structured or designed into an IOR, but in our opinion is a skill or capability of the senior decision makers (Gulati 2009). While the formation and use of IP ties cannot be avoided, this 'symbiotic capability' of senior managers and boundary spanners ensures that these ties are used to positively enhance the IOR.

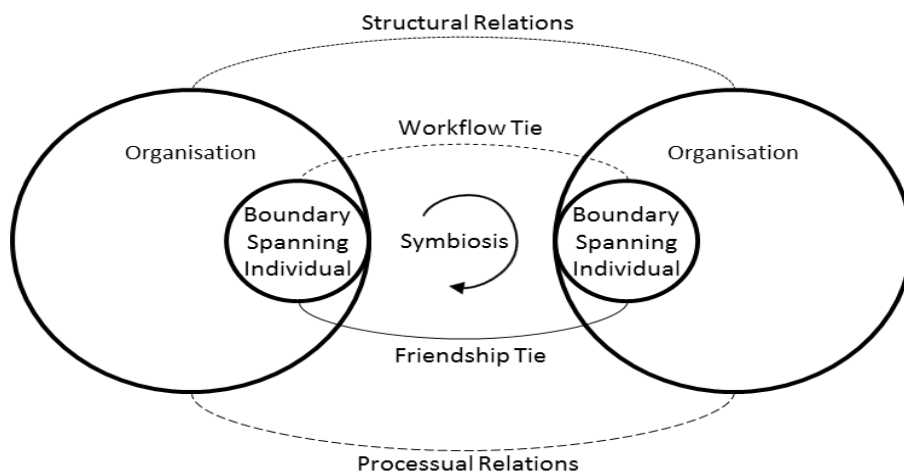


Figure 2. Symbiotic Interpersonal and Interorganizational Networks

CONCLUSION

The purpose of this study has been to empirically examine the multilevel challenges and opportunities that exist in social network theory, and propose a new theoretic conceptualization of how IP and IO networks can be combined when studying interorganizational collaboration. By introducing the term symbiotic existence to interorganizational social network theory, we argue that the development of an IOR occurs through a combination of both interpersonal and interorganizational interactions and the corresponding elements. Decision makers should therefore

strive to effectively leverage these elements for collaborative synergies. IOR evolve and change over time and this would result in many structural and processual changes that will require amendments to the IO network of the relationship. Failing to make the necessary amendments would result in a negative knock on effect on the IP network. Similarly, the boundary spanners of each organisation face day-to-day collaborative challenges. Their activities will therefore gradually take the relationship in to relational dimensions. Failure to recognize these changes in workflow and friendship ties that forms the IP network would have a negative knock on effect to the IO network. Although few studies (e.g Boddy, Macbeth, & Wagner 2000) have suggested a convolutionary effect of formal and informal networks in collaboration, none of them have been able to elucidate how the four elements (structure, processes, workflow ties and friendship relations) can be fruitfully combined in arriving at a more holistic model of collaboration. The model we present thus provides a cause for further exploring the symbiosis of these elements in collaboration. Moreover, we also draw attention to Gittell and Weiss's (2004) argument that intra-organizational structures play a significant role in interorganizational collaboration as from the analysis it was revealed that the parties' intra-organizational networks carry a profound effect on the relationships' IO and IP networks. Further research is thus warranted to explore the effect of intra organizational structures on collaboration.

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EVOLUTION OF DEMAND SUPPLY NETWORK ALIGNMENT AND ITS IMPLEMENTATION – A LITERATURE REVIEW

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ABSTRACT

The paper aims to enhance the current understanding of the demand supply chain management (DSCM) concept by undertaking a comprehensive review of the evolution of DSCM from both a strategic and an implementation perspective. Key concepts of supply chain management (SCM) and demand chain management (DCM) that underpinned DSCM are discussed in this paper. Four major aspects of DSCM research and implementation are discussed in the paper. They include i) theoretical studies; ii) strategic business overview; iii) operational process-driven; and iv) organization restructure and practical value of enablers and obstacles of DSCM.

INTRODUCTION

DSCM has emerged as a prevalent paradigm and effective form of DCM in recent years. It is built upon the network alignment concept which requires not only integration of marketing strength and supply chain capabilities underpinned by DCM but also appropriate configuration of organizational culture and leadership style to align with the external market (Hilletoft, Ericsson & Christopher 2009; Lau 2012). The concept has been put forward in diverse context with various emphases. An example is the 'Dynamic Supply Chain' concept which emphasizes delivery of supply chain value through human resources and practical business administration ([Gattorna 2009](#); [Kerr 2010](#)). There is also terminology of demand supply chain management (DSCM) contending that marketing and supply chain management should be linked closely (Hilletoft 2012). Walters & Rainbird (2004) put a step further by proposing a dysfunctional process-driven operation to execute the concept. Nonetheless, no research to date has yet provided a clear picture of the DSCM approach bringing together previous separate streams of work to enable a comprehensive understanding of the concept. Through a systematic literature review taking into account the growing complexity of demand and supply network in a global context, this study attempts to capture the essence of DSCM from a multi-disciplinary perspective and provide practical insight on its implementation.

METHODOLOGY

The study used the desk-top research methodology involving a two-stage "funneling" process to systematically review the relevant literature on DCM and DCSM. The first stage involved the identification of relevant databases and articles. A broad search of academic

databases highlighted 64 relevant business-related academic databases. Key words, such as “demand”, “supply”, and “demand supply chain”, were used in the identification of the seminal and recent research works in the field. Other sources of information used in the literature review also include online articles, white papers and latest news announcement. More than 500 articles were identified and then reduced to a shortlist of 50 most relevant ones. The second stage of the desktop research used content analysis to highlight and categorize the key issues discussed in these articles.

EVOLUTION of CONCEPT: SCM VS. DCM

DSCM is a concept or approach that evolved from supply chain management (SCM) and demand chain management (DCM). Conventional SCM, emerged in the 1980s, tends to optimize internal production efficiency with supply-focused process comprising inbound logistics, operations, and outbound logistics (Oliver & Webber 1982; Priem & Swink 2012). It aims at cutting costs and refining the intra-business processes (Esper et al. 2010).

With the transfer of the power in the distribution channel from the producer to the consumer, focus of SCM gradually shifted from the upstream supply and midstream production to downstream demand in 1990s. This shift brought about the concept of demand chain management which placed the end user as the organization’s point of departure instead of its final destination (Wieland & Wallenburg 2011). Michael Porter (1985) was among the first who posed the concept of disaggregation of two paradigms. In this regards, the whole network is separated into supply activities and demand marketing service. According to Porter (1985), marketing, sales and service on the end half of the value-chain, collectively driving and sustaining demand, are the three main elements of the demand chain (Figure 1).

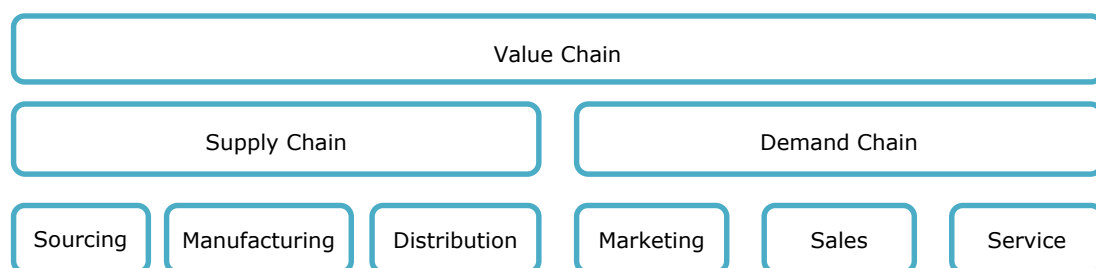


Figure 1 – Demand chain structure (Porter, 1985)

Christopher (2005, p. 5) also proposed an argument against the limitation to the uni-dimensional, cost-focused supply chain concept and suggested the following:

"Supply chain management should be termed demand chain management to reflect the fact that the chain should be driven by the market, not by suppliers. Equally the 'chain' should be replaced by 'network' since there will normally be multiple suppliers and, indeed, suppliers to suppliers as well as multiple customers and customers' customers to be included in the total system."

Actually, DCM precedes SCM. Many studies in the literature have paved the way for the current DCM paradigm formulation. In this paper, these studies were reviewed and categorized into two main stages – the exploratory and the application stages – as shown in Table 1. The first stage, named market-driven supply chain or demand driven supply chain (DDSC), regards supply chain as a market-mediation. It begins with seeking value-adding process from the customer side with more customized supply chain strategic solutions for bullwhip effect alleviation, inventory control and better service performance (Schelmetic 2013). However, the focus is still on the question of “what customers want” instead of “why and how”. It considers demand as an exogenous condition which can be fulfilled with some one-size-fits-all solutions such as vendor managed inventory (VMI), just-in-time (JIT) strategies, and lean manufacturing (Schelmetic 2013). Holmstrom et al. (2001, p. 24) add the argument on the nascent stage of DCM in terms of demand value proposition:

“Demand and supply are linked in two places – the order penetration point and the value-offering point.”

The second stage considers the demand chain as a whole that involves the inside-out coordination from marketing planning with seamless supply chain processing and logistics operation. It is a broader scope connecting marketing factors such as customer behavior study, marketing planning, branding with actionable strategies and plans for the whole groups of firms in the network (Langabeer & Rose 2001). Under this notion, the essence of DCM is the integration of the marketing management and SCM with tight demand creation and fulfillment coordination (Hilletoft 2007; Jüttner, Christopher & Baker 2007; Rainbird 2004; Walters 2006). The aim of DCM is to attract and retain desirable customers and improves its product positioning (effectiveness) in profitable markets (efficiency). To achieving this objective, it may require the dealing with immense complexity in a volatile marketplace, while coping with long distances, trimmed budgets, and perhaps reduced manpower (Hugos 2006). The expanding notion of the broader DCM concept reinforces the importance of the **process management** within the demand and supply networks. On the other hand, it also induces the preliminary DSCM concept (Hammer 2003; Trinca 2003).

Stage	Synopsis	Studies
Phase 1: Replacement of SCM (Ontology)	<ul style="list-style-type: none"> ▪ A more narrow definition of DCM based on distinction between the efficient physical supply and the market mediation roles, which defined the term as market mediation supply chains ▪ Regarding demand as exogenous condition ▪ Addressing the issues in the frame of SCM definition 	(Goldman, Nagel & Preiss 1995); (Fisher 1997); (Cooper, Lambert & Pagh 1997); (Vollmann & Cordon 1998); (Srivastava, Shervani & Fahey 1999); (Lambert & Cooper 2000); (Childerhouse, Aitken & Towill 2002); (Christopher & Payne 2002); (De Treville, Shapiro & Hameri 2004); (Womack & Jones 2010);

Phase 2: Synergy of marketing and SCM (Epistemology)	<ul style="list-style-type: none"> ▪ Integrating demand and supply orientated processes ▪ Defining DCM as a strategic processing management which includes all activities that companies undertake in their quest to create and deliver needs-based customer value propositions ▪ By differentiating products, delivery, sourcing processes to proactively satisfy different customer needs with flexible SC solutions 	(Slater 1997); (Mentzer et al. 2001); (Baker 2004); (Rainbird 2004); (Flint 2004); (Walters & Rainbird 2004); (Walters 2006); (Christopher, Peck & Towill 2006); (Jüttner, Christopher & Baker 2007); (Hammer 2003)
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Table 1 – Evolving phases of the DCM paradigm

DEFINITION OF DSCM

The changes in nomenclature from market-mediation or demand-driven supply chain (DDSC), DCM, to DSCM reflects the paradigm development starting from limited streams to inclusive business scopes with multi-streams. As the theory evolves, **operational process management in DSCM** has been stressed in the current studies to reinforce the concept from fundamental base. Since marketing being highlighted as the centric concept under the DCM, many authors make a step further by advocating DSCM as a practical-focused approach encompassing all cross-disciplinary processes without strict functional organization boundaries ([Jüttner, Christopher & Baker 2007](#); [Rainbird 2004](#); [Van Goor 2007](#)). Hiletoft (2011, p. 187) defines DSCM as “an approach to gain a superior competitive advantage by balancing cost efficiency, responsive effectiveness, differentiation and innovativeness process **across functional organizational and inter-organizational boundaries**”. Some scholars present an overarching proposition to incorporate organizational capabilities into the value proposition from a management perspective.

[Baghai, Coley and White \(2000\)](#) suggest the organizational capabilities that embedded in a company’s people; processes and institutional knowledge are basic value catalyst to enhance the fusion between supply and demand drivers. [Lau \(2012\)](#) strengthens the argument of DSCM as a new field of modern study relating it to the holistic demand supply chain collaboration not only from combination of marketing strength and supply chain capabilities but also corresponding adjustments in business strategy, leadership style and organizational culture. [Gattorna \(2010\)](#) also stresses the important role of human resource in the dynamic alignment framework by integrating marketing rules, internal supply chain strategies with the internal culture and leadership style. In recent years, integration with organizational capabilities and factors has been stressed in the definition of DSCM. Table 2 summarizes the various definitions of DSCM in which key concepts emerged in the evolution process are highlighted.

Reference	Definition	Key Concept	Relative Studies
Vollmann et al. (2000)	“A practice that manages and coordinates the supply chain from end customers backwards to suppliers”(p.82)	Replacement of SCM	Heikkila , 2002; De Treville et al., 2004; Vollmann and Cordon, 1998;
Williams et al. (2002)	“The management of supply production systems designed to promote higher customer satisfaction levels through electronic commerce that facilitates physical flow and	Demand-based supply chain management	Kumar et al. 2000; Sheth et al. 2000; Flint, 2004; Selen and Soliman 2002)

	information transfer, both forwards and backwards between suppliers, manufacturers and customers” (p.692)		
Rainbird (2004)	“An understanding of current and future customer expectations, market characteristics and of the available response alternatives to meet these through deployment of operational processes” (p.242)	Demand and supply chain process management	Hilletoft and Ericsson, 2007; Walters and Rainbird, 2004
Jutterner et al. (2007)	The concept that aims to integrate demand and supply oriented processes. Demand processes are all processes at the customer or market interface aimed at responding to customer demand through value creation; supply processes comprise the tasks necessary for fulfilling demand”(p.38)	Process management	Mentzer et al. 2001; Walters and Rainbird, 2004
Hilletoft et al. (2009)	“The alignment of demand creation and demand fulfillment processes across functional, organizational, and inter-organizational boundaries”(p.1181)	Dynamic alignment	Walters, 2008).
Gattorna (2010)	“The dynamic alignment concept requires that four levels of human endeavor be aligned—marketplace, response(s) to customer demands, internal cultural capabilities, and leadership style—all held together primarily with leadership, organizational structures, processes and technology” (p. 47).	Overarching dynamic network alignment with multi-streams	(Gattorna, 1998, 2003, 2006)

Table 2 – Definitions of DSCM

ANALYSIS AND FINDINGS

Through a comprehensive analysis of the literature and a synthesis of the different views of DSCM, four research areas have been identified. They include: i) theoretical study; ii) strategic business overview; iii) operational process-driven; and iv) functional breakage. These research areas represent the stage of paradigm development according to the diverse research streams (see Tables 3 and 4).

Study	Industry & Research Scope	Theoretical Study (exploratory)	Strategic Business Overview	Operational Process-Driven	Functional Breakage	Focus Stream
(Rainbird 2004; Walters & Rainbird 2004)	Australia Fast food industry: McDonalds	✓	✓	✓		Value chain/DCM
Van Goor (2007)	FMCG DSCM/SC collaboration	✓	✓	✓	✓	DCM
Jüttner, Christopher and Baker (2007)	Range of different industries		✓	✓	✓	DCM
Canever, Van Trijp and Beers (2008)	Beef industry from DSCM perspective		✓	✓		Operational process management
Holmström et al. (2008)	OEM Industry		✓	✓		Segmenting service delivery and asset management based on industrial service operations
Gattorna (2010)	Overarching demand chain network alignment		✓	✓	✓	Business Management/HR/SCM
Esper et al. (2010)	Enterprise based demand supply integration based on knowledge based theory		✓	✓	✓	Organization Management
Lau (2012)	Downstream wholesale and retail distribution		✓	✓		Logistics delivery and Distribution
(Hilletoft 2011, 2012; Hilletoft, Ericsson & Christopher 2009; Hilletoft & Hilmola 2010)	Furniture industry demand and supply chain management	✓	✓	✓		DCM/Marketing

Table 3 – Key studies of DSCM focused on diverse streams

Research Perspective	Description	No. of Studies
Theoretical study (exploratory)	Preliminary study based on theory exploration	4
Strategic business overview	Business strategy planning for network collaboration based on macro-picture	13
Operational process-driven	Specific supply operational process design based on segmented marketing demand	13
Configuration restructure-functional breakage	Inter-organizational and cross-functional organizational process development pumping through the overall demand network on the premise of aligned culture and leadership style.	4

Table 4 – Statistical analysis

As the findings reveal, academic research in DSCM approach is proceeding to maturity. Process management and specific operation based on macro business strategy for DSCM realization has been a research breakthrough contributing to the overall philosophy exploration. However, they are only tested in certain industries on limited business scopes. To date, some research has begun to focus on the dynamic nature of DSCM from broader sense. Although many studies are looking at the practical aspect of DSCM, full-fledge DSCM implementation on configuration restructuring and inter-organizational alignment is still considered as challenging for many reasons. Success DSCM not only relies on seamless network collaboration on each operational process with segmented marketing demand but also fundamental financial investment and constructional changes in the long run (Hilletoft 2012). By analyzing the historical literatures under various streams, Table 5 summarizes the preliminary necessities and challenges in implementing DSCM in the whole industry. It highlights some key issues impeding the process and points out the direction for future research.

Enablers	References	Obstacles	References
Supply chain strategic designing based on marketing/ demand research	(Esper et al. 2010; Hilletoft 2007; Jacobs 2006; Jüttner, Christopher & Baker 2007; Walters & Rainbird 2004)	The revolutionary supply chain reconstruction from physical and mental perspective	(Hilletoft 2007, 2011; Jacobs 2006)
The proper balance between demand creation and fulfilment, between revenue growth and cost reduction	(Ericsson 2011; Esper et al. 2010; Hilletoft 2011; Jacobs 2006; Jüttner, Christopher & Baker 2007)	Challenge to create acceptance for new mindsets and new ways of behaviour (many approaches are still based on old business paradigm with focus on intra company effectiveness and efficiency)	(Ericsson 2011; Jacobs 2006; Van Goor 2007)
Advanced market segmentation and intelligence	(Hilletoft et al., 2009; Juttner et al., 2007; Walters and Rainbird, 2004)	Highly control manpower along the shareholders	(Hilletoft 2007, 2011; Jacobs 2006)
Information sharing/ relationship management	(Charlebois 2008; Frohlich & Westbrook 2002; Williams, Maull & Ellis 2002)	Conflicts of interest along supply chain	(Ericsson 2011; Jacobs 2006; Van Goor 2007)

Trust and loyalty	(Charlebois 2008; Childerhouse, Aitken & Towill 2002; De Treville, Shapiro & Hameri 2004; Esper et al. 2010; Frohlich & Westbrook 2002; Heikkilä 2002)	Huge financial investment	(Hilletoft 2007, 2011; Jacobs 2006; Van Goor 2007)
Integrated IT support	(Al-Mudimigh, Zairi & Ahmed 2004; Selen & Soliman 2002; Walters 2008)		
Commitment from senior leadership style fit (culture change/business strategy alignment/functional process and department fit)	(Esper et al. 2010; Hilletoft 2011; Jüttner, Christopher & Baker 2007; Langabeer & Rose 2001)		

Table 5 – Enablers and obstacles to DSCM implementation

CONCLUSIONS

Through an extensive literature review based on a two-stage 'funneling' process, four research areas representing the derived DSCM agenda are highlighted and discussed in this paper. While many researches have been conducted on DSCM from both strategic and operational perspectives for concept development and implementation, empirical DSCM embedment for enterprises from a broader industry level has not been fully realized. By pinpointing out the enablers and the obstacles to DSCM implementation, this paper contributes to knowledge by reporting the state of the art in DSCM research and pointing a niche for further study.

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NOTE: A full list of references could be obtained from the authors upon request.

ANTECEDENTS OF SPATIAL LOGISTICS EMPLOYMENT CLUSTERS

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ABSTRACT

Purpose: Using a spatial econometric approach, this paper aims to identify the key location-specific factors that shape the spatial formation of city logistics employment clusters.

Methodology/Design: Using the 4-digit ANZSIC classification employed by ABS (Australian Bureau of Statistics), industries that are explicitly related to logistics are first identified and then aggregated at a small area level. Employment data are used as a surrogate measure for city logistics clusters. Key city logistics clusters are identified through a location quotient – an index of employment concentration. Spatial autoregressive techniques are applied to measure the impact of location-specific contextual factors contributing to the development of spatial logistics employment clusters.

Research Findings: the results show that logistics landscape in Victoria is spatially fragmented. Mapping of LQ values identified key spatial logistics employment clusters in the State of Victoria. These spatial logistics clusters in Melbourne are functional trade nodes of high economic activity, which largely represent the conglomerates of transportation, warehousing, high throughput freight distribution centres and intermodal hubs in western parts of Melbourne, around the Dandenong area in the south east and hotspot areas around the airport in the north. The results from the spatial econometric analysis indicate that logistics employment tends to cluster in areas of strategic locations as characterised by access to highways and main roads, proximity to CBD as an employment hub, availability of workforce with required skills, and the size of regional economy within which each area operates.

Research Limitations: the use of employment as a surrogate for the concentration of firms is a limitation. Cross-section analysis only presents a snap shot of logistics landscape, which is subjected to dynamic agglomerative processes. Time-series analysis will help analysing the pathways that clusters traverse through their life-cycle.

Practical Implications: The competitive advantages of geostrategic positioning of logistics cities can be harnessed to create optimal freight corridors through designing a hub-and-spoke service model. Spatial logistics clusters could potentially act as base anchors on high volume freight routes to establish a more efficient freight distribution network. Through further investment in infrastructure and R&D in logistics cities, new business opportunities can be created and the existing capacity of logistics networks to service a larger catchment with greater agility can be enhanced.

Originality/value of the paper: The use of spatial econometrics techniques to identify key location-specific factors to analyse logistics employment clustering at a small area level is the original contribution of this paper.

Keywords: Spatial logistics cluster, cluster theory, geographic information systems and spatial statistics

INTRODUCTION

City logistics clusters, or hubs as they are more commonly termed (Spengpeihl, 2011), are the nodes that tie together the complex web of international trade routes or domestic supply chain networks (Sheffi, 2012). These are a consequence of the changing global logistics landscape, characterised by decentralisation of supply chains and global spread of logistics activities (Waldheim and Berger, 2008). The emergence of city logistics clusters as a phenomenon is evolving to support urban economies in developed countries where the presence of more traditional manufacturing sector firms is diminishing as they

transfer overseas (Chhetri et al, 2014). Newly created city logistics clusters are not only supporting the efficient and effective delivery of goods to market, but also playing key role in generating regional economic growth. Thus, the establishment of city logistics clusters is essential to future regional prosperity. Sheffi (2012) attributes this prosperity to a "positive feedback loop", suggesting that the more firms join a regional cluster, the more efficient it will become, and in turn logistics operations will grow to reduce shared costs, and overall service levels will improve.

In recent years, cluster-based development approach has seen widely implemented to stimulate economic growth. Recent studies by Chhetri et al., (2014), Sheffi (2012), Wang and Ducruet (2012), Spengpeihl (2011), Cidell (2010) and Mangan et al. (2008) have reinforced the significance of cluster-based approach to improve the efficiency of logistics operations and to augment supply chain performance. Despite the extant literature on cluster research, there are two critical areas, which have largely overlooked. Firstly, issues around *in situ* measurement and delineation of city logistics clusters, in terms of territorial expression, are not explicitly tackled. Geographic delineation of cluster boundary thus marred with substantial degree of vagueness and positioning inaccuracy. Thus, the cluster concept has proven to be difficult to assign precise and well-ordered analytical substance (Martin and Sunley 2003). In the absence of a clear measurement framework, researchers constructed clusters from the reach of innovation activity, to district, and sometimes even regions without using rigorous methods or procedures. Secondly, the analysis that extends beyond the morphological representation of clusters towards the identification of explanatory factors shaping the spatial formation city logistics clusters is simply missing. As argued by Bowen (2008), changing geography of logistics is not only shaping the metropolitan landscape, but also connecting and integrating metropolitan, regional and national economies. Such significant geographical "re"-landscaping of logistics space, particularly after the rapid decline of manufacturing districts, are not sufficiently theorised in the extant literature. This paper therefore aims to apply spatial econometric approach to identify the contextual factors shaping the spatial formation of city logistics clusters in Victoria, Australia. This will be achieved through answering the following two research questions.

- Where are the key city logistics clusters?
- What are the significant location-specific factors that drive the spatial formation of logistics employment clusters?

This paper begins with a brief review of literature in the broader area of cluster research, with particular focus on logistics. The theoretical underpinning of cluster theory, coupled with establishing the modelling framework, will be carried out. The research methodology is then presented the description of the datasets used and methods employed. Results and analysis are then outlined. The paper finally concludes with a summary of major findings and by setting the context for future research.

LITERATURE REVIEW

Logistics activities are attached to space and space matters in accessing economic opportunities (Fernandez and Su, 2004). A city logistics cluster is a spatial agglomeration of logistics activities. Thus, it is essentially a 'spatial phenomenon', as it holds location-specific attributes. Agglomeration is a concentration of logistics activities in space, in the most general sense defined as "the locus of heightened economic activity" (Press, 2006). Hofe and Chen (2006, pp. 8-9) state that "all cluster concepts appear to have their roots to a more or lesser extent in agglomeration theory." Agglomeration economies in a clustered structure provide efficiency gains by providing incentive for firms to co-locate and to form an agglomeration to reduce forward and backward transactions and transportation costs due to proximity effect. Distance-sensitive transaction costs imply that diversity is fostered in agglomerations (Florax and Plane, 2004, p. 171).

Logistics hubs are often located adjacent to urban centres as well as the international trade gateways that are major ports and airports. This is to consolidate and distribute the influx of increasing quantities of products into and out of specific regions from and to

various global locations. Spatial logistics clusters or hubs have also emerged in response to the agglomeration of manufacturing firms and the need to distribute their outputs to disparate global locations (Sheffi, 2012). Established major logistics hubs such as the deep sea ports of Singapore and Rotterdam, the growth of new ports in the Pearl River Delta, China, and newly developed bespoke “logistics cities” of Dubai and Zaragoza, Spain illustrate the growth of logistics services (after Sheffi, 2012; Spengpeihl, 2011). As such Robinson (2006) finds that a strategic focus on enhancing what is termed port-oriented landside logistics is necessary to improve the flow of logistics through the ports and cope with continued growth. Mangan et al. (2008) extend this argument to propose that ports themselves offer a more strategic role than has been conventionally perceived. Hesse (2008) goes one step further by conceptualising the notion of city as a terminal as supposed to a market place. The intensification of the process of port regionalisation, in the case of ports or as “logistics localization”, representing agglomeration of logistics functions such as storage, consolidation and high throughput distribution nodes is a part of the reconfiguration of urban land use.

Co-location of firms within a geographically bounded area is partly an outcome of spatial processes, as it is related to decisions about location choices. Spatial processes however may not necessarily create clusters, but they certainly shape where and how they develop and evolve. Co-location enables firms to achieve external economies of scale, which occur outside a firm by increasing the scope of operation to benefit from factors such as better transportation services and reduced costs. Thus, location is a key to reducing costs through external scale. Localized externalities are location-specific cost advantages through which firms get access to initial resource endowments and immobile resources. Firms from similar industrial specializations take the advantage of being located in close proximity to one another. The benefits emanating from information spillover, a joint pool of skilled labor, lower cost search and matching processes in labor and service/product markets, local intraindustry specialization, and availability of local specialized services (Gordon and McCann, 2000).

City logistics clusters are functional nodes of high economic activity, creating regional growth and forming foci of innovation (Chhetri et al., 2008). They are empowered to control and regulate the distribution of freight and thus they act as gateways to and from a region/country, shaping the way commodity logistics operations are formed. In some regions, economic activities concentrated at transport terminals such as ports or airports create logistics hubs where there is a large spatial accumulation of logistics-related value-adding activities. The “districtparks” of the likes of Rotterdam and Antwerp evidence this with numerous distribution centres located at the ports to break bulk shipments from the east and sort them for distribution to different markets within Europe (Spengpeihl, 2011). Cidell (2010) similarly noted a rapid transformation of the logistics landscape in the USA with the detection of two distinctive trends. First is the move towards inland distribution centres and second is the suburbanisation of freight activity. The increased concentration and inland shift were attributed to more congested gateways, increased containerisation, and high level of throughput, which necessitated releasing capacity in dockside space for maritime activities and accessing cheaper industrial land in suburbia. This raises the issue of de-clustering whereby costs associated with traffic congestion, technological sharing, and rent increases begin to escalate. Robinson (2006), Mangan et al. (2008) and Sheffi (2012) therefore argue such clusters should increase their scope of activities to include more value-added logistics services beyond conventional storage and supply.

The emergence of logistics cities, hubs, gateways and regions around the world is the evidence of the vital role that logistics plays in the post-industrial economy. The locational variability of space economy plays a vital role in shaping the spatial organisation of logistics operations and clustering. The logistics clusters are essentially demand-driven services nodes, which are heavily dependent on localised and destination-based socio-economic structures to support services to customers. Logistics

activities tend to cluster around areas of resource advantages. The geographic variability in resource endowments such as accessibility to transport, or the size of regional economy foster or prohibit logistics activities to be clustered or dispersed around key strategic nodes. These differences in turn provide comparative advantages for resource-rich areas, which are strategically positioned to efficiently harness these resources to compete with other regions (Ritchie & Crouch, 2003, p. 23). These strategic areas are more likely to achieve 'increasing return of scale' and 'economies of agglomeration', which enable logistics firms to reduce transaction costs and increase the volume and frequency of service.

The core argument presented in this paper is to measure the impact of location-specific differences on the agglomerative behaviour of logistics activities or employment. Agglomerative economies are operative when centrifugal forces are strong, which in turn lead to more spatially concentrated employment behaviour. 'Diseconomies of scale' however starts to operate when centrifugal forces, such as congestion or overheated land value, disperse employment and create randomised spatial patterns with no specific order. Most economic studies however have empirically modelled the growth determinants of firms in a cluster, but only a few estimated the effects of locational attributes on firms' choice to co-locate with other firms within a cluster. Firms and employment clusters exist for a variety of reasons, but they are largely conditioned, if not controlled, by regional differences in cost advantages. Furthermore, the efficiency gained from externality effects associated with location-specific advantages is often neglected in those economic models (Hoogstra and Dikk, p. 180-181). However, modelling the impact of location-specific attributes on logistics employment clustering at an aggregate level necessitates adopting a spatial approach, which takes into account the spatial dependence. A spatial econometric approach is applied to estimate the spatial parameters driving the logistics employment clustering. Examining the relationships between the attributes of geographic space and logistics employment clustering will enable identifying the key mechanism by which spatial factors augment or deter the clustering tendency.

DATASETS USED

Two primary data sources were used in this study: 2006 Census Journey to Work (JTW) data (using the Australian New Zealand Industrial Classification (ANZSIC)) and GIS coverage for destination zones (in this case Statistical Local Areas (SLA)). The JTW data provided information about where people live and work, what industry they work in and what transport modes they use. The types of industry in the JTW data were classified using the ANZSIC codes at a four-digit level, supplied by the Australian Bureau of Statistics for the 2011 census, where JTW data comprises the number of jobs by industry. A number of measures are generated using GIS data, including a range of accessibility measures (See Table 1).

The location-specific attributes are used as model variables to represent the contextual characteristics of local economies. The variables and their associated dimensions used for modelling are listed in Table 1. These dimensions are specifically chosen to capture location-specific externalities, which largely are related to cost advantages due to differences in initial resource endowment and immobile resources. These location externalities are represented through a total of 17 explanatory variables, which are selected to represent five broad dimensions of geographic space, namely

- i) urban-economic structure;
- ii) accessibility to amenities;
- iii) local economy; and
- iv) demand variables.

Table 1: List of Dimensions, variables and measurements

Dimension	Variable	Measure	Data source
Dependent Variable	Spatial logistics employment clusters	Location quotient – an index of logistics employment concentration	ABS data
Independent variables			
Urban-economic structure	Built-up area	Number of dwellings per square kilometre	ABS data
	Landuse mix	Entropy measure to quantify land use diversity	Landuse data
	Human capital - Index of Education and Occupation (IE&O)	Reflect the educational and occupational level of communities. A low score indicates relatively lower education and occupation status of people in the area in general.	ABS SEIFA Index
Accessibility to amenities	Train stations	Network distance to the nearest train station	GIS data
	Road network density	Major road network length per square kilometre	GIS data
	Airport	Network distance to the nearest major airport	GIS data
	seaport	Network distance to the nearest seaport	GIS data
	Melbourne CBD	Network distance to Melbourne CBD	GIS data
Local Economy	Gross regional product	GRP is the measure of size or net wealth generated by the economy	ABS data
	Size of local employment base	Total employment in all industry sectors	ABS data
	Weighted Retail potential index	Total count of shopping centre weighted by their sizes divided by the state average	GIS data
Demand variable	Index of Economic Resources (IER)	A relative socio-economic advantage and disadvantage, defined by variables related to income and wealth. A low score indicates a relative lack of access to economic resources in general.	ABS SEIFA Index
	Equalised net worth (ENW)	Net worth represents the value of household assets minus the value of household liabilities, which is adjusted by average household size	ABS Survey of income and housing
	Household income	Median weekly household income	ABS data

METHOD

City logistics clusters are quantified using a measure of concentration, called location quotient (LQ). LQ is a ratio of logistics employment to total employment in an area to the ratio of employment in logistics to total employment in Victoria. It is calculated for each local area using the following equation. For example, a LQ of 1.0 means that a SLA and the state of Victoria are equally hold the same ratios between T&H employment to total

employment; while an LQ of 2 means that the SLA has twice the ratio of Victoria. Values greater than 1.0 show higher level of clustering; whilst values below 1.0 indicates lower level of clustering.

$$LQ = \frac{\frac{\text{Logistics employment in a SLA}}{\text{Total employment in a SLA}}}{\frac{\text{Logistics employment in Victoria}}{\text{Total employment in Victoria}}}$$

The impacts of location-specific attributes on logistics employment clustering, represented through LQ, are measured using spatial econometric techniques: spatial error model and spatial lag model. The results of these models are then compared with the outputs produced from Ordinary Least Square (OLS) method.

Spatial economics is "a collection of techniques that deal with the peculiarities caused by space in statistical analysis..." (Anselin 1988). Legendre (1993) states that spatial autocorrelation is "the property of random variables taking values, at pairs of locations a certain distance apart, that are more similar (positive autocorrelation) or less similar (negative autocorrelation) than expected for randomly associated pairs of observations". Autocorrelation is therefore a fact of life that exists in the natural or human world in various forms and over a wide range of spatial and temporal scales.

Spatial Autocorrelation occurs when values of a variable are not independent from each other (Tobler 1970). The spatial econometrics are appropriate to spatial data where spatial dependence in observations often exists. It requires the specification and testing of models to include spill-over effects. Most statistical models function on the assumption that the values of observations in each sample are independent of one another. Exclusion of these spatial effects may produce bias or inefficient estimation of parameters. It measures the strength of spatial autocorrelation and tests the assumption of independence or randomness. In other words, spatial autocorrelation measures the extent, to which the occurrence of an event in an area constrains, or makes more probable, the occurrence of an event in a neighbouring area.

Many statistical methods such as ordinary least squares regressions and their inferences are inappropriate because of the assumption of non-spatial independence and non-random selection of observations. In other words, the assumption that any event has an equal probability of occurring at any position in the region and the position of any event is independent of the position of any other. If observations such as unemployment rate are spatially clustered in some areas than others, then the estimates generated through the correlation or OLS estimator will be biased and overly precise. It is because the areas with higher concentration of events will have an impact on the model estimates and there are actually fewer number of independent observations than are being assumed. This could result downwardly biased estimate of error variables that in turn inflates the observed R2 values.

Assuming that spatial autocorrelation exists, it is then important to fit the spatial model. Two main types of models are commonly applied, the spatial error and the spatial lag model. The spatial error model attributes the unexplained error to be a result of spatial structure in the error terms. That is, unexplained error can be accounted for by clustering the error terms. In contrast, the spatial lag model stipulates that as well as being the main effects, the response is also a function of its neighbours. For instance, if unit i and unit j are neighbours, then the observation x_i will affect the observation x_j .

The spatial lag model estimates a coefficient similar to the one obtained for other independent variables. Spatial lag is the weighted average, which is computed from values of neighbouring areas adjacent to the target area. The formula theoretically suggests that depended variable is actively influenced by neighbours and independent variable is easily modified to incorporate spatial lag.

$$y = \rho W_1 y + X\beta + \varepsilon,$$

$$\varepsilon \sim N(0, \sigma^2 I_n).$$

where y is an $n \times 1$ vector of dependent variables, X is an $n \times k$ vector of explanatory variables, W_1 and W_2 are $n \times n$ known weight matrices, β is a $k \times 1$ parameter vector associated with the variables X , ρ is the coefficient of the spatially lagged dependent variable, and λ is the coefficient in the spatial autoregressive structure for the error disturbance ε .

The spatial error model (SEM) includes a spatially correlated error structure by considering the distinct effect of missing variable in spatial lag error term and by observing heterogeneity in the observation units and sampling pattern.

The SEM model takes the form:

$$y = X\beta + \mu,$$

$$\mu = \lambda W_2 \mu + \varepsilon,$$

$$\varepsilon \sim N(0, \sigma^2 I_n).$$

Inference for these models proceeds in the usual way, by examining the goodness of fit of the models to the data.

RESULTS AND ANALYSIS

The analysis begins with computing a Moran I to measure the spatial autocorrelation (see for detail Chhetri et al 2014). The Moran's I computed for logistics employment is 0.53, which indicate a positive spatial autocorrelation, suggesting observations (LQ values) are spatially dependent. That is, SLAs that are close together have similar LQ values than those that are distant apart. This suggests that there is a prevalence of 'spill-over' tendency, whereby high concentration of logistics employment at a particular area exerts a positive or negative effect on its neighbouring areas. This also suggests the presence of spatial dependence, which essentially requires the use spatial econometric techniques to account for spatial dependence to eliminate over or under estimation of regression coefficients. The spatial econometric models are therefore built to identify the underlying factors that drive the clustering of logistics employment in Victoria.

Data screening has been conducted to meet the assumptions required for linear modelling. Pair-wise inter-correlations between predictor variables were found to be insignificant in most cases ($p < 0.05$).

The analysis begins with building a simple Ordinary Least Square (OLS) linear model that estimates the parameters driving the logistics employment clustering at a Local Area level. A test for residual spatial dependence is conducted to evaluate whether neighbouring values are more similar than they are expected to be. A number of tests based on asymptotic approaches are also conducted to test whether spatial correlation exists in the residuals. The Moran I test, Likelihood Ratio test, and Lagrange Multiplier test are executed to measure the statistical significance of spatial dependence. These tests are based on maximum likelihood estimation.

The presence of spatial autocorrelation in the OLS residuals has been detected. The significant Moran's I ($p > 0.001$) suggests that observations are spatially correlated and are dependent on space. Assumption that spatially adjacent observations are more likely

to affect spatial interactions among neighbouring units than to those located further away. However, the Moran's I test does not capture whether the spatially auto-correlated residuals are driven by spatial process or an error process. Therefore, spatial lag and spatial error model are estimated and the results are compared with Ordinary Least Square (OLS) outputs. It has been suggested that the spatial process is best represented by the spatial lag model, whilst the error process is best estimated through spatial error models with a slight improvement in r-squared value. For the spatial lag model, there is a distinction between the residual and the prediction error. The latter is the difference between the observed value and the predicted value that uses only exogenous variables, rather than treating the spatial lag W_y as observed. For the spatial error, the prediction error is the difference between observed and predicted y , whereas the "residuals" are the spatially filtered residuals. Lagrange Multiplier error (test value 11.725, p 0.0002) and lag (test value 8.64, p 0.0010) tests suggest the spatial lag model is a better fit for this dataset.

Table 2: Spatial Econometric modelling results

	Ordinary least square (OLS)	Sig.	Spatial Lag Model (SAR)	Sig.	Spatial Error Model (SEM)	Sig.
Constant	1.01		1.110		1.122	
Built-up Area	0.015		0.019		0.005	
Landuse mix	0.012		0.022		0.081	
Human capital - Index of Education and Occupation (IE&O)	-0.088		-0.053		-0.059	*
Accessibility to train station	-0.014		-0.001		-0.021	
Road network density	0.98	*	1.21	*	1.03	
Accessibility to Airports	0.083		0.026		0.04	
Accessibility to seaports	-0.091	*	-0.103	*	-0.189	*
Accessibility to Melbourne CBD	-0.801	*	-1.12	*	-0.988	*
Gross regional product	0.251	*	0.124	*	0.142	*
Size of local employment base	0.45	*	0.55	*	0.41	
Weighted Retail potential index	0.023		0.016		0.036	
Index of Economic Resources (IER)	0.781	*	0.895	*	0.763	*
Equalised net worth (ENW)	0.012		0.020		0.019	
<i>R</i>	<i>0.41</i>		<i>0.49</i>		<i>0.45</i>	
<i>Breusch-Pagan LM</i>	<i>0.512</i>		<i>0.522</i>		<i>0.523</i>	
<i>Log Likelihood</i>	<i>-355.21</i>		<i>-201.81</i>		<i>-211.2</i>	
<i>Number of Observations</i>	<i>193</i>		<i>193</i>		<i>193</i>	

Table 2 presents the results of spatial econometric models. The OLS model explains about 41 percent of the variability (an R Squared value of 0.41); whilst the R Square values for the SAR and SEM models are 0.49 and 0.45 respectively. The value of F test for OLS model is 20.1, which is significant (p .000). The coefficients of the model variables are also given in Table 2, where a positive coefficient of a variable means an increase in the LQ value of T&H employment with an increase in the value of that variable. The Breusch-Pagan test was found to be insignificant, thus the heteroscedasticity is not a problem. The Log likelihood value declined from -355.21 for

OLS to -201.81 for the SAR model, which indicates the improved fit for the added variable (i.e. spatially lagged dependent variable).

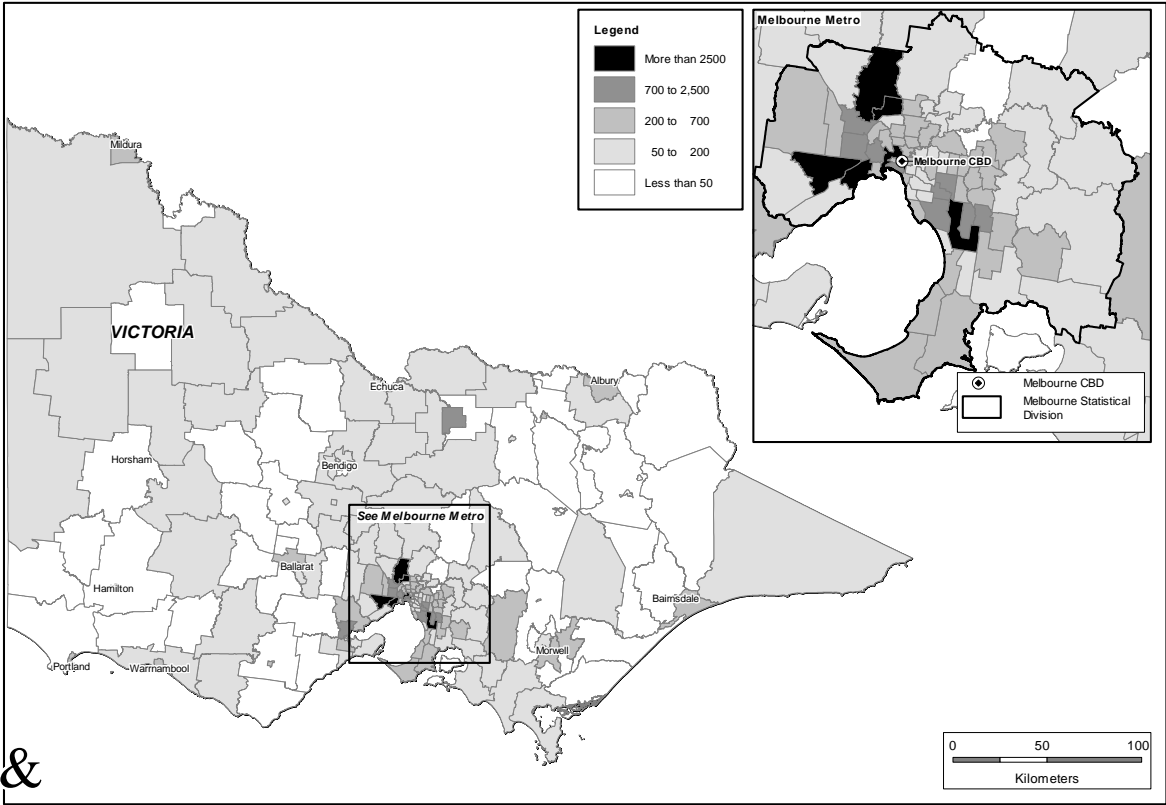


Figure 1: Spatial logistics employment clusters in Victoria, 2006

The results in Table 2 show clustering of logistics employment in Victoria is largely driven by road network density, accessibility to Melbourne CBD and seaports; availability of human capital, and the scale of regional economy. In the spatial lag model, *Rho* emerges as significant and positive. This suggests that the concentration of T&H employment is affected, if not controlled, by spatial processes via 'spill-over' with positive effect on neighbouring areas. In SAR, $Rho (\delta)$ is 0.37, which suggests that if logistics employment to nearest-neighbours of a particular area increases by 1%, concentration (LQ) of logistics employment to that area will increase by 0.37% through the spatial spillover effect. The lambda emerges as a significant and positive in the spatial error model, which suggests the existence of 'unspecified' spatial dependence on residuals between neighbouring areas. Other variables have no significant impact of logistics employment clustering. Demand related variables were not statistically significant, meaning the logistics employment is less likely to be attracted in areas of higher consumption.

CONCLUSION

In conclusion, the development of a spatial methodology enabled the identification of significant spatial logistics employment clusters in the State of Victoria. These spatial logistics clusters in Melbourne are functional trade nodes of high economic activity, which largely represent the conglomerates of transportation, warehousing, high throughput freight distribution centres and intermodal hubs in western parts of Melbourne, around the Dandenong area in the south east and hotspot areas around the airport in the north. The results from the spatial econometric analysis indicate that logistics employment tends to cluster in areas of strategic locations as characterised by access to highways and main roads, proximity to CBD as an employment hub, availability of workforce with required skills, and the size of regional economy within which each area operates.

The concentration of logistics providers within a locale that will inevitably help minimise transport costs and reduce lead-times via effective infrastructure use and skills interchangeability. The implications of this research therefore lie in harnessing the potential associated with agglomeration and multiplier effects through industry clusters in the supply of logistics services. The empirical findings thus support the commonly held notion that the logistics hub could be transmuted into as a growth pole to support regional economies to help stimulate economic growth, generate employment opportunities and create foci of innovation.

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Section 8: Supply Chain Performance Assessment

UNDERSTANDING DRIVERS OF TRADE AND TRANSPORT PERFORMANCE

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ABSTRACT

The World Bank's Logistics Performance Index (LPI) provides comprehensive data on countries' trade logistics performance at the national or regional level. The LPI, used in conjunction with other in-house resources, enables a deeper understanding of the elements that drive logistics performance and those that hinder performance. Collectively and individually, the private and public sector stakeholders have an interest in improving logistics performance and keeping industry profitable and competitive. This study is a first attempt to develop a standardized framework for quantifying the impact of trade and transport policies on the LPI components. This paper presents a preliminary assessment of factors behind the countries' trade and transport performance scores by peer group evaluations and performance comparisons over a variety of different analytical approaches.

INTRODUCTION

Today, the biggest obstacles to international trade are physical, administrative and informal restrictions on the movement of goods. Reductions in supply chain barriers have a larger effect on economic growth and competitiveness than removing tariffs. Improving only border administration and transport and communications infrastructure would lead to an increase of some 4.7% in global GDP, six times more than would result from complete worldwide tariff elimination (WEF, 2013). Freight transport performance is a strong determinant of national economic competitiveness. The comparative efficiency of a country's logistics chain has a vital importance in attracting investment and enhancing industrial competitiveness. In this context, the World Bank's Logistics Performance Index (LPI) provides the most comprehensive international comparison tool to measure the trade and transport facilitation friendliness of countries. Understanding and decomposing the components of trade and logistics performance can help countries to improve freight transport efficiency and highlight where international cooperation is helpful to overcome barriers.

Increasingly respected by policy makers, the LPI has helped significantly in enhancing the dialogue between policy makers and the private sector for determining priorities in trade and transportation facilitation. Collectively and individually, the private and public sector stakeholders have an interest in improving logistics performance and keeping industry profitable and competitive. But making trade logistics work for competitiveness at the country or sub-regional level requires more than just raising awareness. An in-depth multidimensional assessment of the trade and transport performance in relation to the action plans and policies requires a variety of different analytical approaches.

This study is a first attempt to develop a standardized framework for quantifying the impact of trade and transport policies on the LPI components. It employs LPI, in conjunction with other data resources, to acquire a deeper understanding of the elements that drive logistics performance and those that hinder performance. This paper presents a preliminary assessment of factors behind the countries' trade and transport performances scores by peer group evaluations and performance comparisons over a variety of analytical approaches.

REVIEW OF THE EXISTING EFFORTS ON MEASURING LOGISTICS PERFORMANCE

Despite the amplitude of literature on logistics performance measurement, the current state of research on the macro level logistics performance assessment has not been covered adequately in the literature; more emphasis has been placed on the micro level than on macro-national level. Collecting the data related to logistics performance in advance is expensive and there is a lack of a procedural model to systematically evaluate countries using freely accessible secondary data (Valle and Dircksen, 2011). Three major indicators of country-specific framework conditions for shaping logistical processes are given by The World Bank's Logistics Performance Index (LPI), Doing Business Report and Enterprise Surveys, and the World Economic Forum's Global Competitive Index (GCI).

A multi-dimensional assessment of logistics performance, the LPI of World Bank, is an international benchmarking tool focusing specifically on measuring the trade and transport facilitation friendliness of a particular country, inducing them to realize logistics challenges and opportunities it encounters. The LPI summarizes the performance of countries through six dimensions that capture the most important aspects of the current logistics environment: Efficiency of the customs clearance process, quality of trade and transport-related infrastructure, ease of arranging competitively priced shipments, competence and quality of logistics services, ability to track and trace consignments and frequency with which shipments reach the consignee within the scheduled or expected time (Arvis et al., 2014). The LPI provides not only a comprehensive portrait of current logistics assessment worldwide, but also an analysis of performance trends which makes it possible to understand the direction of development over time.

Performance is evaluated using a 5-point scale and the overall LPI is aggregated as a weighted average of the seven areas of logistics performance. The LPI also includes a set of domestic performance indicators which is not included in the overall country score. Domestic assessment is made by the respondents residing in the countries under evaluation, providing information on the quality of infrastructure, the performance of core services, the friendliness of trade clearance procedures, and the time, cost, and reliability of import and export supply chains. It is also complemented with quantitative information on particular aspects of international supply chains in respondents' countries of work, including import/export, lead time, supply chain costs, customs clearance, and the percentage of shipments subjected to physical inspection (Arvis et al., 2012).

The Doing Business Report, on the other hand, evaluates the environment of entrepreneurial activities in terms of legal guidelines and other general conditions. The Enterprise Surveys consider 12 thematic areas but choose to present them as a separate evaluation of 30 indicators rather than as a summarizing index. The GCIs calculation is far more complex because of the broad spectrum of macroeconomic factors upon which it is based. Overall, the index lists 11 indicators relevant to logistical planning (Schwab, 2010).

In addition to these general indexes, three more specific measures are used to evaluate countries' transportation networks: the Liner Shipping Connectivity Index (LSCI) deals with international scheduled ocean shipping, the Air Connectivity Index (ACI) with international scheduled flights and the Rural Access Index (RAI) with road infrastructure in rural areas (Valle and Dircksen, 2011). CSCMP's Annual State of Logistics Reports

estimate annual logistical expenditures in the United States. The study combines data related to three key components to estimate logistics expenditures: inventory carrying cost, transportation cost, and administrative cost.

There exist a number of academic studies to evaluate the macro level logistics performance. Rodrigues et al. (2005) have provided an estimation method to quantify the size of logistics expenditures in a global economy by using secondary data between 1992 and 2003 and neural network methodology. Their model is based on four pillars: total GDP, government sector production, industrial-sector production and the total trade ratio. McKinnon (2009) has assessed the first ten years of the UK Government's "transport key performance indicator (KPI)" program which benchmarks the efficiency of road freight operations. Gupta et al. (2011) have measured the extent of restrictions on trade in logistics services in the ASEAN+6 economies, through the construction of a logistics regulatory restrictiveness index. They also have conducted a preliminary exploration of the correlation between logistics regulatory restrictiveness and logistics sector performance, as measured by the LPI. Balan et al. (2006) have formulated a Supply Chain Management Index (SCMI) with the help of questionnaire survey and analysis over 26 countries from all over the world which were selected randomly on the basis of their economic growth (GDP) in the global market. The difference between the SCMI of underdeveloped, developing and developed nations with respect to the ideal SCMI has been evaluated by using the method of gap analysis. However, neither details of this index nor the development method has been provided. Cooper et al. (1990), with an emphasis upon the users of logistical services, have used five key indicators to develop a picture of logistics efficiency in Europe. They have conducted a series of personal interviews with 54 companies based in Europe, to collect information related to key indicators for logistics performance, namely: Systematic logistics planning, optimized holdings of inventory, rationalized number of logistics service suppliers, good customer service performance, and the prices of logistics services. They have used a simple two level scale, referring to a strength or a weakness of performance under each indicator.

Clark et al. (2004) have identified three determinants of port efficiency, Fink et al. (2002) have constructed a cargo handling restrictions index to capture the restrictions and special requirements imposed on foreign suppliers of cargo handling services. Hausman et al. (2005) have employed the global logistics indicators developed by the World Bank to estimate the impact of logistics performance on the level of bilateral trade. These indicators are based on time, cost, variability, complexity, and risk.

The overview of the current state of research shows that, despite its high importance, establishing a clear relationship between performance indicators and the transport policy objectives, to transform indicator values into relevant actions and linking those actions to past and future development, is not properly addressed in the literature. This paper presents the initial findings of a project which aims at developing a general framework for quantification of the impact of transport policies on LPI components based on a standardized method. It presents the findings of a desk research which gathers background information from both published reports and statistical data sources.

RESEARCH DESIGN

Dataset

The present empirical research is based on indicators of trade logistics quality obtained from several sources. The first source of logistics data is the LPI results across four editions, where each year's scores in each component were given weights: 0.067 for 2007, 0.133 for 2010, 0.267 for 2012, and 0.533 percent for 2014, the most recent data carrying the most weight. This indicator reduces random variation from one LPI survey to another and enables the comparison of 166 countries.

The second data source used in the econometric analysis is the infrastructure component of the *Global Competitiveness Index* from the World Economic Forum's *Global Competitiveness Report* (GCI). It includes an overall measure of infrastructure quality as well as sub-components relating to the quality of air, road, port, rail, telecommunications and electricity infrastructure. The indicators used are for the years 2007 and 2014. Similar to the LPI indicators, the individual components of the GCI infrastructure index are highly correlated amongst each other, but not so between reporter and partner countries.

Finally, we have used some of the data published by the World Bank's *Doing Business: Trading Across Borders* to measure the ease with which countries are able to trade internationally. We select the metrics associated with procedural requirements for exporting and importing a standardized container of goods, such as the number of documents per shipment, shipment times, and trade costs.

The econometric analysis uses cross-sectional data for 98 countries concerning the latest LPI and important logistics indicators between 2007 and 2014. The positive impact of higher quality infrastructure on higher quality trade logistics is well established in previous studies. In this study, we have investigated the relationship between the relative changes in LPI scores and changes in other metrics, to have a better understanding of the drivers of an improvement or a decline in the LPI performance. Because these indices are representatives of the whole logistics industry and macroeconomic situation, direct comparisons among the indices may conceal the specific relationships that exist in direction and amplitude of the performance improvement.

Determinants of the Changes in the LPI

Table 1 presents the results of the Pearson correlation analysis between the GCI and LPI variables. The table shows that Trade Barriers is significantly correlated with Infrastructure, International Shipments, Quality, and consequently, the Overall LPI Score. On the other hand, an improvement on Trade Barriers is not correlated with a change in LPI Customs performance. This is an important result because, even though the direction of the effect is unknown, it is a sign of positive impact of decreasing the non-tariff barriers, which limit the ability of imported goods to compete in the domestic market, on the LPI scores.

	<i>Customs Procedures</i>	<i>Trade Barriers</i>	<i>Exports (%GDP)</i>	<i>Imports (%GDP)</i>	<i>Transport infr.</i>
Overall LPI	-0,05	0,23*	-0,15	0,12	0,16
Customs	-0,14	0,08	-0,02	0,02	0,12
Infrastructure	-0,11	0,21*	-0,04	0,06	0,13
International Shipments	-0,23**	0,24*	-0,32**	0,09	0,10
Quality	0,11	0,24*	-0,18	0,07	0,26**
Tracking and Tracing	0,18	0,16	-0,12	0,20	0,05
Timeliness	0,00	0,07	0,07	0,11	0,07

(** $p < 0.01$, * $p < 0.05$, 97 df)

Table 1- Correlation Matrix of LPI Scores with GCI Scores (%Change 2007-2014)

An interesting result is the negative correlation between the Customs Procedures and the first four LPI related variables, though mostly insignificant. Especially the negative relation between percent change in LPI's Customs performance and percent change in GCI's Customs performance requires detailed study. The only significant negative correlation of Customs Procedures exists with International Shipments. Even though the effect can be explained by the macroeconomic factors which make the services more

expensive in high income countries, cost impacts of simplifying and improving customs procedures requires further analysis.

	<i>Documents to export</i>	<i>Time to export</i>	<i>Cost to export</i>	<i>Documents to import</i>	<i>Time to import</i>	<i>Cost to import</i>
Time to export	0,70**	1,00				
Cost to export	-0,30**	-0,33**	1,00			
Documents to import	0,83**	0,65**	-0,27**	1,00		
Time to import	0,68**	0,93**	-0,35**	0,66**	1,00	
Cost to import	-0,28**	-0,29**	0,75**	-0,33**	-0,32**	1,00

(** $p < 0.01$, * $p < 0.05$, 189 df)

Table 2- Correlation Matrix of Trade Related Indicators (Doing Business: 2013)

The results show that Exports (%GDP) is negatively correlated with almost all LPI scores, but the significant negative correlation only exists with availability of internationally competitive shipments. This is mainly a result of the significant negative correlation between the countries' income level and costs to import and export, as presented in Table 2. High income countries generally provide better quality and simplified customs procedures such as less number of documents. For example, export lead times are twice as long for low-income countries as for high-income countries (Arvis et. Al, 2014), but high income countries have higher priced shipments, possibly because macroeconomic factors generally make services more expensive there.

There is a positive correlation between all LPI related variables and Transport Infrastructure, which is a combined index of the factors listed in Table 3. This table shows that the main determinants of the LPI score are the quality of freight transport related infrastructure, such as port and road quality.

	<i>Quality of Overall Structure</i>	<i>Quality of Roads</i>	<i>Quality of Air Inf.</i>	<i>Quality of Port Infr.</i>	<i>Quality of Railroad Inf.</i>
Overall LPI	0,33**	0,18	0,00	0,32**	0,04
Customs	0,14	-0,01	-0,03	0,22*	0,02
Infrastructure International	0,27**	0,09	0,04	0,31**	0,03
Shipments	0,31**	0,15	-0,01	0,20*	0,11
Quality	0,31**	0,24*	0,09	0,34**	0,13
Tracking and Tracing	0,33**	0,28**	0,02	0,31**	0,08
Timeliness	0,15	0,06	-0,06	0,16	-0,12

(** $p < 0.01$, * $p < 0.05$, 97 df)

Table 3 - Correlation Matrix of LPI Scores with GCI's Transportation Infrastructure Metrics

Development of Logistics Efficient Frontier

We have employed Data Envelopment Analysis (CCR-DEA) model to identify the efficient frontier of countries that might be used as benchmarks and analyse the potential areas of improvement. DEA is a special application of linear programming (LP) based on the frontier methodology of Farrel (1957), advanced by Charnes et al. (1995). A general description of the model may be found in several studies (Weber (1996) and Shafer and Bryd (2000), and a detailed explanation is given in Cooper et. al. (1998) and Sherman and Ladino (1995).

There are numerous variations of DEA models for different purposes. We have implemented a simple input-oriented, single input, multi output model which is based on "Pareto-Koopmans Efficiency". A country is considered fully efficient (CCR-efficient) if and only if it is not possible to improve any input or output without worsening some other input or output (Cooper, 1999), within its reference income group. The model takes six dimensions of the LPI score as outputs and tries to maximize their values against the single unit input criteria. The Farrell efficiency (F_k) for each supplier is obtained using the following model:

$$\text{Min} \quad F_k - \varepsilon \sum_i s_i^+ \quad (1)$$

subject to

$$\sum_j \lambda_j - F_k = 0 \quad (2)$$

$$\sum_j y_{ij} \lambda_j - s_i^+ - y_{ik} = 0 \quad \forall i \quad (3)$$

$$\lambda_j \geq 0, s_i^+ \geq 0, \varepsilon \ll 1 \quad (4)$$

In the model; y_{ij} refers to the levels of performance level of country j on indicator i , (k refers to the country being assessed), λ_j is the reference weight associated with country j ; s_i^+ is the slack variable for performance indicator i , and ε is a very small positive number. A Farrell efficiency value of $F_k=1.0$, with zero slack ($s_i^+ = 0$) for a particular country indicates that the vendor is CCR-efficient compared to the other countries in the model.

The findings show significant differences in logistics efficiency across countries. The average efficiency score of the countries is around 77.8% with the standard deviation of 0.12. As illustrated in Figure 1, efficiency scores obtained by DEA are slightly different than the overall LPI scores. This is mainly because of DEA's nonparametric behaviour which doesn't require a functional form to assign weights to scores. DEA allows the countries to use their relatively better performance on one of the LPI sub-dimensions as a competitive advantage. The least efficient country is Afghanistan with the minimum efficiency score of 56%, even though it is not ranked last in the overall LPI score. Germany, Singapore, Luxembourg, and Netherlands show the best values for overall efficiency with a score of 1. Except Netherlands, all efficient countries have also zero slacks for each input and output in the model.

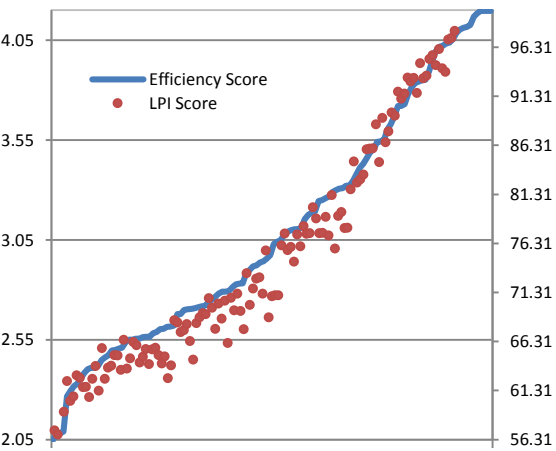


Figure 1-Efficiency and the LPI Scores

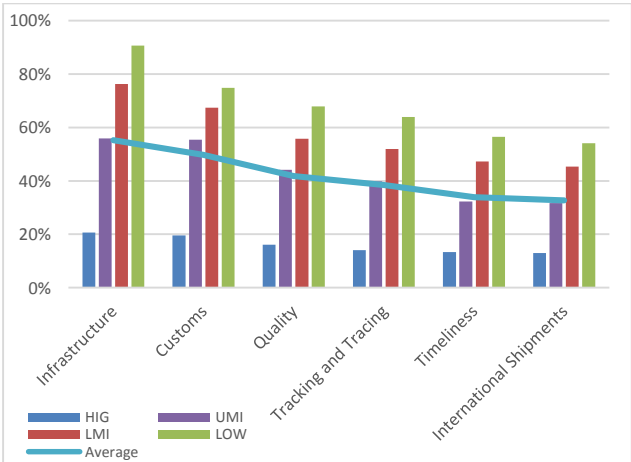


Figure 2-Average Percentage Improvement Levels

Figure 2 illustrates the areas of improvement for inefficient countries, grouped in four major income groups. Findings show that even though there is a modest convergence of LPI scores since 2007 (Arvis et. Al, 2014), which is explained by a perceived improvement in trade supporting infrastructure in low- and middle income countries, infrastructure still remains as the area which requires highest percentage of improvement (55.2%). It is followed by customs and border management and quality of logistics services. The dimension which requires the least amount of improvement is ease of arranging competitively priced shipments, with an average improvement level of 32.7%.

High income countries outperform low-income countries by 53 percent, lower middle-income countries by 42 percent, and upper middle-income countries by 30 percent. To obtain a more consistent comparison and to eliminate the impact of income on the analysis, we have repeated DEA separately under four income groups and identified the outperforming countries in their peer groups with similar incomes. Top performers of each group are illustrated in Figure 3, where the bubble size shows the number of the countries covered in the benchmark set.

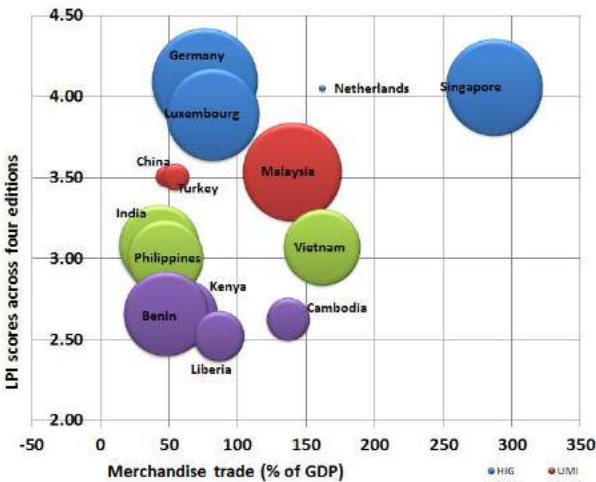


Figure 3- Logistics Efficient Countries in Each Income Group

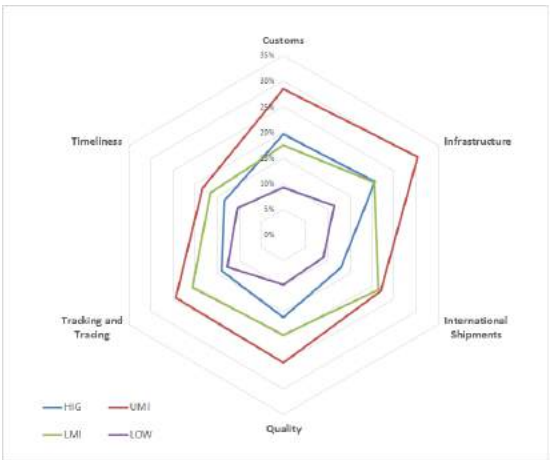


Figure 4-Average Percentage of Potential Improvement for Each Income Group

Analysis under different peer groups of the countries provides interesting results. Figure 4 illustrates the average percentage improvement of each LPI sub-dimension, required for full efficiency for each economical group. Highest improvement levels are observed in upper-middle level income countries, where the gap between the highest and the lowest performers is big. On the other hand, low income level countries presents the lowest level of gap, as a result of relatively similar LPI scores. Besides infrastructure, customs management also appears to be an area of potential improvement, mainly for upper-middle and high income countries. The findings supports the fact that although significant progress has been made, efficient and effective performance is not spread evenly among all customs administrations.

CONCLUSION

For countries, it is important to establish a clear relationship between performance indicators and the transport policy objectives, in order to transform indicator values into relevant action and link them to past and future development. Findings show that even though most aspects of the country’s logistics performance are in line with previous findings, the LPI score is a function of various factors, with complicated associations within structure and time, and improving logistics performance is a complex task which requires comprehensive reforms and long-term commitments from policymakers and private stakeholders.

Further studies will cover identification of the set of policy areas and potential components that affect trade and logistics regulations, procedures, and operations that can be implemented to improve logistics performance systems and a mapping of identified components with the performance indicators associated with LPI dimensions. We aim to develop a general framework for quantification of the impact of transport policies on LPI components which will further be extended to a generic toolkit for managing policy changes, suggest future projects to realize opportunities to remove the trade impediments.

ACKNOWLEDGMENTS

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A FRAMEWORK TO MEASURE LOGISTICS PERFORMANCE OF HUMANITARIAN ORGANIZATIONS

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ABSTRACT

This paper presents a Supply Chain Operations Reference (SCOR) framework for logistics performance measurement in humanitarian organizations as a case study of SCOR adaptation. Initiated by Save the Children International (SCI), a large international humanitarian organization, this paper maps the supply chain processes of SCI and develops a set of twenty-four performance indicators for SCI as well as other similar humanitarian organizations to measure and monitor their supply chain performance. Using both performance attributes and logistics processes as the classification dimensions from SCOR, we develop a SCOR framework in the context of the humanitarian supply chain. Further validation among the humanitarian organizations shows the importance of these metrics as well as the difficulty in their implementation. Only five of the original twenty-four indicators can be readily implemented in most relief organizations based on their existing procedures and practices.

INTRODUCTION

Global disasters have been increasing in diversity, frequency and severity for the past decades. To mitigate the effect of such disasters, humanitarian relief organizations (HROs) across the world are busy saving lives and helping surviving victims in disaster-prone areas where the poor infrastructure often makes humanitarian logistics critical. Today, there is a strong demand for greater effectiveness and efficiency in humanitarian logistics operations as almost 60-80% of the expenses incurred in humanitarian operations are due to logistics activities (Wassenhove, 2006).

To improve the humanitarian logistics operations, performance measurement is the first step. Despite its significance, performance measures and measurement systems have not been widely developed and systematically implemented in the relief chain (Beamon and Balciik, 2008). In addition to the common problems in the non-profit sector such as performance criteria ambiguity (O'Neill and Young, 1988), the inherently unique characteristics of the disaster relief environment make the relief chain performance measurement even more challenging.

This paper attempts to address this research gap and develops a set of Key Performance Indicators (KPIs) which could be used by the HROs in their logistics operations at the country level. We develop a performance measurement framework for the supply chain processes with reference to the Supply Chain Operations Reference (SCOR) model and its associated performance metrics. With the support of Save the Children International (SCI), a large international HRO, we managed to map its relief chain and develop a performance measurement framework for SCI and other similar HROs. Twenty-four KPIs are proposed

based on SCOR, which are then validated by both SCI and the other international HROs participating in the study.

COMMERCIAL AND HUMANITARIAN LOGISTICS PERFORMANCE MEASUREMENT

Vahrenkamp and Siepermann (2005) describe performance metrics as the consolidated quantitative data to measure operations and improvement, which provides a holistic view of the complex structures and interrelations in a system. There are many studies related to supply chain performance measurement with various approaches, different objectives, and industrial settings (Garcia et al., 2012). To measure the performance of a supply chain systematically, reference process models, representing a specific ordering of work activities across time and place, could be valuable tools (Verdouw et al., 2010). SCOR, developed by the Supply Chain Council (SCC), is one of the most popular reference process models used in supply chain management. It uses benchmarking and best practice data to prioritize the supply chain activities, quantify the potential benefits of specific process improvements, and determine financial justifications (Stewart, 1997).

In the context of humanitarian logistics, performance measurement is equally crucial. Developing the right performance measurements can assist a humanitarian organization to better measure the impact of disasters, enhance preparedness and as a result alleviate the impact of such disasters, and ultimately efficiently manage donor funds to maximize the assistance to the beneficiaries (Beamon and Balcik, 2008).

While most performance measurement frameworks in humanitarian organizations are borrowed from the commercial world, Henderson et al. (2002) have argued that many commercial performance metrics are not applicable to humanitarian organizations, for example, the “bottom line” measurement of profit /loss. Davidson (2006) has proposed a framework of four performance indicators, namely, appeal coverage, donation to delivery time, financial efficiency, and assessment accuracy. The study also reported that the HROs are not accustomed to performance measurement, making the implementation of such a framework more challenging. Beamon and Balcik (2008) have also proposed a performance measurement framework for HROs after comparing the differences between commercial and humanitarian organizations in areas such as revenue, goals, stakeholders, and performance measurement. They proposed a three-part framework performance measurement system focusing on resource performance metrics, output performance metrics, and flexibility metrics. Recently, Blecken (2010) has presented a supply chain process modelling method to measure the performance of HROs.

In summary, performance measurement in the humanitarian organizations is less established compared to the commercial world. While there are some well-known generic frameworks for commercial firms such as the SCOR model, there is no universally accepted performance

measurement framework for humanitarian organizations and it is difficult to develop the appropriate metrics (Tatham and Hughes, 2011). Moreover, many humanitarian organizations do not have appropriate performance measurement metrics, and those that do tend to make the mistake of employing too many metrics (Sawhill and Williamson, 2001), which in turn stretches their resources in data tracking and maintenance. Another challenge seen in many a humanitarian organization is the lack of data and a proper system to capture the needed information at all levels uniformly. Additionally, the data standard and quality vary from country to country and there is no consistency in the data definition across the different organizational functions, creating much difficulty in the development of a proper performance management framework.

RESEARCH METHOD

The objective of this paper is to develop a performance measurement framework for supply chain processes in humanitarian organizations, and propose key measurement metrics using an appropriate supply chain tool. The study is thus conducted in three stages. The first stage is the selection of a reference process model. Based on our literature review and a discussion with the experienced field professionals from the HROs, we decided to adopt SCOR as the core reference model. SCOR has been in existence since 1996 and is a comprehensive framework that links processes, metrics, best practices, and technology into a single structure in the commercial world. In the context of SCI, it needs a generic and flexible tool to support its on-going consolidation process in its various country branches. The overall operation processes in these branches are adequately covered by SCOR.

In the second stage, we develop a KPI framework as a generic measurement of the humanitarian supply chain. An overarching map of the existing supply chain processes in SCI is generated against the generic process framework in SCOR. As there are three generic levels in SCOR, the mapping is done at the three levels respectively. At the same time, we identify the relevant performance attributes based on the HROs' inputs as the other dimensions of the framework. We then screen all performance metrics on these attributes from Level 1 to Level 3, so as to develop the metrics relevant to humanitarian logistics activities. Suitable metrics are selected and adapted through a two-pronged process of elimination and identification. The method we use is a combination of the literature scan, industrial knowledge from the commercial world, and feedback from SCI. We compare the existing KPIs used in the other HROs as well if this information is accessible. During this process, our primary focus is on the high impact areas that are closely linked to the HRO's objective of "value for money" and have the potential to deliver tangible benefits. A generic supply chain process and an initial set of KPIs are proposed at the end of this stage.

In the third stage, we validate the draft KPIs with the other HROs through face-to-face or telephone interviews with key logistics personnel in the field, regional centres, and

headquarters to elicit their feedback on the validity, availability, and quality of the input data. During the validation process, we seek to understand if the current system (i.e. procedures, reports, tools, and forms) in an HRO is capable of capturing the needed data as well as the degree of data integrity and quality. We thus differentiate the KPIs into two categories: (i) KPIs that are measurable immediately and should be implemented, and (ii) KPIs that are not measurable immediately and would only be implemented in the future. The validation process was conducted through organizational and personal contacts. A questionnaire was sent out to the HROs, both large and small, and both religious and secular ones.

PROPOSED FRAMEWORK

To develop a set of logistics performance indicators, we use both the performance attributes and logistics processes developed above as the classification dimensions. The five performance attributes in the original SCOR model, namely, reliability, responsiveness, agility, cost, and asset management, were carefully evaluated. In the context of humanitarian logistics, all attributes except asset attribute are important. Reliability or quality is a key requirement of any supply chain. Measuring the reliability of logistics processes and products is a way to improve these processes. Responsiveness or timeliness is related to the response time of the supply chain, a key aspect in humanitarian operations. Cost is the chief measure of logistics financial performance, and all three attributes are widely used in the literature (Garcia et al., 2012). Agility or the chain's response to demand surges is a critical aspect in emergency relief operations. Only asset management is less important as the HROs are normally asset-light without manufacturing facilities or other high-value fixed assets. SCI also views the performance attributes related to reliability, responsiveness, agility, and cost as relevant to achieving its objective of "value for money". We thus adopt the four performance attributes from the SCOR model: reliability, responsiveness, agility, and cost.

On the logistics processes, likewise, we adopt the SCOR processes in the context of humanitarian operations. We take SCI (and other similar international HROs) as the focal company in our analysis and focus on the supply chain processes under SCI's control. The delivery processes at the ground level are thus not covered. In order to make the performance measurement framework manageable, considering the complexity of the humanitarian supply chain, the generic catalogue of indicators or KPIs is structured in a hierarchy of three levels, consistent with the SCOR model (SCC, 2010).

At Level 1, the original SCOR processes are plan, source, make, deliver, and return. In the context of humanitarian operations, the HROs normally do not manufacture humanitarian goods and collect any return relief items. We thus remove the make and return processes and add store to highlight the storing process in relief operations. The processes under the Level 1 of the framework are therefore plan, source, store, and deliver. Here, plan includes the activities to balance the demand and supply in developing the best plans to meet the

sourcing, inventory and delivery requirements. Source includes the activities to source and procure goods and services to meet demand from the ground. Store includes the activities to receive and inspect goods as well as to store and dispatch the stocked goods. Delivery includes the activities related to the management of the received goods as well as the delivery of goods from the HRO.

The KPIs at this level contain the indicators that reflect the overall performance of the HRO. These first level indicators will show the result of the efficiency of the HRO along the supply chain, and the combined use of these indicators will help to assess the overall logistics performance of the HRO on the aspects of reliability, responsiveness, agility, and logistics costs. In total, four KPIs: perfect order fulfillment, order fulfillment cycle time, upside supply chain flexibility, and supply chain management cost, are adopted at this level.

At Level 2, the processes plan and source are further decomposed into four sub-processes, P1 (plan source), P2 (plan store), P3 (plan delivery), and P4 (plan for good-in-kind (GIK, goods given by donors directly)); S1 (source for goods intended for storage), S2 (source for goods intended for immediate distribution), S3 (source for GIK intended for storage), and S4 (source for GIK intended for immediate distribution). Figure 1 shows the Level 2 processes in SCI.

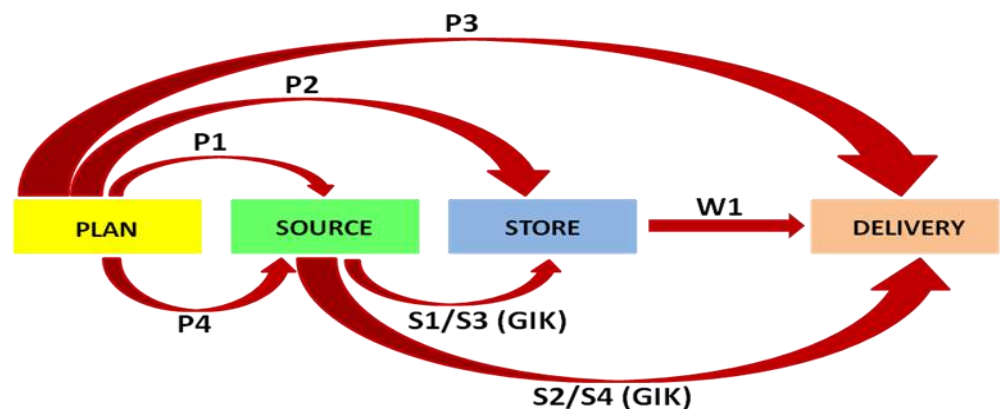


Figure 1: SCOR Level 2 model for SCI's supply chain

A total of thirteen KPIs: percentage of goods delivered in full, percentage of goods delivered on time, documentation accuracy, perfection condition percentage, sourcing cycle time, assembly cycle time, delivery fulfillment cycle time, upside source flexibility, upside delivery flexibility, cost to plan, cost to source, cost to deliver, and supply chain risk mitigation cost, are adopted at Level 2. Most of the KPIs adopted at Level 2 are closely related to the KPIs adopted for Level 1. For example, the three KPIs on cycle time (source, assembly, and delivery) are closely related to Level 1 KPI "order fulfillment cycle time" to measure the chain's responsiveness along the three different processes.

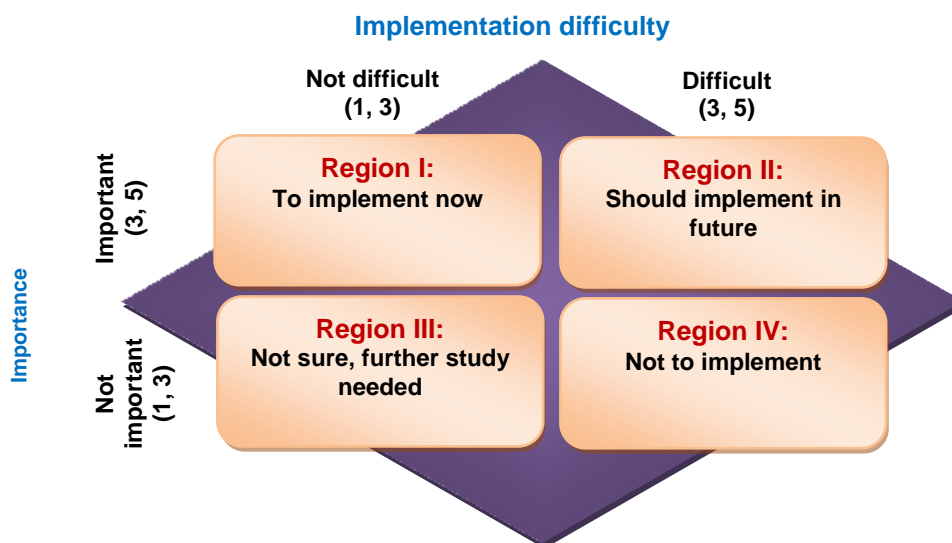
Similarly, at Level 3, the main supply process processes are mapped according to the SCOR processes while all administrative procedures and the details of the last mile delivery processes are excluded. Further, we adopted several KPIs at Level 3 to measure the related Level 3 processes. Since the focus of the study is an HRO's logistics performance at the country level, we only adopt nine important Level 3 KPIs, seven of which are measuring some high impact aspects with potential to deliver the tangible benefits to the HRO, including the risk mitigation plan, in stock percentage, external event response, on-hand inventory, purchase order cycle time, cost to manage inventory, and cost to manage chain performance. The other two KPIs, "store documentation accuracy" and "delivery documentation accuracy", are more detailed measures of the Level 2 KPI "documentation accuracy" and can help in the analysis of that Level 2 KPIs.

KPI VALIDATION AND ANALYSIS

Among the total 26 KPIs proposed thus far, we remove two Level 1 KPIs to avoid duplication between the levels. The two removed KPIs, "perfect order fulfillment" and "supply chain management cost", are well represented by their respective Level 2 components.

Next, we surveyed thirteen international HROs, and received seven responses between May and June 2013, yielding a response rate of 54 percent. Among the seven respondents, two are from SCI's branches (one in Indonesia and one regional office), three are from the large HROs, while the other two respondents are from the smaller international HROs. The respondents are asked to evaluate the **importance** and **implementation difficulties** of each KPI with a coupled five-point Likert scale ((1, 1) = (not important at all, not difficult at all) and (5, 5) = (very important, very difficult to implement)).

Figure 2: Strategy for KPI implementation



Based on the survey feedback, we first classify the 24 KPIs into four quadrants of a 2x2 matrix of importance versus difficulty. Clearly, the proper strategy for the KPIs in Region I is to implement them, and the reasonable strategy for the KPIs in Region IV would be not to implement these KPIs. The strategies for the KPIs in Region II and Region III are trickier. For the KPIs that are important but difficult to measure, the HROs may need to explore possible means to measure them, and the strategy would be to implement in future. For the KPIs in Region III, the strategy is unclear. The HROs may need to examine these KPIs individually to decide whether to measure them or not. Figure 2 summarizes the strategies.

Based on the strategies in Figure 2, we explore the strategies for the 24 KPIs. From the initial results, all the KPIs are in either Region I (5 KPIs) or Region II (19 KPIs), thus the strategic choice is only between implementing now or later.

As all the KPIs are valued as important, we further differentiate the KPIs by importance into two groups, highly important (average importance score of at least 4 and higher), and less important ones (average importance score of between 3 and 4). We can then divide the 24 KPIs into four sub-groups by importance and implementation difficulty as shown in Table 1.

Highly Important (4,5)	% goods are delivered in full and on time (L2); Current on hand inventories (L3); Source cycle time (L2); Current purchase order cycle time (L3)	Three KPIs on Documentation accuracy (3 to 5, L2 or L3); Perfect condition % (L2); Order fulfillment cycle time (L1); In stock % (L3); External event	Cost to plan (L2); Cost to source (L2); Cost to delivery (L2); Supply chain risk mitigation cost (L2)
Relatively Less Important (1,3)		Risk mitigation plan (L3); Assembly cycle time (L2); Delivery cycle time (L2)	Upside supply chain flexibility (L1); Upside source flexibility (L2); Upside delivery flexibility (L2); Cost to manage
	Not difficult (1,3)	Some difficulty (3,4)	Very difficult (4,5)

Table 1: KPI matrix by importance and difficulty

The first sub-group (upper-left) consists of KPIs that are highly important (score 4 and above) and easy to measure (score below 3), which can be implemented quite quickly. The five KPIs in this sub-group include two KPIs on reliability (“percentage of orders delivered in full” and “delivery performance to customer commit date”), one KPI on responsiveness (“source cycle time”), and two KPIs on agility (“current on hand inventories” and “current purchase order cycle times”). The first two KPIs can be combined as one index to measure the delivery reliability, GOTIF (goods are delivered in full and on time). Thus we have four KPIs as a start. From the feedback, some HROs feel that GOTIF could be difficult to measure for last mile delivery. Thus we have to add a constraint that this KPI is limited to the delivery of supplies. Similarly, “source cycle time” and “current purchase order cycle time” refer to the procurement process. The two KPIs are similar, but the former includes the time for internal order processing while the latter refers to the suppliers’ lead time only.

The KPIs in next sub-groups (upper-middle) are highly important (score 4 and above) but are somewhat difficult to measure (score between 3 and 4). The eight KPIs include four KPIs on reliability (three KPIs on documentation and KPI “perfect condition percentage”), three KPIs on responsiveness (“order fulfillment cycle time”, “In stock percentage”, and “external event response”), and one KPI on cost (“cost to manage product inventory”). The KPIs in this sub-group is the focus of our study as these KPIs can be implemented based on the existing reporting systems in the HROs with some modification. For the four KPIs on reliability, the difficulty in measuring the three KPIs on documentation is the lack of records as well as the difficulty in validating the KPIs. The KPI “perfect condition percentage” faces a similar problem in implementation. For the first two KPIs on responsiveness, the measuring difficulty also lies in the order data checking and tracking. The other KPI on responsiveness is more related to the demand data estimation.

The third sub-group (upper-right) consists of highly important KPIs but the most difficult to measure. There are a total of four KPIs in the group, and are all related to cost. It shows that the current financial system in the HROs does not fit with the typical costing used for supply chain operations. It would be important for HROs to develop more relevant measures on these KPIs though it may take time and effort due to the difficulty in measurement.

The KPIs in the last sub-group (lower) comprise the less important KPIs but are also difficult to measure. These KPIs are not a priority in this project unless improvements to the system can make them easier to measure.

CONCLUSION

The concept of a performance measurement framework is well established in commercial organizations but this generally lags in humanitarian organizations. Most humanitarian organizations recognize the importance of establishing a suitable performance measurement system and the positive results it brings to their organization. Transferring the know-how and experience in performance measurement from the commercial to humanitarian organizations makes good sense. The SCOR model, being a framework that links business processes, metrics, best practices and technology to improve the effectiveness of supply chain management, is a logical next step in the evolution of performance measurement in the humanitarian organizations.

This paper delineates how the SCOR framework can be adapted for the humanitarian supply chain. With the support of SCI and the other HROs, we managed to map the supply chain processes of SCI and develop a set of twenty-four practical KPIs for SCI and the other HROs to measure and monitor supply chain performance effectively. These metrics cover the key elements of quality, time, and cost in humanitarian supply chains, and assist the HROs to measure their performance in terms of agility, responsiveness, reliability and cost effectiveness for the entire supply chain process. More importantly, through these metrics, the HROs are able to benchmark internally against the previous periods, externally with the other HROs and set realistic objectives with quantifiable goals, all of which support their continuous improvement effort journey.

The validation of the KPIs with the HROs shows the importance of these KPIs as well as the difficulty in their implementation. Only five KPIs of the original twenty-four indicators can be readily implemented in most of the HROs based on their existing procedures and practices. As such, the HROs need to improve on their supply chain management by integrating their internal procedures across other operations functions such as finance, awards management, and distribution activities. Such an integration attempt may lead to more effective measurement of their logistics performance, including supply chain cost estimation. Though the sample size is rather small for the generation of the results, further empirical study comparing countries with huge logistics expenses and countries with small logistics expenses may improve our understanding of the framework as well as the twenty-four metrics.

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DOES COLD CHAIN COLLABORATION REDUCE FOOD WASTAGE? AN AUSTRALIAN CASE STUDY OF A FRUIT AND VEGETABLES COLD CHAIN

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ABSTRACT

Food wastage is a serious problem. It is reported that as much as one third of all food produced globally for human consumption, which equates to 1.3 billion tons per annum, is lost in the distribution process. Reducing food wastage through efficiency improvement in the cold supply chain is regarded as one of the most feasible solutions to the problem.

This paper investigates how collaboration in a fresh fruit and vegetable cold chain can improve operational efficiency, thereby helping reduce perishable food wastage. The collaboration between a distribution centre of a large supermarket chain in Australia and the growers / suppliers in the operation of a fruit and vegetable cold chain was used as case study for investigation. The findings reveal that collaboration improves sharing of information and knowledge, helps standardize processes and procedures, sets benchmarks and key performance indicators for monitoring, and provides training and investment opportunities for efficiency enhancement. These practices result in better performance of the cold supply chain than that of the pre-collaboration situation. Consequently, food wastage has been significantly reduced.

INTRODUCTION and BACKGROUND

Food wastage is a critical global issue. As much as 1.3 billion tons or one third of all food produced for human consumption is lost before or after it reaches the consumer globally (Gustavsson et al., 2011), perishable products being the most vulnerable. In Australia, for example, four billion Australian dollars at retail value were lost in 2010 from perished fresh fruit and vegetables due to the breakdown of the cold chain system (IBIS World, 2010). The importance of food and its contribution to feeding the burgeoning population, which is expected to reach 9.2 billion by 2050 (UN Report, 2007), has prompted numerous avenues to arrest food wastage. Cold supply chain (or cold chain in short) using refrigeration technology, which helps preserve the freshness of post-harvest fresh food from source to consumption, is often used as a means to reduce food wastage during the distribution process.

Cold chain helps preserve quality of perishable products through temperature control, traceability monitoring, and agility enhancement throughout the chain. Temperature control is most critical. Deficiency, abuse or fluctuation of temperature in the cold chain not only increases the deterioration through decay or aging of the product but can also trigger safety problems (Raab et al., 2011; Kader, 2005). Transparency and agility are two other important elements of cold chain operation. While the former is achieved through traceability systems, quality and place of origin labelling initiatives, the latter refers to the manoeuvrability and quick response needed to

meet the changes in demand in terms of both volume and variety (Christopher, 2000). Agility in the cold chain increases consumer satisfaction as a result of keeping quality and freshness of products, continuity of supply and reduction in product losses (Montanari, 2008). These features are the main criteria that differentiate the cold chain from the ambient supply chain as shown in Table 1.

Table 1: Comparisons between a cold chain and a non-perishable goods ambient supply chain

Properties	Ambient Supply Chain – non-perishables goods	Cold Chain – perishables goods	Challenges faced by Cold Chain
Nature of Goods	Temperature insensitive	Temperature sensitive	Temperature controls
Type of Goods	Usually for external use	Usually foods and orally ingested products	Safety and security critical
Time sensitive	No time constraints; Monitoring not needed; No issues with delays in arrivals at destination	Susceptible to time; need monitoring; delays affect quality	Minimum delays
Perished/Degrade	Not easily perished	Perished easily/can downgrade or deteriorate	Product useless if perished or deteriorated
Transport	Ordinary transport	Specific/specialised transport medium with temperature control/monitoring facilities	Availability of such transport medium is limited
Products transported	Different products can be transported	Specific products with temperature sensitivity	Optimisation – different products need different temperature surroundings
Traceability	Not much intense traceability needed	Needs to be monitored and identified	Ascertain freshness and integrity of product

However, fragmented operation and lack of coordination often lead to deficiency, abuse or fluctuation in temperature control along the cold chain resulting in bruising, rotting, aging and wilting of the perishable produce hence a large amount of wastage. Inadequate investments in new technologies, poor maintenance of refrigerated storage facilities, and lack of consistent and standardised operational practices have significantly contributed to this temperature abuse (Yahia, 2008). To overcome these difficulties, it is believed that cold chain collaboration would allow companies to leverage the expertise and experience of others on an operational basis so that together they perform better than they do separately. Such collaboration also provides opportunities for investments among the collaborating partners.

Through the examination of a fruit and vegetable cold chain in Australia, this paper attempts to answer the following questions about collaboration and food wastage:

- i. Can collaboration help improve operational efficiency through better temperature control, traceability mechanisms and enhanced agility across the entire cold chain?
- ii. How does cold chain collaboration drive excellence in practice through improved information sharing, integrated and standardised processes and procedures, aligned performance measurement and joint planning and investment in infrastructure as reported in the literature?

COLD CHAIN COLLABORATION

Like other supply chains, strong cold chain performance depends on good collaboration among partners which is built on relationships, trust and intention to work together. By definition, collaboration is a set of interdependent companies working closely together to manage the flow of goods, information and funds to offer superior customer value at the least cost (Fearne et al., 2006; Simatupang and

Sridharan 2002) and hence offer substantial benefits to the partners (Mentzer et al., 2000). Collaboration allows companies to leverage on each other on an operational basis so that together they perform better than they did separately (Min et al., 2005). Collaborating firms share risks (Kogut, 1988), access complimentary resources (Park et al., 2004) and enhance productivity, profit performance and competitive advantage (Kalwani and Narayandas, 1995; Mentzer et al., 2000).

Collaboration will also help sustain investments in storage equipment, infrastructure, information systems, and standardisation of practices without particularly putting the burden on any one player. This view is well supported by many management theories such as resource-based view (RBV) (Barratt and Oke, 2007) and network theories (Axelsson and Easton, 1992). RBV Theory claims that investing in relation-specific assets enables partnering firms to build competitive advantage because of their rare, valuable and difficult to imitate nature (Barney, 1991). Network Theory states that firms can gain stronger competitive edge by working cooperatively than by operating individually (Axelsson and Easton, 1992). Networks with long term supply chain relationships featuring trust and knowledge sharing can deliver lower business costs than firms operating on their own. Partners in a cold chain can gain stronger competitive edge by pooling inter-firm efficiencies. Collaboration also helps to drive up market shares, sales and product development while maximising the profits and returns on investments (Simatupang and Sridharan, 2002). This is achieved by consistent information sharing, decision synchronisation, incentive alignment and coordinated mechanisms of risks and rewards sharing (Simatupang and Sridharan, 2004). Improved business relationships encourage information exchange, conflict resolution and co-innovation between business partners (Min et al., 2005).

For collaboration to be successful, a range of disciplines in the cold chain management must be strengthened and work diligently. Some of them include (a) standardisation of processes and procedures where all collaborating partners follow set methods in dealing with the commodity, (b) setting of benchmarks and key performances to ensure all activities are fairly measured for a share of rewards, (c) training and knowledge enrichment which ensures that the entire cold chain network operates in the same wavelength, and (d) providing optimum environment for investment resulting in operational excellence and providing climate for fair share of returns on investments (Raab et al., 2011). These needs force cold chain members to re-strategise to include cooperation and collaboration with demand aligned objectives, open communications, sharing resources, risks and rewards. Such alignment allows synchronised actions along the chain which build capabilities, relationships and trust. Furthermore, collaboration via a trust culture leads to learning and innovation mentality which can be shared across the entire network, promoting team strength. This team strength helps develop relationships and foster better work environment leading to an efficient, effective, robust and caring cold chain.

METHODOLOGY

This study attempts to investigate how cold chain collaboration can help reduce food wastage through efficiency improvement. Owing to the explorative nature of the research, the case study methodology was used to collect both qualitative and quantitative evidences, looking at the organisational, processes and people aspects of collaboration. One of the major supermarket cold chains in Australia with well-developed cold chain operations was studied for the presence of collaboration and

the extent of fruit and vegetables loss. Qualitatively, key personnel in its cold chain distribution centre (DC) who make decisions in the cold chain operation were identified and interviewed to investigate the drivers and the challenges for collaboration. Quantitatively, temperature monitoring and agility data were collected and analysed. This enabled an objective comparison between the actual performance in the receipt and inspection of the four vegetables and the four fruits identified for study and the agreed operation procedures between cold chain partners. Apart from the supermarket, farmers/growers supplying to the supermarket were also approached to study their understanding and implementation of cold chain functionalities in the growing and handling of fruits and vegetables. These were conducted through semi-structured interviews and on-site observations.

Data collection was carried out at the DC in early morning when the trucks carrying the goods from the growers arrived. Temperature tests and traceability tests in terms of labelling and farm/grower details were observed and compared with the accompanying documentation. Descriptive statistics and within-case analysis were used to ascertain if the temperatures on receipt are as per standards. Within-case analysis was also used to analyse the information collected in semi-structured interviews with DC managers and farmers/growers. The objective was to study the DC's cold chain operations in detail concentrating on the main features and looking for emerging trends, shortcomings or unique work cultures as a way to identify the drivers and the challenges.

FINDINGS

i) Supermarket

The DC fulfils orders, distributing over one million cases per week to the supermarket's stores nationwide. It basically operates with two sections – the incoming and outgoing sections. The incoming section takes care of goods that arrive from the vendors (growers/suppliers). These goods have to be in agreed and approved conditions before they are accepted. They undergo rigorous scrutiny including visual and temperature tests, which are conducted on all goods received at the DC, before acceptance. Vegetables and fruits perish easily and need special attention and care in handling and during transportation and storage to ensure they are not damaged, bruised or wilted. Prior to collaborating directly with the farm/growers, the supermarket sourced its supplies from a wholesaler which served as a middleman. Table 2 summarizes the differences in operation between the two scenarios as reported by the DC managers during the interviews.

Table 2: Cold chain attributes between a wholesaler-sourced and direct-sourced environment

		Sourced from Wholesaler (without collaboration)	Sourced directly from Suppliers (with collaboration)
1	Temperature control	- no control - produce from various suppliers	- controlled through agreed specifications - use only approved suppliers
2	Traceability / monitoring	- unable to trace origin of product	- identified through packaging, date of harvest, expiry dates, certificate of assurance
3	Agility	- minimum shipment details or information	- reduce transport time from farm to DC - under temperature control situations, able to supply to supermarket shelves fresher and better quality products
4	Costs	- middleman costs and handling unavoidable, hence higher costs	- avoid middlemen costs - lower costs - competitive prices to consumers
5	Quality	- no control, produce from various sources	- agreed specifications ensure quality for size, colour and eating quality - Quality Assurance program ensure best practice standards and regulations are complied

The four vegetables (broccoli, cauliflower, bok choy and wombak) and the four fruits (strawberry, raspberry, grapes and mangoes) identified for investigation on temperature controls were selected due to their easy perishable nature. In a typical example, 25 temperature readings each of the 4 produces being researched were observed. They had been delivered from the suppliers/farmers to the DC in the duration as stipulated in the specification which means they arrived on time, thus illustrating the on-time agile delivery. Using descriptive statistical analysis, the mean and standard deviation of the temperatures were calculated. As shown in Table 3, the temperature readings upon receipt were well within the parameters agreed between the supermarket and the supplier and the standard deviations indicate the closeness of these readings to the mean temperatures for each product. This suggests a good collaboration between the parties as there is shared interest to get it right as otherwise the consequences can be rejection and waste.

Table 3: Temperature recordings of the incoming vegetables and fruits investigated

	Vegetables				Fruit			
	Broccoli	Cauliflower	Bok Choy	Wombak	Strawberry	Raspberry	Grapes	Mangoes
Specs	0-5 deg	0-5 deg	0-5 deg	2-6 deg	2-6 deg	2-6 deg	3-6 deg	13-18 deg
Max temp among 25 readings	2.90	2.60	2.90	2.15	2.90	2.65	3.90	15.20
Min temp among 25 readings	1.15	1.20	1.00	1.00	2.00	2.10	2.40	13.60
Mean/average temp for 25 readings	2.11	1.90	1.68	1.65	2.32	2.34	3.34	14.47
Standard deviation	0.51	0.43	0.36	0.32	0.24	0.17	0.38	0.37

According to the DC managers, the cycle for vegetables and fruits starts at the procurement department at the supermarket's head office where procurement managers/buyers, based on forecasts received from its retail outlets and from historical sales offtake figures, place orders on suppliers in its supplier lists. Stringent supplier approval/selection processes are in place for all suppliers of the supermarket. The meetings with suppliers detail, among others, the product specifications of the items to be sourced from the suppliers, their storage and transport methods and temperatures, the packaging involved and duration in transit. At the DC, all goods received are assessed and approved in accordance to the product specifications agreed. Assessment methods which include visual appearance, sensory, shape, maturity elements, agreed temperature parameters (inspected using temperature probes), accepted certificate of analysis details are employed and all details are recorded and records stored for future references.

In terms of driver for collaboration, buying direct from the farmers/producers, without going through the middlemen, ensures a better return to local farmers. It keeps the costs down and prices competitive for the supermarket as well. Dealing directly with suppliers also reduces time taken to transport from the farms to the supermarket shelves (agility), resulting in fresher and better quality products through careful temperature control and traceability mechanisms. Such arrangements also help the supermarket to be in control of processes, standards, specifications and quality. It also gives the supermarket exclusivity. Although vegetables and fruits are basically generic, the place where they are grown and the growing process determines the taste, colour and appearance to which the supermarket can claim bragging rights. These findings suggest that cold chain collaboration does provide various positive incentives to all chain members and hence can be a growing trend in the fruit and vegetable retailing industry.

ii) Growers/Farmers

According to the growers/farmers interviewed, collaborating with the supermarket enables them to change their business outlook internally on methods and operations and externally to align with retailer/consumer wants to deliver more value. Through continued collaboration, relationship has strengthened from mainly transactional partnership (Duthie et al., 2012). The growers have picked up from the supermarket the rigorous testing methods such as shelf life testing, chemical testing, maturity testing and at various points, have incorporated the HACCP and Freshcare standards. Such tests and assurances were not strictly or loosely enforced or conducted prior to the collaboration. Upon collaboration, mandatory documentation processes have been put in place to better control product quality and maintain traceability. They include (i) growers consignment with summary of type of product / quantity / size / grade and date packed (ii) Department of Primary Industries plant health certificate with appropriate Interstate Certification Assurance treatment program recorded (iii) pallet movement or transfer declaration and (iv) a transport manifest. In addition to these, bar coding for primary/secondary packaging of products were introduced in collaboration with the supermarket. The bar coding process has now become a routine for the growers to sort their harvest and pack them before pre-cooling and moving into the refrigerated warehouse for storage before shipment to the retailers, both local and inter-state.

Cold chain management is imperative to all growers. There are many variables in how this is managed, which include characteristics of the product, distance to destination, customer specifications and whether services other than cooling are required (i.e., ripening, fumigation, etc.). Characteristics of the product include at what temperature the goods must be maintained at, how quickly does this temperature need to be achieved in order to maximise the shelf life potential, what other products can and cannot be mixed together either in transit or in storage, duration that the goods can and will be stored for are some of them. It is a common understanding that better working knowledge of the cold chain has helped to reduce food wastage, including fruit and vegetables. The players in the chain – growers, transporters and retailers – collaborate all the time as there is a shared interest in getting it right.

THE COLLABORATION CYCLE

Based on the findings of this study, a collaboration cycle between suppliers and retailers of a fruit and vegetable cold chain can be envisaged. In a collaborative environment, knowledge and skills sharing is an exceptionally complex system of information exchange by which internal and external conditions are monitored. Taking the case company as an example (Figure 1), the interchange of knowledge sharing in the cold chain collaboration process commences at the consumer level as in all goods and services sales sectors. The consumers determine the likes and preferences through their buying/consumption patterns. These signals are picked by the retailers who then decide on the products to be sold. Subsequently, in liaison with the Quality Assurance team, product specifications and standards are prepared. Suitable suppliers from an existing list or new suppliers are identified and called for interview to ascertain if they can support the new products at the specifications and standards levels. The suppliers in turn state their skills and capability in supplying the products and share their knowledge of the products, thus information exchange is established and where needed, the standards and specifications are amended. These suppliers then go through the Quality Assurance audits to ensure they comply with the best practice standards and regulations. Once the supplier is finalized and the specifications and standards are agreed, they (specs and standards) are

approved and become the basis on which all deliveries and requirements are based on. The operation at the distribution centre leverages the knowledge and skill sharing among the different parties involved in the process to achieve better temperature control, traceability and agility of the perishable products. This ensures shorter lead time, higher quality of products hence better food safety, and longer shelf lives of products at retail outlets. These improvements help increase customer satisfaction and confidence in the products. As captured in Table 4, the knowledge and skill sharing through collaborative efforts on the part of the retailers, transporters and suppliers ensure that good, acceptable and quality products move along the cold chain. It also allows other processes to take effect – performance measurements of all parties that ensure all 'signatories' to the specifications and standards follow the accepted guidelines; where necessary, planning and investments in infrastructure are made - examples being new cold room facilities, transport or even training for the farmers/suppliers and new strains of seeds and seedlings. These coordinated and collaborative activities drive cold chain excellence, benefitting all parties – farmers/growers, transporters, retailers and ultimately, the consumers.

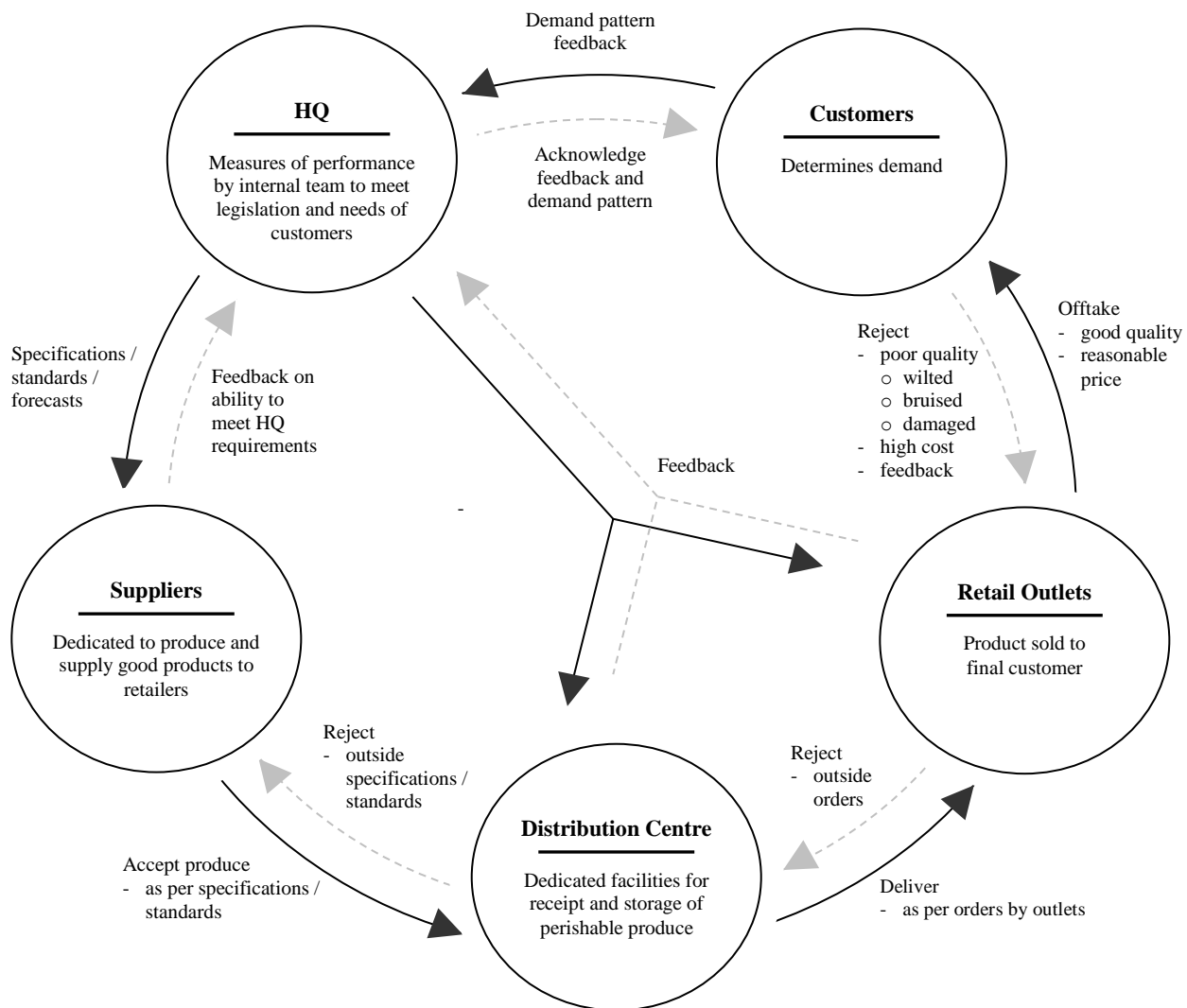


Figure 1: Cold chain collaboration process for perishable fruits and vegetables
 Table 4: Features of collaboration in a grower/supermarket relationship

Collaboration Features	Outcome of grower/supermarket relationship
1) Improved information sharing	<ul style="list-style-type: none"> • Exchange of information on consumer preferences • Decisions on produce to be grown and sold • Forecast / quantity to be grown/sold are exchanged
2) Standardisation of processes and procedures	<ul style="list-style-type: none"> • Based on feedback from consumers, the likes/dislikes are filtered and form basis for standards – visual, shape, colour, quality, safety parameters, packaging standards
3) Setting of benchmarks and key performance indicators	<ul style="list-style-type: none"> • Supply duration and accepted quantity and quality, supply reliability, temperature and traceability parameters, lead time and agility settings.
4) Training and knowledge enrichment	<ul style="list-style-type: none"> • Crop/seedling details, growing and harvesting details to optimize demand periods, double crops, cash crops, allowed pesticide and dosage, manure types suitable for land and crops • Correct packaging to minimize damage and prevent wastage
5) Providing optimum environment for investment	<ul style="list-style-type: none"> • Infrastructure – cold rooms, cold trucks/transportation, additional farming land, ploughing/harvesting vehicles

CONCLUSION

Leveraging of knowledge and skills can help drive excellence in cold chain collaboration. Findings of this study on cold chain collaboration seem to support this notion and shows that better temperature control, traceability and agility can be achieved through knowledge/skill sharing among parties and coordination in activities. This is realized by improved information sharing through trust and relationship building, standardization of processes and procedures, setting up of benchmarks and key performance indicators to be adopted by all parties involved, providing training to enrich knowledge and ensure consistence in practices, and offering an optimal environment for joining planning and investment for continuous improvement in overall cold chain efficiency. With the above findings, the two research questions posed at the beginning of this paper are answered satisfactorily. Through cold chain collaboration, temperature abuse is reduced, traceability and monitoring improves, lead times are shortened, thereby increasing agility of the operation. These improvements not only improved profits for all parties in the cold chain but most importantly significantly reduce food wastage in comparison with the no-collaboration situation. As such, it is concluded that cold chain collaboration does reduce food wastage and help arrest the food shortage problem of the globe.

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(Further references will be provided on request.)

AN EMPIRICAL STUDY ON CRITICAL SUCCESS FACTORS (CSFs) IN SUGAR SUPPLY CHAIN (SC) IN MALAYSIA

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ABSTRACT

This paper aims to identify CSFs (Critical Success Factors) for wholesalers in industry, as derived from previous studies. On top of the previous studies, this paper will present the chronology, area of research and methodological approach pertaining to factors that influence the performance of wholesaler as a sugar distributor. A structured review of the literature uses a stage refinement process. This paper covers the year's 2000 to 2013, and is restricted to the past 13 years for final assessment. CSFs of wholesaler identify three aspects such as price, distribution, publicity, goods and services.

INTRODUCTION

The food manufacturing industry plays an important role in developing countries because it has a majority share in agricultural resource-based industries (Kalirajan & Tse, 1989). Malaysia is a developing country and aims to join the developed countries group by 2020 (Ali, 2011). Therefore, food production plays an important role as a source of income and is one of the economic backbones of Malaysia (Majid, 2012).

According to (USDA, 2012a, 2012b), Malaysia is actively involved in production of sugar and also actively collaborates with world sugar exporters. The amount of raw sugar imported from other countries to Malaysia in November 2012 was about 1,870 metric tones of sugar. Growth of Malaysia's population had caused the increase in demand for sugar. The incremental rate for Malaysian population growth has been almost 3.4 percent annually between the year of 2000 and 2010. This will cause an increase in demand for sugar as high as 36 percent by 2020 (Hun, 2011). Unfortunately, the production of sugar by Malaysia is not keeping up (World Bank Report, 2012).

Unsatisfactory wholesaler services are usually complained about by customers, especially during Eid Festival. A familiar issue highlighted among committees is that the sugar supply is not sufficient in meeting sugar demand in Malaysia. Between 2011 and 2013, the production of sugar increased after Malaysia faced by its two main problems, namely hoarding stocks (Daily, 2009) and smuggling activities (Dzulkifly, 2010).

Based on MSM (2011), the Malayan Sugar Manufacturing (MSM) is the primary market and selling sugar in Malaysia. MSM is an active company in manufacturing and selling sugar products for committee. The company sold 542, 676 mt of refined sugar product to distributors and retailers in 2010 in Malaysia. Besides that, they also export sugar products, typically when there is an excess in supply after domestic demand has been met. Their major markets outside of Malaysia are Australia, New Zealand, Pakistan, Philippines, Singapore, Vietnam, and Indonesia. Export sales typically account for approximately 5% to 15% of their total sales, depending on the level of domestic and global sugar demand. The percentage of import and export activities for sugar and sugar confectionery in Malaysia are as follows:

The sugar supply chain in Malaysia needs to improve their overall performance to ensure that the quality and quantities of sugar in Malaysia meets the consumer

demands. In order to improve their services and quality, organizations of the sugar industry need to rely on several factors, especially CSFs (Yusof and Aspinwall, 1999).

Year	2008	2009	Increment
EXPORT	RM481.70 million	RM549.60 million	14.1 %
IMPORT	RM1,733.80 million	RM2,470.50 million	42.5 %

Source: Malaysian-German Chamber of Commerce & Industry, (2011)

Table 1: Percentage of Import and Export activities for sugar and sugar confectionery in Malaysia

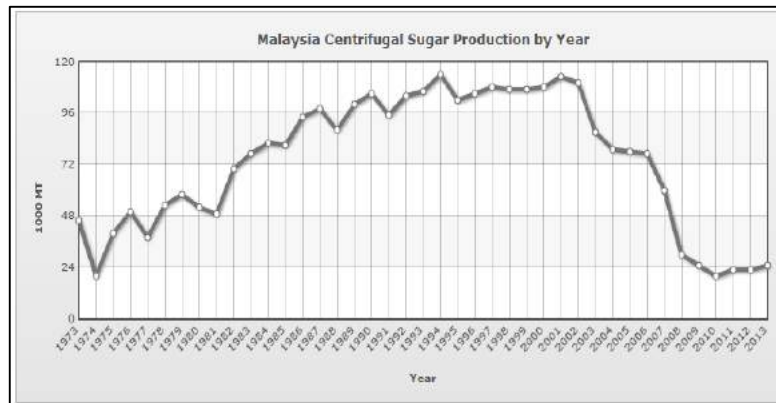


Figure 1: Pattern of Sugar Production in Malaysia (World Bank report, 2012)

However, the CSFs for the sugar industry in Malaysia are not completely determined and handled by managers when it comes to the sugar industry supply chain. This can be seen in the analysis in this paper. Twenty-four articles from journal and articles between 2000 until 2013 pertaining to CSFs for supply chain were reviewed. Therefore, this paper aims to identify the CSFs for wholesalers in the industry as derived from previous studies.

LITERATURE REVIEW

Supply Chain (SC)

The Supply Chain (SC) concept refers to a process of producing goods and delivers them to the consumer. In general, the purpose of the SC concept is to meet the demands of the consumers. The definition of SC includes an understanding of the process from the beginning when raw materials are procured. Items are then produced at one or more factories and transferred to the distribution center, then shipped to the retailers, and finally to customer (Houshyar, Mukhtar, & Sulaiman, 2010; Li, 2007).

The paradigm of the SC concept begins with demand to supply points. Then, it proceeds to finish the process at the demand point (Altekar, 2005). There are a few groups involved in this process, including raw material suppliers, manufacturers, distributors (wholesaler), retailers, and customers. **Figure 2** shows the operation of a supply chain. The sugar SC in Malaysia involves raw

sugar which is manufactured by two manufacturing companies, and the result is a variety of sugar products.

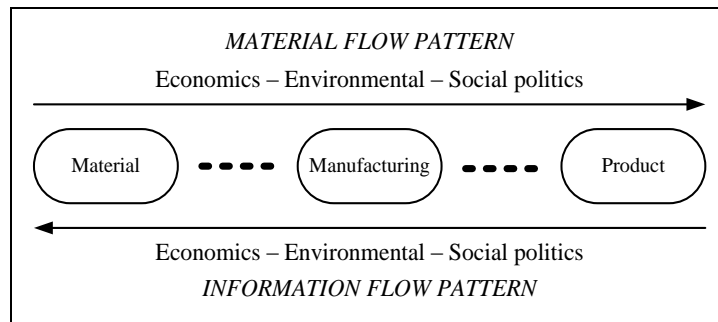


Figure 2: Supply chain level (Gu & Jing, 2011; Othman & Mustafa, 2012)

Apparently, the sugar industry in Malaysia also has a SC network which is similar with other industries. The Sugar SC in Malaysia is organized to include manufacturers, wholesalers, and retailers and end consumers. Every party relies on each other in order to enable the success of the SC. The sugar industry in Malaysia contributes to the national economics, due to the related sugar based products such as soft drinks.

Wholesaler

Decisions need to be made by all parties including manufacturers, wholesalers, retailers and customers. This is because by making decision for their management complexity, the parties could improve their performance. Unfortunately, as wholesalers are part of a competitive business, this requires the wholesaler to deal with various problems, and many new factors (Farfan, 2013; Balasescu et al., 2009). Some researchers have recommended that wholesaler companies need to improve their strategic decisions such as market selection, positioning, and mix marketing, including a range of goods, services, prices, publicities, and distribution in their businesses (Balasescu et al., 2009) **(see Figure 2.1).**

Goods and services are the bridge in building profitable customer relationships. Producers or manufacturers must offer their best product and services to suit their customers' needs and desires. While adding customer value through the products and services they offer, wholesalers often optimize their product lines and stocks to meet customers' immediate needs. They can reduce costs of warehouse by minimizing the number of stocks that they carry, and only carry the most-profitable products for just-in-time delivery. Distribution is critically important to the wholesalers. They must choose their physical locations, facilities, and web locations carefully in order to provide immediate delivery to their customers. The last factors which need to be taken into consideration by the wholesalers are publicity and promotion. Most of the wholesalers have not made full use of promotion, although promotion can be a vital part of wholesaler success. Now, it seems that wholesalers experience difficulty incorporating all kinds of promotion including advertising, sales promotion, personal marketing, and public relations. They still consider sales as a single salesperson talking to a single customer. However, it is a team effort to sell, build, and serve major clients.

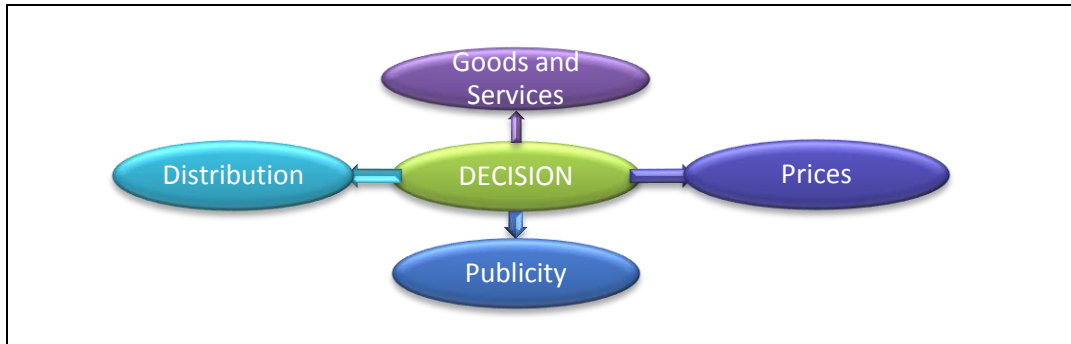


Figure 2.1 Decisions has been taken by wholesaler (Balasescu et al., 2009)

Critical Success Factors (CSFs)

Chronological progression of this research area in term of publication volume in CSFs is shown in **Figure 2.2**. The first articles date back to 2000, but the breakthroughs in this research scope did not occur until 2009. There were 15 articles that had been published between 2009 and 2013, which accounted for 62 percent of all articles found. The increase in numbers of published papers about CSFs by researchers shows that the existence of CSFs among industrial managers is very significant, especially for companies desiring maximum progress.

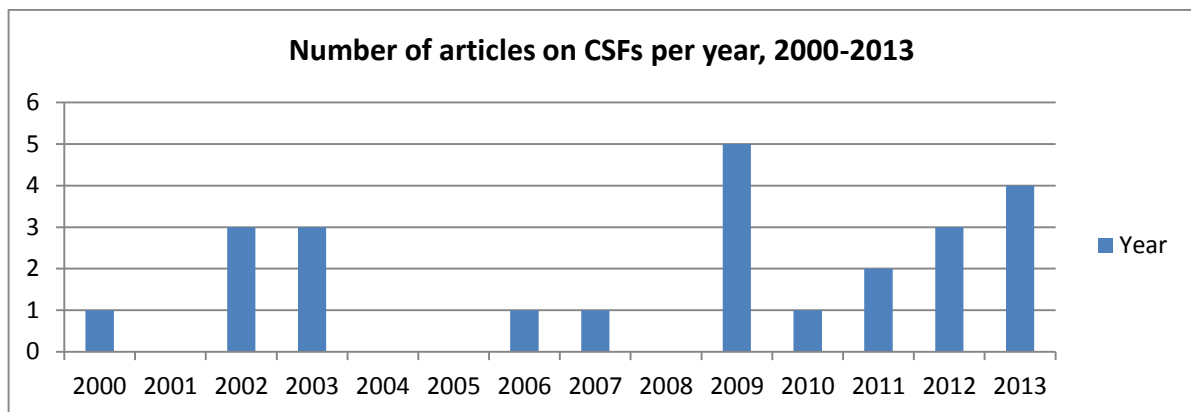


Figure 2.2: Number of articles on CSFs per year, 2000-2013

In SC process, it would be an advantage to the managers who are aware of business strategies and use it in achieving their business goals. Since CSFs were popularized by Rockart (1979), there are several definitions of the CSFs which account for various perspectives by previous researchers. A prior definition of CSFs was proposed by Rockart and Bullen (1981). They defined CSFs as follows:

"... the limited number of areas in which satisfactory results will ensure successful competitive performance for the individual, department, or organization."

By previous researchers in various perspectives, definition of CSFs also varies. For example, consider the quality management aspect as defined by Saraph, Benson, and Schroeder (1989). These researchers defined CSFs as "... Critical management planning and action should be practiced to achieve effective quality management in the business units."

Moreover, from the published papers and journals, it can be seen that many of the seare related to CSFs. The publications had touched on various areas such as pharmaceuticals (Awan et al., 2009), insurance (Shih et al., 2009), electronics (Kess et al., 2010) and food (Ju, 2012) as in **Table 2**.

This paper also analyzed journals produced according to the methods used in their paper and it was analyzed in percentage form. Among the methods used were quantitative, qualitative, and mixed methods. All three methods have been used in research to achieve the study research objective, namely identifying CSFs. The most famous method that had been used for CSFs is the quantitative method, which covered 55 percent of the studies. It is followed by the qualitative and mixed method with 27 percent and 18 percent, respectively (see Figure 2.3).

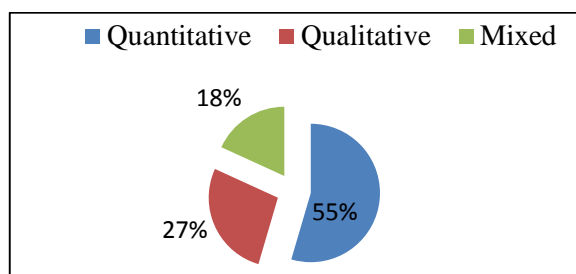


Figure 2.3: Percentage of the method used to identify CSFs

From the results of previous studies, there are several success factors that have been studied by researchers in various angles and areas. According to Tibar (2002), CSFs can be divided into several categories according to the area that being studied. Food management was among the categories studied by Tibar (2002) and included marketing, management and quality, product development, information management, Technological innovation, personnel, efficiency, finance and general management.

Others areas from previous studies include the petrochemical industry, new product development, and the food industry. According to (Busi, Barry, & Chan, 2011), they found six CSFs connected to instrumentation and control engineering (ICE) of petrochemical industry. The CSFs were identified to ensure the success of an ICE project. The CSFs that had been selected for the ICE which had been implemented is circulated to the area of skill personnel, proper documentation of project decision throughout the project life cycle, safety design and adherence. The adherence is to change management procedures, and alignment of project goal with organizational strategic objectives.

As previously stated, CSFs are different for different level of management. CSFs are also different depending on the industry, organization and individual. Authors discuss the CSFs in a variety of views; for instance, there are researchers who had conducted their research focusing on top management (Busi et al., 2011; Fryer et al., 2007; Rockart and Bullen, 1981; Saraph et al., 1989; Suwannaporn and Speech, 2010). On top of that, CSFs for first-line managers are also important. Thus, they attracted the attention of Doherty and Ellis-Chadwick, (2009); Grewal et al., (2010) due to their responsibility to fulfill customer demands.

Author	Year	Industry
Zakuan et al.	2013	TQM
Ju	2012	Food
Sedighi & Zand	2012	Knowledge management
Shahu et al.	2012	Construction
Busi et al.	2011	ICE projects
Kess et al.	2010	Electronic

Awan et al.	2009	Pharmaceutical
Shih et al.	2009	M-commerce in insurance
Yang et al.	2009	Construction
Salas et al.	2009	Health Care
Ernst	2003	NPD
Umble et al.	2003	Enterprise Resource Planning (ERP)

Table 2: Summarize of CSFs in industry had been studied

METHODOLOGY

The literature for CSFs in sugar industry selected from previous research had been analyzed. The data for literature review had been gathered by means of electronic database. Those databases are Emerald Management Plus (search article from 2000 until 2013), EBSCO, Academic Search Premier (article from 2000 until 2013), IEEE Explore Digital Library (article from 2000 to 2013) and Science Direct (article from 2000 to 2013). The first keyword that been searched was the Critical Success Factors (CSFs). The second search was circulated between the journals and articles that had been published and the abstract of all issues of these journals systematically searched. The literature covered was between year 2000 and year 2013, specifically on basic material and procedure.

Then, in order to fulfill the objective of this paper to investigate CSFs for sugar wholesalers in Malaysia, a questionnaire was developing by applying information from Hadiguna (2013). The concept of the questionnaire uses quantitative data due to multiple roles of factors, such as standard of achievement and operation achievement. The questionnaire was divided in to four main sections, namely (i) respondent identity; (ii) rating assessment; (iii) opinion and; (iv) definition of terms. The first section was basic information about respondent identity such as name of company, work experience and position. The second section consists of four categories of decisions made by wholesalers, which the wholesalers were asked to rank their level of importance. The third section proposed a new important factor by respondents and is intended to advance the understanding of critical factors for sugar wholesaler. The last section was a list of term definition as guidance for wholesaler to understand the terms.

FINDING AND ANALYSIS

A pilot study was conducted to improve and validate questionnaire. The questionnaire was improved in term of format and layout, wording of sentences, and overall content. A total of 15 questionnaires were distributed to quality practitioners in wholesale business for sugar industry. Six of fifteen respondents were responded the questionnaire, for a 40% response rate.

From the pilot study, some concern was expressed on several factors which were not relevant with sugar wholesaler in Malaysia. Initially, the questionnaire had 14 factors which are general for all wholesalers. The factors questionnaire was reduced to 13 factors as one factor was removed from the questionnaire. This is because fewer than 50% respondent responded that strategic business location is not an important factor. Sentence structure of the factors was also changed. For example, "process management" was change to "Good process management" and "time management" was changed to "Good time management".

Another point worth mentioning was a change in the rating assessment format on category of factors. The initial category was too general for sugar wholesalers to

make a decision. However, the category was changed and broken down into four critical categories, specifically goods and services, prices, distribution and publicity.

From the pilot study conducted, CSFs in this study have three decisions to make. The decisions involved in this framework which are goods and services, distribution and publicity. Unfortunately, price decision is not an important aspect in this study because the price of sugar in Malaysia is controlled by the government. Any transactions involving the purchase of raw sugar fall under government control. Manufacturers only process the raw sugar and produced the sugar for the market. Then they will supply it to the wholesalers and customer based on the demand. Thus, the proposed conceptual framework for CSFs in this study pertaining to the decisions taken by wholesaler consists of three decisions, namely goods and services, distribution, and publicity, as seen in Figure 2.1.

In short, the questionnaire was validated via the pilot study among wholesalers. It was intended to provide a successful questionnaire for authors to launch the main survey.

CONCLUSION

Items such as chronology, methodological use, and area of research were discussed as in the literature review and methodology section, while the framework for decisions taken by sugar wholesaler was explained in the data analysis section. It can be said that the CSFs study or researches had merged into various areas by looking at the published works such as journal in recent years. Besides, an increasing number research touch on the issue of CSFs as can be seen through the increment of number of journals published from 2000 until 2013. Due to the variety of CSFs research published, there are many CSFs identified for particular industries.

Therefore, to improve of the system for sugar wholesaler in the aspect of handling and efficient distribution to meet customers' needs, CSFs are the first thing that should be considered in their service. This is because CSFs are very significant tools for the management in any industry including the sugar industry, and through the availability of these CSFs, management can improve their performance in the areas of business, especially wholesalers sectors in the sugar industry. In order to facilitate the evaluation of CSFs in the sugar wholesale industry, a framework of DSS will be designed based on the CSFs in literature review and feedbacks from respondents.

ACKNOWLEDGMENT

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APPLICATION OF THE ACTIVITY COST MODEL TO 3D PRINTER TECHNOLOGY

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ABSTRACT

3D printers allow the 3D replication of a solid object, and can virtually shape any item from a digital graphics file. This product makes innovation with the introduction of 3D printer technology in the manufacturing field. Attention of these situations, we examined the possibility of 3D printer in terms of manufacturing processes, product inventory, and product yield. For clearing this process, we tried to discuss through two steps: "the mechanism of added value" and "the mechanism of cost estimation." To solve these problems, we first analyse process flows between the usual process and the 3D process in the context of wire manufacture. Second, we apply these processes to IDEF0 analysis, which expresses the process activity. Using IDEF0, we calculate cost variation using the "cost-matrix method." Finally, we discuss the cost conditions and the concept of added value.

INTRODUCTION

In recent times, the Japanese economy has soared owing to the "ABEnomics" effect. Not all manufacturing companies, however, are feeling these positive effects. In particular, small- and medium-sized companies are far from feeling the economic recovery. These businesses are, instead, preparing for the rising cost of materials, tax increases, and depreciation of the yen. As a result, there remain significant economic problems in the manufacturing sector.

On the other hand, opportunities within manufacturing have expanded with the introduction of 3D printer technology. These printers allow the 3D replication of a solid object, and can virtually shape any item from a digital graphics file. The print product is made from a powder or resin, which makes any item relatively cheap to produce. In his second State of the Union address (The White House, 2013), U.S. President Obama made reference to 3D printing: "3D printing is helping to fund and guarantee the next revolution in manufacturing in America." The Japanese government also supports firms investing in 3D print technology by offering subsidies and reduced taxes (Ministry of Economy, Trade and Industry, 2014). Although 3D print technology represents an evolutionary leap for the manufacturing industry, this technology is also widely available to general consumers, especially as the price decreases. The range of applications for this manufacturing technology is extensive, including the automobile industry, consumer electronics parts, medical organs, and architectural models (Leukers, et. al., 2005, Silva, et. al., 2008, Parthasarathy, et. al., 2011). It is also suitable to small-lot production runs of many products. If you have the digital design specifications for a desk and chair, you can manufacture your design in a moment, at a small cost.

Recent studies and reports signal high expectations for new product development and innovation using 3D print technology (Campbell, et. al., 2011, Sisson and Thompson, 2012). In this study, we examine the applicability of this technology in terms of manufacturing processes, product inventory, and product yield. It is expected that manual process skills are no longer needed, since 3D print technology can produce an object automatically and accurately. Production styles are also changing, from "erasable" manufacturing, which is the traditional method

of shaping an object from a solid material, to “additional” manufacturing, which involves adding resin to a metal powder and creating an object using only one machine. Thus, the scope of this study is expanded to include yield percentages, product stock levels, etc.

To establish the terms of comparison, it is necessary to change the way we understand and calculate “cost” and “value added.” In this research, therefore, we compare the cases of a traditional process (called the “usual process”) and a process using 3D print technology (“3D process”) as they apply to a wire manufacturing company. Moreover, using a “cost matrix” method, we analyze the diversification of raw materials, in-process inventory, product yield, time, human activities, and so on.

PREVIOUS STUDIES AND PURPOSE OF THIS SITUDY

They have a few studies focus on the 3D printing. First of all, they are dedicated on the possibility of the printing (Foroozmehr and KovacevicR, 2009). For example, Lim et. al. (2012) discuss large-scale additive manufacturing processes that have been applied in the construction and architecture arena and focuses on ‘Concrete Printing.’ A number of new criteria have been developed to classify these process specific parameters. Second approaches are focused on the efficient way of the printing (Zhang and Khoshnevis, 2013). Jin et. al. (2013) present an adaptive approach to improve the process planning of Rapid Prototyping/ Manufacturing (RP/M) for complex product models such as biomedical models. They introduced a mixed tool-path generation algorithm to develop to generate contour tool-paths. Five case studies of complex biomedical models were used to verify and demonstrate. The other approaches are also discussed about the cost effect. Kenny (2013) examines the potential cost benefits of incorporating 3D printing. That research uses the knowledge value added (KVA) methodology to analyze modeled data and capture and quantify the benefits.

These previous studies have failed to identify any particular theme around manufacturing or stock management processes with the introduction of 3D print technology. Therefore, considering the possible proliferation of 3D print technology, we examine the following indicators:

- The mechanism of added value
- The mechanism of cost estimation; in particular, the design, materials, in-process inventory, yield, time, and human activities.

The mechanism of adding value is discussed in terms of changes to manufacturing procedures from the design process to the finished product. Because 3D printing does not require manual processing operations, where a prototype and mold are fashioned, we must discuss the loss of these manual processes. The mechanism of cost estimation is discussed on the basis of the new cost structure introduced by 3D print technology.

To solve these problems, we first analyse process flows between the usual process and the 3D process in the context of wire manufacture. Second, we apply these processes to IDEF0 analysis, which expresses the process activity. Using IDEF0, we calculate cost variation using the “cost-matrix method.” Finally, we discuss the cost conditions and the concept of added value.

ABOUT A COMPANY A AND THE INTRODUCTION OF THE 3D PROCESS

This study assumes that a manufacturer, Company A, has processes to make wires from plastic (Process 1). The drawn wires are used to create a finished product (Process 2), which is then delivered to the customer (Figure 1). Company A has two steps in its manufacture of finished products from raw materials. Company A, however, is faced with manufacturing process problems. For example, Company A holds large in-process inventory stock because their processing time is in deference to the short lead times needed to meet customers’ delivery demands. In addition, Company A spends considerable time

setting up for each new custom product run. However, the most significant problem for Company A is the percentage of yield derived from the finished product, as the manufactured wire needs to be cut as ordered.

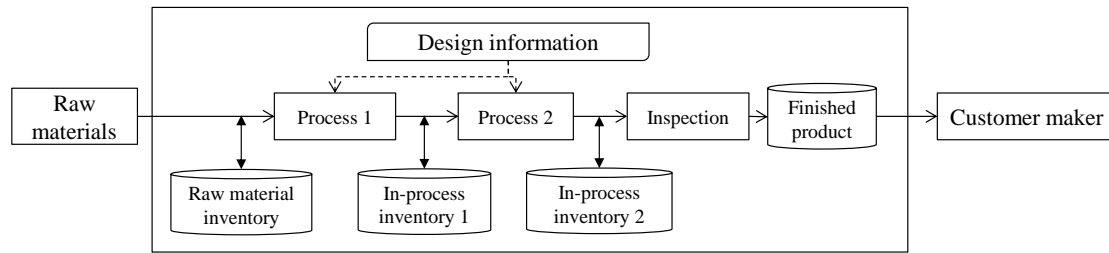


Figure 1: Usual process

Consequently, we apply the 3D process to Company A, as shown in Figure 2. In this case, the design form is directly sent to the 3D printer following a customer order. If there is no design information, then the final molded product is captured by the 3D scanner, which converts the 3D spatial image to a digital file. After the raw materials arrive, the finished product can be printed, quality inspected, and delivered to the customer quickly and easily. This situation is analogous to the “crowdfunding” model; that is, the company can start printing the product as soon as it is known that the product is sold.

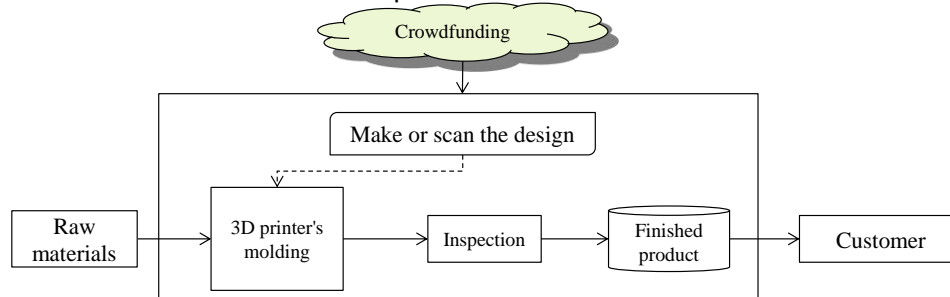


Figure 2: 3D process

USING IDEFO AND THE COST CALCULATING MODEL

Using IDEFO

Comparing the usual process and the 3D process, the IDEFO is useful for distinguishing between the manual and automated activities; thus, we introduce the concept of IDEFO (Figure 3). The flow of materials from raw materials to intermediate and finished products is expressed as input on the left-hand side (I), and output on the right-hand side, with arrows (Y) at the activity box. Mechanical arrow (M) shows at below of the box, like human activities, equipment, etc. Top of the arrow (C) is the limited condition, like the order information, money, etc. Using the hierarchy feature of IDEFO, a nested structure can represent. In each layer, they have one output of the product or the service.

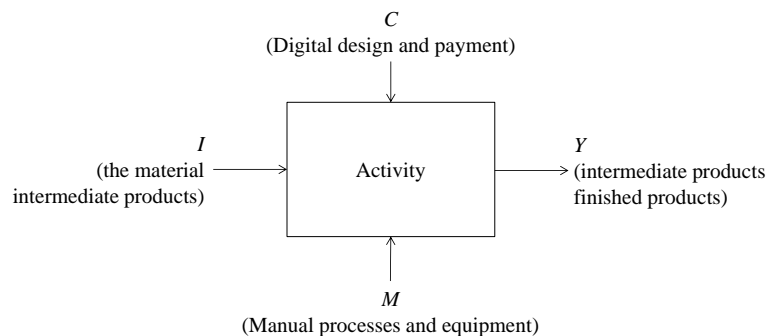


Figure 3: Activity of IDEFO

Analyzing the process and structure through the IDEF0 requires input on the costs of manual labor, costs of raw materials, intermediate product inventory, equipment, and profit and loss, which are then calculated for each activity using a cost matrix method. Figure 4 is Company A's business process as analyzed by IDEF0. The figure of the "3D modeling," for example, is that input is the design or scanner information and output is the STL (Standard Triangulated Language) file.

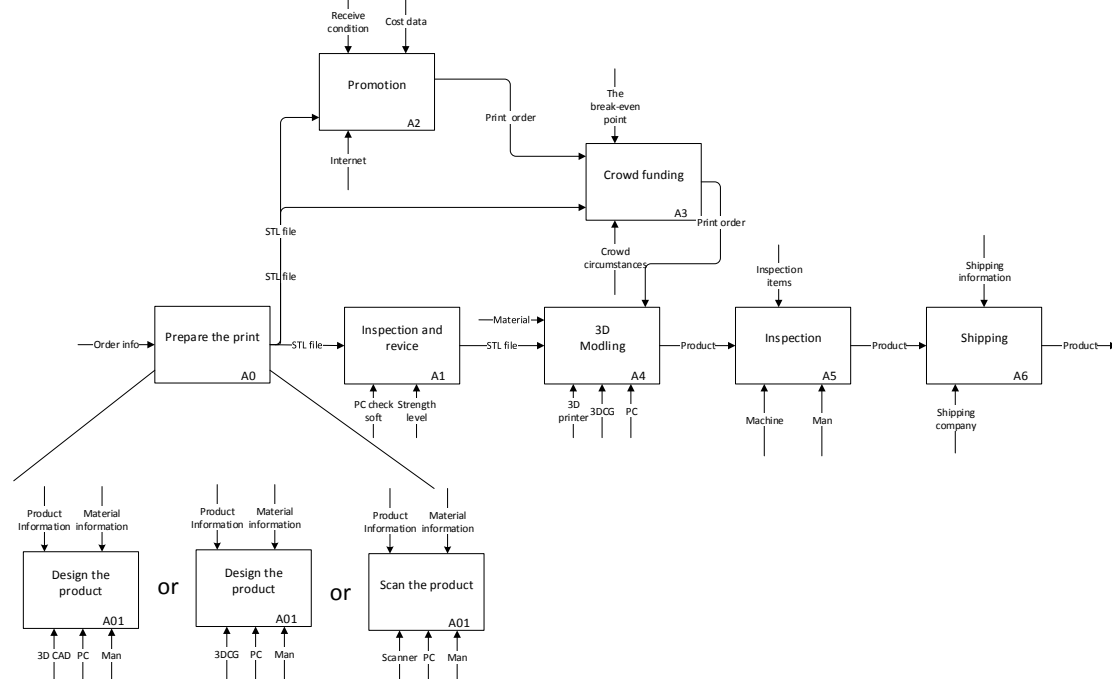


Figure 4: Company A's business process by IDEF0

The top of arrow is the limited condition of the parts and the materials, and bottom of the arrow is the mechanism for the activation.

The usual process in wire manufacture involves six processes. The characteristic feature is that these processes must occur in a set linear sequence. Company A's policy is that they carry sufficient in-process inventory to meet the short lead times demanded by customers.

The 3D process also has six stages; however, these significantly differ from the usual process. These steps are

- 1) 3D printing model - STL file consists of 3D data for applying to the 3D printer. A STL file is the documents of the three-dimensional representation created by the PC. They have three ways to make the data: 3DCAD, 3DCG, and 3D scanner.
- 2) Promotion and sale - In the case of a private sale, fundraising is recommended through crowdfunding sites on the internet.
- 3) Check and fix the quality of data - Checking software drafts the STL file and the reality shape. It is also checked strengthens in this stage.
- 4) Molding by the 3D printer - 3D printer molds the finished product after designating the row material.
- 5) Quality check - Quality check is conducted after manufacturing the product.
- 6) Delivery - Product is delivered to the customer.

Equipment required is a PC, 3D drawing software, and a 3D printer. It repeatedly performs on individual support from step 3 to 6.

Next, the cost matrix method is conducted to calculate the processing cost.

The cost calculating model

The cost calculating model is formed as follows:

The cost of the product or the semi-finished product $Y_{y(n)}^n$ of activity A_n is as follow:

$$C^n = \left[c(Y_1^n) \quad c(Y_2^n) \quad \cdots \quad c(Y_{y(n)}^n) \right]^T = \left[Q^n \mid R^n \right] \left[\begin{array}{c|c} E^{i(n)} & 0 \\ \hline 0 & E^{m(n)} - S^n \end{array} \right] \left[\begin{array}{c|c} U^n & 0 \\ \hline 0 & S^n \end{array} \right] \left[\begin{array}{c} I^n \\ \hline M^n \end{array} \right] \quad (1)$$

Where

n : the number of the activity

C^n : unit matrix of the cost

$c(Y_{y(n)}^n)$: the cost of the $Y_{y(n)}^n$

Q_n : the cost of the material

R_n : the operating time

$E^{a(b)}$: the unit matrix of $a(b)$

S^n : the unit cost of the operating time

U^n : the unit cost of the material

I^n : the amount of the material

M^n : the number of the human

The material matrix is as follow:

$$Q^n = \begin{bmatrix} q_{11}^n & q_{12}^n & \cdots & q_{1n}^n \\ q_{21}^n & q_{22}^n & \cdots & q_{2n}^n \\ \vdots & \vdots & \ddots & \vdots \\ q_{y(n)1}^n & q_{y(n)2}^n & \cdots & q_{y(n)n}^n \end{bmatrix} \quad (2)$$

Where

$q_{y(n)n}^n$: the amount of the required material

The operating time matrix as follow:

$$R^n = \begin{bmatrix} r_{11}^n & r_{12}^n & \cdots & r_{1m(n)}^n \\ r_{21}^n & r_{22}^n & \cdots & r_{2m(n)}^n \\ \vdots & \vdots & \ddots & \vdots \\ r_{y(n)1}^n & r_{y(n)2}^n & \cdots & r_{y(n)m(n)}^n \end{bmatrix} \quad (3)$$

Where

$r_{y(n)n}^n$: the operating time

The unit of the material cost matrix as follow:

$$U^n = \begin{bmatrix} u_1^n & 0 & \cdots & 0 & 0 \\ 0 & u_2^n & \cdots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \cdots & 0 & u_{i(n)}^n \end{bmatrix} \quad (4)$$

Where

$i(n)$: The number of the input material or semi-product

$u_{i(n)}^n$: the unit of the material cost

The amount of the material flow matrix as follow:

$$I^n = \left[I_1^n \quad I_2^n \quad \cdots \quad I_{i(n)}^n \right]^T \quad (5)$$

Where

$I_{i(n)}^n$: The amount of the material flow

The unit cost of the operating time matrix as follow:

$$S^n = \begin{bmatrix} s_1^n & 0 & \cdots & 0 & 0 \\ 0 & s_2^n & \cdots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \cdots & 0 & s_{m(n)}^n \end{bmatrix} \quad (6)$$

Where

$m(n)$: the amount of the mechanism

$s_{m(n)}^n$: The amount of the material flow

The number of the equipment matrix as follow:

$$M^n = \begin{bmatrix} M_1^n & M_2^n & \cdots & M_{m(n)}^n \end{bmatrix}^T \quad (7)$$

Where

$M_{m(n)}^n$: The number of the equipment operating time

CALCULATE THE ADDED VALUE AND APPLY TO THE CROWDFUNDING REQUIREMENTS

Understanding added value derived by 3D printing

Added value is compared between the usual process and 3D process based on design specifications, raw materials, in-process inventory, yield, time, and manual input.

First of all, at the stage of the design, the added value is considered not to the "object" but to the "design." It is said that the value added created by the time is the same point as the design information in the manufacturing place. That is, the design information decides the time of working. Therefore, high quality design decides the time shorter of working. It is useful to construct the design from the STL file and 3D scanner.

Second, in the usual process, a significant time delay occurs between ordering the raw material and delivering the finished product. The reason is that the basic wire must be made by supplier and then transported to the our company. In the 3D process, however, the manufacturer only needs to load the required resin and powder into the 3D printer. However, stock levels remain an issue in both the usual and the 3D processes.

Third, each process has a different relationship between manufacturing time and manual input. The usual process has two different processing points, which increases the inventory of in-process stock and increases the lead time. In these processing fields, they have another bottleneck from the viewpoint of the cost. These are the human activity, non-automation mechanism, and works and check the quality inspection by their workers hands. Therefore, if a 3D printer is introduced in these processing, it is not necessity of the "manual labor" and decrease the cost drastically.

Fourth, in 3D printing, the added value is computed purely from printing time in the manufacturing process. That is, the stacking pitch decides the printing performance because this pitch decides the printing time. Currently, depending on the printer, it takes 1 h to make the 10-cm-tall figure using a 3D printer. In the past, however, it took 1 h print time for an A4 paper using a 2D printer. It is hoped that future 3D printers will demonstrate improved performance, higher quality, and lower cost in future.

Fifth, when applying the usual process, wire strength is checked at each stage of manufacturing. In the 3D process, strength and size are checked only at the end of the process. This is a topic for future research.

Finally, considering product yield, the percentage yield from the 3D process is 100%, making 3D printing a very compelling technology.

A discussion about crowdfunding

"Crowdfunding" is an online method whereby an unspecified number of people cooperate to amass the financial resources needed to fund a project.

"Crowdfunding" is a word that represents a group of people (the "crowd") who invest in an idea or project ("funding"), and enter into an arrangement with the inventor/initiator. Crowdfunding plans vary in their form, depending on the returns to funders. This research is focus on the "purchase type" to support by purchasing some goods or rights. Appeared the internet and the 3-D printer, even a private person or a small business company can sell the idea product through the internet site. At that time, they are changed the minds of the self-financing and asset. That is, if the goal numbers of orders have reached, they have to get the funds from the crowdfunding people and start the manufacturing and sell to the supporters.

Overall cost + the prospective profit \leq gross profit by the number of orders

It is called the "Crowdfunding" that upper condition is formed. This method can decrease the risk of the designer. It is also possible to the individual production orders system.

CONCLUSION

3D printers allow the 3D replication of a solid object, and can virtually shape any item from a digital graphics file. This product makes innovation with the introduction of 3D printer technology in the manufacturing field. Attention of these situations, we examined the possibility of 3D printer in terms of manufacturing processes, product inventory, and product yield. For clearing this process, we tried to discuss through two steps: "the mechanism of added value" and "the mechanism of cost estimation." Through this study, we cleared the difference of process between the usual process and the 3D process, applied to IDEF0 and cost matrix, and discussed the understanding added value derived by 3D printing

We have, however, a lot of future studies. Those are 1) application to other companies, 2) clarification of the works and the relationship of the crowdfunding, 3) numerical real example, and so on.

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COLD CHAINS EVALUATION FRAMEWORK IN A FRAGMENTED MARKET

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Abstract

In developing countries the cold chain industry is highly fragmented compared with mostly vertically integrated cold chains in developed countries, making cold chain the weakest link in the supply chain. In such a fragmented industry, a shipper's need to protect the integrity of its products and brand while supporting multiple shipment types and managing the supply and demand surges becomes critical. The objective of this work is to identify the dynamics behind the working of a successful cold chain in developing economies, and conceptualize and build a framework to evaluate Cold Chain Service Providers (CCSP) in such a fragmented industry.

Through literature review, industry Analysis and value chain assessment along with field data on cold chain performances in China this work develops parameters for CCSP's assessment. These parameters are country agnostic. A system dynamics approach is used to analyze the proliferation of fragmented cold chain industry in emerging economies.

This work develops a framework to evaluate CCSP using identified parameters at four levels of hierarchical evaluation tree. The numerical analysis and weight of parameters are developed, with the option to disaggregate (and aggregate) from Level 1 to 4 (and from Level 4 to Level 1) through Analytic Hierarchy Process (AHP). The framework facilitates the evaluation of CCSP in various dimensions of Strategic, Tactical and Operational fit with an organization and suggests a systematic approach to monitor performance of CCSP using key metrics and parameters.

Introduction

Food and beverage industry is far more complex today than at a time when fewer products, more stable demand and high margins were the industry norm. Over the years, significant changes have taken in the way business is done. However, the task to meet customers' requirements by getting the right products to the right place, at the right time, and in the right condition has not changed. In fact, it has become stronger irrespective of geography, region, continent and industry.

Food and beverage industry is a high-volume, fast-moving, low and high-margin business. The industry has inherent complexity to convert ingredients and raw materials into food and beverage products with same or changed recipe and deliver to the retail location. The transportation and delivery of temperature-controlled food and beverage products is a fast-growing part of the overall industry. There are three reasons for this:

- **Rapid Growth:** Growth (in type and volume) of food and beverage products and globalization of companies in emerging markets
- **Global Sourcing and Distribution:** Globalization of logistics as global trade rises coupled with high product value and longer lead-time, both for input materials, and finished products

- **Increased regulatory need and Impact of Quality of Life:** Regulatory framework has become more detailed and rigorous, with tighter specifications and stringent enforcement

However, such growth worsens the challenges from food spoilage. As per Cold Chain Centre (CSIRO) *about \$17 billion is lost globally as a result of food spoilage during transportation and storage. In order to address problems of food spoilage coupled with increased awareness about health and well-being, refrigeration and air conditioning are steadily becoming a part of everyday life in food and beverage industry.* A recent survey conducted by ColdChainIQ (Dec 2011 – February 2012) found that 81% of the respondents think regulators around the globe are paying closer attention to temperature controls in Cold Supply Chains. It also found that 94% of the respondents feel finding cost-effective services and solutions is the greatest challenge in storage and distribution of temperature sensitive products and 63% emphasized that temperature control is a critical part of product integrity as it can compromise the safety and can pose serious implications to end consumers.

In general, food products may pass through 17 or more handlers during distribution, enduring delays and substandard intermediate storage. Without a proper tracking system, cold chain breach might go unnoticed at first, but poor temperature control can lead to spoilage through bacterial growth. A manufacturer or retailer may unknowingly or unintentionally sell inferior foods with serious implications. The problem can become more pronounced when one enters and tends to grow in emerging economies as China.

Literature review

To capture the broadest range of cold chain studies for inclusion within this analysis, a literature review of published studies is performed with the following objectives; (i) to identify the purpose of cold chains and the significance in the food industry, (ii) study the importance of temperature conditions within existing cold chain infrastructures, (iii) review supplier selection methodology and (iv) identify measures that drive cold chains and 3PL management.

World Health Organization official documents (Agreement n.d.) emphasize the importance of ensuring that drug products and medicine reach the end users, practitioners, patients and consumers, in its intended form. The documents describe processes and activities (including integrity of products, storage, packaging, labeling and distribution) to facilitate the systematic control, measurement and analysis of products from the start till the ultimate delivery point across the supply chain. The manual on blood cold chain equipment (Blood n.d.) defines the blood cold chain as “a series of interconnected activities involving equipment, personnel and processes that are critical for the safe storage and transportation of blood from collection to transfusion”. Like any process, the chain is only as strong as its weakest link, and a failure of a link will result in the collapse of the chain. The document suggests various devices such as portable thermometers, digital electronic probes and temperature recorders/thermographs (e.g. electronic data loggers, chart recorders) to capture temperature variations.

A cold chain is maintained over several transport activities, but with two potential breaches in its integrity, namely Temperature Excursion or Transport integrity. In the first case, it could involve the cargo being left exposed during the unloading process, and in the latter case, the product could have been stored in a refrigerated warehouse at a temperature below the product's storage specifications. Therefore, the challenge remains the conditions in which products are exposed to intermittent and temporary lapses in the integrity of the cold chain, resulting in decline in the product's shelf life or spoilage.

Ruiz-garcia and Lunadei (2010) tried to determine whether vaccines were being exposed to temperatures outside the recommended storage range of 2–8 °C. By studying temperature excursion, authors intend to identify specific points and practices in the vaccine distribution system where temperature problems were occurring. Further, food safety and quality is intractably linked to interaction of temperature and moisture as studied by Zaroni and Zavanella (2012). They showed the significance of temperature on the product quality degradation via linking the rate of quality degradation and temperature using Arrhenius equation.

Prakash et al. (2012) study the use of RFID for the precise measurement of temperature during product distribution. The temperature monitoring is done in stages of transportation and storage. This paper focuses on monitoring and adjustment temperature in a warehouse using a combination of RFID receivers and ThermochroniButtons. However, the study did not suggest factors, with certainty, which lead to freezing of vaccines during transport in refrigerated trucks. Freezing during transport in cold boxes or vaccine carriers was probably due to the vials coming directly into contact either with ice or with an icepack. Such possibilities suggest that there is a need to first understand whether temperature goes beyond limits and then investigate various factors that may have led to such a situation. Identification of critical factors will help measure the performance of cold chain service providers.

Logistics et al. (2011a) compared with the conventional logistics system and summarized the 5 principles of Cold Chain Logistics, what is called **Principle of the Cold Chain Logistics** namely '3P', '3C', '3T', '3Q', and '3M'.

- **'3P' principle:** Produce, Processing, and Package. They signify quality of raw material produce, the high technology processing, and the packaging
- **'3C' principle:** *It's important to Care* for the products, keep environment Clean and Cool.
- **'3T' principle:** The quality of products depends on Time, Temperature, and Tolerance of the transportation.
- **'3Q' principle:** Quantity and Quality of equipment, and the Quick operation organization in the Cold Chain Logistics.
- **'3M' principle:** M stands for Means, Methods and Management of storage.

In an extensive literature review by de Boer et al. (2001) titled "A review of methods supporting supplier selection" they aimed at covering all phases in the supplier selection process from initial problem definition, over the formulation of criteria, the qualification of potential suppliers, to the final choice among the qualified suppliers. Overall, the following key elements were observed during the literature review:

- a) Limited research is available to assess the performance of Cold Chain Logistics Providers (Mukherjee, 2009; Egeröd and Nordling, n.d.; Agarwal and Vijayvargy, 2013). Table-1 gives the list of parameters identified for CCSP evaluation. Author's also found that many critical parameters such as Strategic Relationship, Experience, Delivery, Shelf-life and Price are not considered for the evaluation of CCSP
- b) No case study was developed to systematically assess or evaluate CCSP in a fragmented economy such as China
- c) A study of fragmented cold chain markets in developing countries has not been extensively covered – what strategies and dynamics will drive growth of cold chain is still not fairly studied.

d) The following critical dimensions have been identified;

- Temperature excursions or exposure beyond the desired limit may have an impact on quality and freshness to Shipper products.
- Hemispheric, climatic and seasonal variations may affect products as well
- Omni-channel capability, in terms of Mode of shipments (e.g. truck, FLT/LTL, air), of CCSP is an important dimension for growth in fragmented industry
- Number of legs in delivery: Direct shipment through air means less variation and eliminates needs for multiple handling
- Packaging – maintain package under both extreme temperatures (cold/hot) can be a significant challenge

Literature Review		Value Chain Assessment		System Dynamics (Industry Analysis)		
Category	Criteria	Category	Criteria	Category	Criteria	
General	General attention from supplier and uniqueness	Delivery	Geographical spread (Geographical coverage) and Omni-Channel network	Equipments, Facilities	Asset ownership	
Production	Condition facilities/equipment, Tidiness in production facilities		Range of services provided including basic and value-added services			Ageing Condition of facilities/equipment
Quality	Total value of complaints and rejections		Geographical Location	Delivery Fulfillment Lead time	Standardization	Asset Productivity
	Responsiveness and Durability			OTIF		Labor Productivity
	Traceability; Quality and Complaints management system		Reverse logistics service offerings	Competitive Capability	Production-technical competence	
Logistics / Delivery	Ergonomic quality, Safety and Inprocess control/inspection	Fragmented Cold Chain Supplies Network	Degree of vertically integrated CCSP	Contracting	Technical support knowledge	
	Accuracy in logistics data		Traceability (Track and Trace)			Contract Period
	Hitrate - Quantity, Time		In-process control/inspection		Cost Variance as per market	
Lead time reduction; Short term flexibility in order volume	Appropriate Co-ordination with tier-2 & 3 cold chain providers			Payment Term		
Product development	Product documentation		CCSP's Knowledge about second tier supplier	Pricing	Equipments, Depreciation, Interest, Labor, Facility, Operations, Utilities, IT costs as percentage of total cost of transportation	
	R&D competence and Technical support		Ability to form alliances with other service providers to supplement its capabilities			
Purchasing	Cost reducing initiatives	CCSP's relative competitiveness	Government Regulation	Cost of Fuel Consumption		
	Supply chain risk assessment	CCSP's accreditation			Inbound and Outbound Cost and Margins	
	Investment plans and future visions	Prior experience in product line, similar industry of shipper		Energy and waste parameters		
Environment	Capacity for increased demand	CCSP's ability to grow with Shipper	People Management	Green House Gas Emissions expressed in grams CO ₂ per metric tonne per km		
	Cost structure	CCSP risk assessment ability			Efforts towards employee drivers Training	
	Location distance	Regulatory Compliance		Employee satisfaction level and Labor Relations		
Price	Energy and waste parameters	Temperature Consistency	Stage of CCSP	Quality of dispatch personnel, Managerial staff		
	Public disclosure of environmental record	Temperature Time out of Range			Reputation of CCSP	
Supplier profile	Potential for environmental cooperation	Environmental Stewardship	Strategic stability	Experience in similar product and with similar companies		
	Produce Price and Cost reduction plan				Financial stability	
Risk	Financial status and Market share		Contracting	State of Art Technology		
Relationship	Production facility of capacity; Location of warehouses				CCSP's ability to grow with Shipper	
	Low quality of delivered product				Gain Sharing	
	Production and Delivery delays			Supply Chain Flexibility		
	Supplier customer base			Relationship quality		
	Ability to identify needs; Supplier availability			Dependency on CCSP		
				Preference given to Shipper		

Table 1 - Parameter Bank; Source: Authors

Methodology

Unlike the Cold Chain Industry in developed countries, in developing countries is highly fragmented and therefore, Shippers in developing countries face extreme challenges in findings the right Cold Chain Service Providers (CCSP). It is therefore important to adopt a methodology and process that caters to the specific needs of developing countries while selecting CCSP.

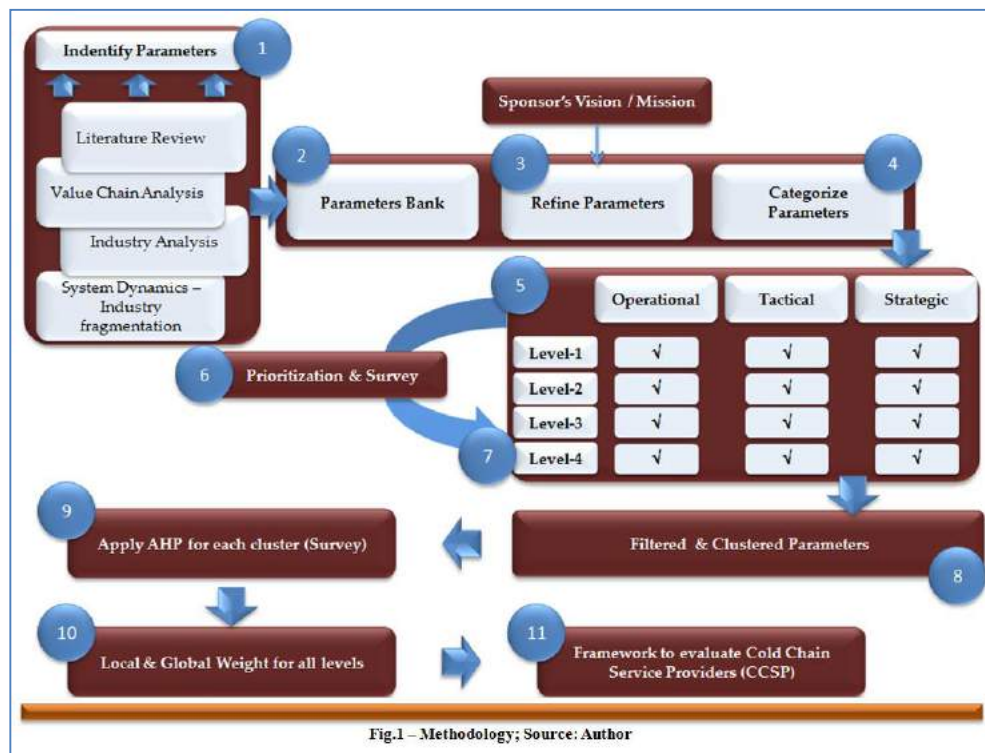
Through the literature review, it was identified that most carriers' selection method emphasizes on perception and price. But such an approach is not very useful for developing countries where there is high variance in the performances of CCSP. For this reason, finding a CCSP in a fragmented industry such as China requires different comparison criteria.

The present work proposes an evaluation framework for CCSP based on quantitative and qualitative criteria. A number of dimensions are included such as cultural, operational and strategic. A combination of Literature Review, Industry Analysis and Value Chain Mapping of the Sponsor Company from the food and beverage industry is used to develop the

framework for evaluation and identification of potential Cold Chain Service Providers (CCSP).

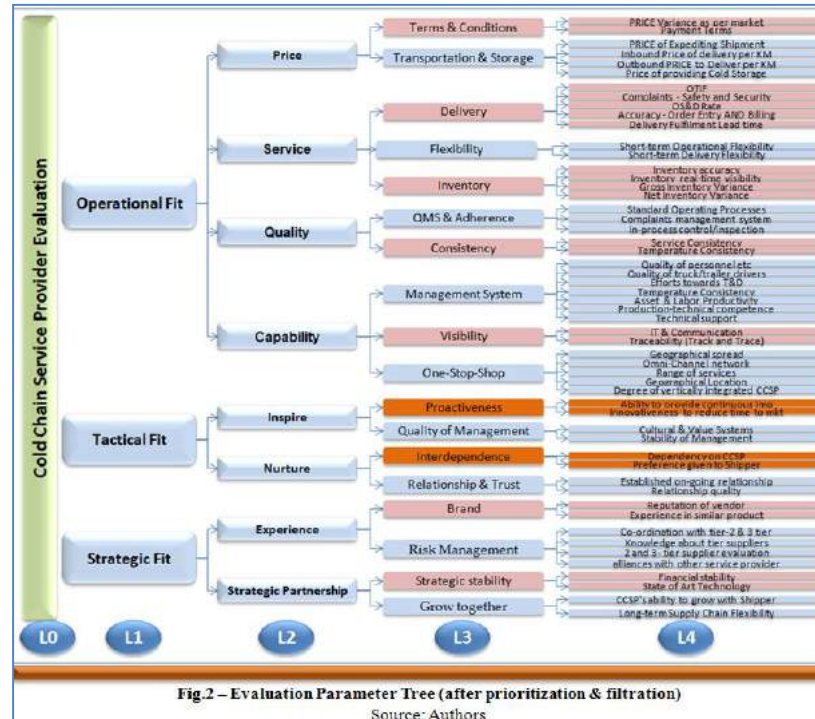
The systematic steps of the methodology are shown diagrammatically in **Figure-1**. The methodology has the following 11 key steps:

- 1) **Identify Parameters:** Dimensions will be identified using a combination of Literature Review, and Value Chain Assessment, Industry Analysis and System Dynamics model. The associated performance measures affecting cold-chains from the beginning of the post-production stage and continuing through the delivery of the goods to the customer distribution centre are captured through understanding of food and beverage industry's requirements. These parameters form the Parameter Bank (indicative in **Table-1**) which is subsequently refined, categorized and filtered to build the final set of parameters for the evaluation of Cold Chain Service Providers.



- 2) **Parameters Bank:** Previous step leads to a number of quantitative and qualitative parameters in completely unstructured form(**Table-1**)
- 3) **Refine Parameter:** The parameter bank is refined by slicing and dicing and combining many of them and used vision, mission and strategic direction to structure and organize parameters.
- 4) **Categorize Parameters:** Post refinement of parameters, they are segmented various dimensions as described in Step-5
- 5) **Parameter Structure:** Step 4 led to the categorization of parameters in three main dimensions, namely Operational, Tactical and Strategic fit. These were developed considering the short-term and long-term plan of the companies. These main categories are called Level-1 parameters. However, evaluation of CCSP cannot be done at such a high level and therefore it's important to break each of Level-1 dimensions into further lower level elements from Level-2 to Level-4. The lowest level is the Level-4 and includes the easily measurable elements.

- 6) **Prioritization and Survey:** Using survey critical parameters are identified
- 7) **Outcome of Step-6:** High ranking parameters from the Step-6 are kept for further analysis (50% parameters identified in Step 5 remain after Step 7. Here the parameters are kept in the same structure as described in Step-5, called Evaluation Parameter Tree and shown in **Figure-2**.



- 8) **Filtration and Clusterization of Parameters:** Filter out non-critical parameters based on survey. Clusterize parameters to facilitate subsequent step
- 9) **Apply Analytic Hierarchy Process (AHP)** to identify local and global weight of parameters and give recommendation for leveraging model findings. Analytic Hierarchy Process (AHP) was developed by Saaty 1985. AHP is used as an integrator – it is called integrator as it encompasses all the above dimensions/parameters in one common framework using a pair-wise comparison matrix to select the CCSP. Since multiple parameters are used to measure CCSP, the AHP model makes it possible to take several factors into consideration simultaneously, and make numerical tradeoffs to arrive at a synthesis or conclusion. Using AHP, one can form clusters by breaking ultimate objective into lower and measurable level and subsequently arrive at local and global weight facilitating evaluation of CCSP.
- 10) **Local and Global Weight for all levels:** Outcome of Apply Analytic Hierarchy Process (AHP) is the local and global weight of parameters
- 11) **Framework to evaluate Cold Chain Service Provider (CCSP):** The Evaluation Parameters Tree of Step-7 will have local and global weight now and is the final CCSP Evaluation Framework (shown in Figure-4).

Model Findings

Strategic and Tactical fit together comprise 55% of total weight, suggesting that sufficient focus on Strategic and Tactical fit is required in evaluating CCSP in fragmented industries(**Figure-3**). In other words, while evaluating CCSPs', shippers should spend

considerable time to understand the long-term and operational fit. Analysis of Level-4 parameters revealed that 11 parameters account for 75% of the total weight of Operational fit, three parameters account for 75% of the total weight of the Tactical Fit (or 21% of the total weight for the overall CCSP evaluation) and another three parameters account for 75% of the total weight of Tactical Fit (or 20% of the total weight for CCSP evaluation). Overall, just 12 Level-4 parameters comprise 75% of the total weight for CCSP evaluation.

Further analysis also suggests that IT capability and Temperature and Service Consistency are more important than pricing parameters. Pricing parameters including payment terms comprise 12% of the total weight. This suggests that non-price levers are much more important in fragmented markets. The significance weight to price and network parameters account for 24% of the total weight (Figure-3, Table-2). This suggests that CCSP are measured more on the basis of price efficiency and partially, network inefficiency of shippers. Therefore, higher weight indicates that shippers can leverage suppliers better if they optimize their network properly.

It is also found that three parameters, Temperature Consistency, IT Capability and Communication with Trucks/Trailers account for 10% of the total weight. These are the only parameters that make the evaluation framework for CCSP different from non-cold chain 3PLs. In other words, if one compares the parameters to evaluate CCSP and non-cold chain 3PLs, it can be found that except for one service parameter and high level of visibility in transportation and warehouse, the parameters used to evaluate CCSP are not much different from a non-cold chain 3PLs. Global and local weight for all parameters from Level 1 to Level-4 is shown in **Table-2** and is the **“Comprehensive Cold Chain Service Provider Evaluation Framework”**.

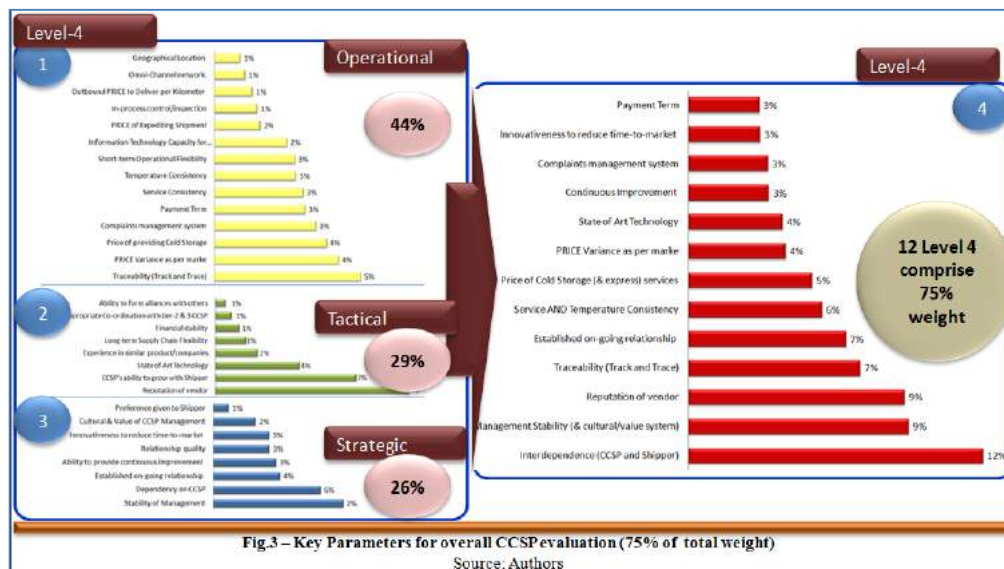


Fig.3 – Key Parameters for overall CCSP evaluation (75% of total weight)

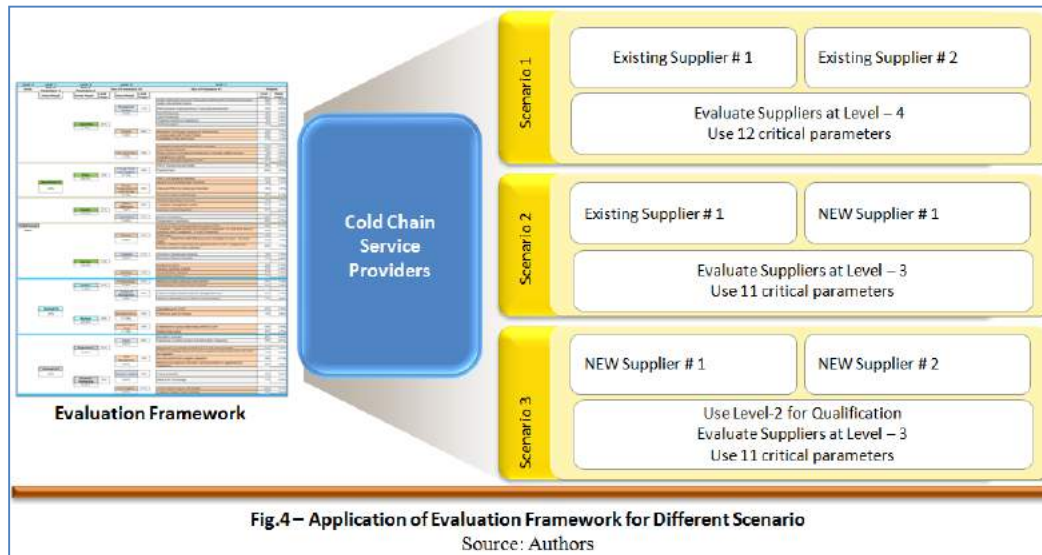
Source: Authors

Conclusions

This study sought to answer one primary questions: “How to evaluate Cold Chain Service Providers in a fragmented market”. In regards to that, research suggests not to evaluate CCSP just on the basis of Operational fit in a fragmented market like in emerging economies. Shippers should give sufficient focus on the Tactical and Strategic fit assessment of CCSP that are drawn from the shipper’s vision, mission and strategic directions. The study further recommends to use different levels of evaluation framework for evaluating CCSP. In other words, the study suggests to use level-2 dimensions of the “Evaluation Framework”

(Figure-4) for the identification of CCSP and level-3 for the qualification of CCSP. It also means that while evaluating new suppliers, shippers should use level-2 and 3 dimensions and use level-3 dimensions for evaluating New and Existing CCSP and level-4 for evaluating Existing CCSPs.

The weightage of various parameters indicates significant opportunity in the areas of Cost Management, and Network Optimization in emerging economies and recommends building long-term relationship with some of the CCSPs while growing in emerging economies.



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PERFORMANCE ENGINEERING IN A SUPPLY CHAIN: A CASE STUDY

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Abstract

This paper presents the results of a case study about robustness in supply chain management, conducted with an international transport logistics provider for valuable goods. In general, transport logistics providers for valuable goods have to be more robust by nature and depend of continuous engineering of its performances. Robustness can be seen as an umbrella term which consists of a subset of business concepts and tools. These concepts and tools interdepend on each other. Their aim is to control and monitor performance indicators, keep defined quality, detect risks and threats in and out of the organization, etc.

Keywords: Robustness, reliability, resilience, risk management, quality management, business continuity management, business process engineering

1 Introduction

Latest since the 9/11 attacks and its enormous impacts to global economy, supply chain (SC) robustness came in the focus of managers. Shortly after the attacks, Snyder (2003) argued that SC robustness is characterized by the well performance of the chain – also with respect to uncertain future conditions. Similar argue Vlajic et al. (2012): SC robustness is “a desired property of a supply chain that is reflected in SC performances”. Thus, in the center of SC robustness is (a) to keep (defined) performance¹ and (b) to develop measurements to close the gap between expectation and real performance.

This paper presents the results of a case study analysis about the practical implementation to maintain and increase SC robustness. Also, this paper shows the overlapping and gaps between theory and an applied practice model of SC robustness. The aim of this paper is to explore, describe and explain the complex phenomena of SC robustness and how it is applied in practice. The case study partner was Swissgold XX (SXX), an international transport logistics provider for valuable goods. The area of tension of this paper deal with the ...

- Theoretical definition of SC robustness and related tools and concepts
- Highlighting of the importance of related and supporting business tools and concepts
- Detailed presentation of SC robustness efforts at Swissgold XX and its comparison with the found results of the literature research
- Demarcate the concept of SC robustness from supply chain resilience
- Interfaces and points of contact of SC robustness and SC resilience

The paper is organized as follows: In the section two, the research design gets presented. Section three comprises a literature review to highlight the status quo and to get in touch with the topic. In section four, the case study gets introduced. Section five comprises the analysis of the case study, the presentation of the finding and the conclusion.

¹ also under challenged conditions

2 Research Design

As mentioned above, the method used in this paper is the "exploratory instrumental single case study analysis".

- **Case Study Analysis**
As Schramm (1971) highlights (*in Yin (2014)*), a case study analysis tries to illuminate a decision or set of decision as "why they were taken, how they were implemented, and with what result". Yin (2014) highlights that a case study is an appropriate method when a contemporary phenomenon over which a researcher has little or no control or the boundaries between phenomenon and context may not be clearly evident.
- **Single**
The single case study analysis is the classic form of case study analysis and is basically to describe and analyze the case (Yin (2014)).
- **Instrumental**
According to Stake (1995) (also Baxter and Jack (2008)), an instrumental case study provides real insights in examined phenomenon and helps to refine a theory. The case is of secondary interest; it plays a supportive role. The case is often looked at in depth, its contexts scrutinized, its ordinary activities detailed, and because it helps the researcher pursue the external interest.
- **Exploratory**
Exploratory case studies are used to explore situations in which the intervention being evaluated has no clear, single set of outcomes (Baxter and Jack, 2008). As Yin (2014) highlights, exploratory cases will be debating the value of further investigating various hypotheses of propositions.

The method of the "exploratory instrumental case study analysis" seems to be appropriate to explore and describe how and with what results SC robustness is implemented at an international transport logistics provider for valuable goods.

According to Yin (2014), a case study consists of the components (a) research question, (b) its propositions, (c) its unit(s) of analysis, (d) a determination of how the data are linked to the propositions and (e) criteria to interpret the findings.

2.1 Research question

The authors of this paper want to explore and describe the term "supply chain robustness" and how and with what results this term finds its application in practice. Therefore the research question for this case study is:

How is "supply chain robustness" defined, handled and implemented at an international transport logistics provider for valuable good? What are the results of supply chain robustness measurements?

2.2 Propositions

According to Yin (2014), propositions directs attention to the topics that should be examined within the scope of study. Additional, proposition narrowing the research question and helps to find relevant evidence. Following, propositions to narrow the scope of study and research question get presented.

- Maintaining supply chain robustness is an organization as well as a supply chain comprehensive concept
- Supply chain robustness is a subset of business tools and concepts as control and statistics, quality management, risk management, safety- and security management and Information Technologies (IT)

- Supply chain robustness is measurable with (operational) key performance indicators
- IT is an important determinant of supply chain robustness. Nonetheless, supply chain robustness is mainly determined by the human factor
- Supply chain robustness is wedded with supply chain resilience; supply chain robustness is a part and depends of supply chain resilience (and vice versa)
- While supply chain resilience is mainly found and applied at the operational business level, supply chain robustness is established at the strategic and tactical business level

These propositions later will guide the findings in the final chapter.

2.3 Unit of analysis & boundaries of the case

The "unit of analysis" is "Swissgold XX"² (SXX). Swissgold XX is an international transport logistics service provider and successfully specializes in the logistics for valuable goods for over 35 years. SXX' headquarter is located in Winterthur (Switzerland). Strategic departments at the headquarter are the 'Board of Managers', 'Controlling', 'Business Development & Sales', 'Process & Quality / IT' as well as 'Safety & Security' (S&S). The S&S department, object of examination of this case study analysis, focuses on the management of strategic safety- and security measures and the compliance of the quality of SXX' products and services*.

The method of data collection for this case study consists of unstructured expert interviews. According to Mayring (2002), unstructured expert interview enables the researcher asking adjusted questions to the situation. Nevertheless, interview guidelines to narrowing the concrete problem definition were developed and distributed to the interviewees. The interviewees of this case study were the Safety- and Security department officer Urs Lüthimann³ and the SXX operational manager of the United States, John Simpson⁴. Both interviewees have a huge experience and knowledge in the management of robustness and resilience in transport logistics.

The interviews have been done on the 13th of May and 14th of June 2013 as well as on the 25th of February and 17th of March 2014. Each interview lasted ~ 1,5 h. Originally, the interviews in 2013 were conducted for a case study with the title "Resilience in Transport Logistics"⁵. These interviews are highly related to the concept of supply chain resilience. Interview 1* (13th of May 2013) was done with Urs, strategic safety- and compliance manager. Interview 2⁺ (14th of June 2013) was done with Urs and John. The interviews (3[±] and 4[§]) in spring 2014 were conducted with Urs and contain specific information about supply chain robustness in transport logistics. Additional, a questionnaire to evaluate efforts for business continuity and reliability in the SXX network was distributed to all SXX operational subsidiary managers (June, 2013). 4 of 6 (or 66,67 %) of the managers returned this questionnaire. Some results are included in this case study too.

SXX is an excellent "unit of analysis". In dependence to Weick and Sutcliffe (2001), transport logistics providers for valuable goods are the "High Reliability Organizations" of the transport logistics industry. As the interviewees highlighted many times: "SXX carrying valuable goods as gold, silver, (historical) artificial ... goods with high values. These goods are not a piece of wood, or something else. There are high emotions behind. We cannot afford any errors or mistakes and must live supply chain robustness and reliability"[±].

² Company name; name editorially modified

³ Urs Lüthimann; name editorially modified

⁴ John Simpson; name editorially modified

⁵ Presented at the MKWI 2014 in Paderborn; (Maurer and Lechner 2014)

2.4 Determination of data linked to propositions

In this subchapter, the determination of how collected data are linked to the propositions gets presented.

- SC robustness bases on organizational interdisciplinary and incorporates the strategic, tactical and operational business level.
- SC robustness is an over-organizational capability and includes all SC stakeholders.
- SC robustness is a subset of business tools and concepts. It incorporates safety- and security management, control and statistics and Information and Communication Technologies (ICT).
- ICT is an important determinant of SC robustness. ICT is and mainly used to keep defined process requirements and statistics. SC robustness is mainly determined by the human factor – ICT plays a secondary role and is considered as an important support tool.
- SC robustness is measurable with several key performance indicators (KPI).
- SC robustness is wedded with SC resilience. Its interface and points of contact are efforts in safety and security.
- Control and statistics is a predominant concept in SC robustness. In comparison to SC resilience, SC robustness is mainly found at the strategic and tactical business level.

2.5 Criteria to interpretation of findings

Used method for interpreting case study evidence is the logic model technique. According to Muroy and Lauber (2004) as well as Funnel and Rogers (2011) (*in Yin (2014)*), logic model technique is a useful method, especially in case study evaluation and in studying theories of change. As Yin (2014) argues, the logic model technique “stipulates and operationalizes a complex chain of occurrences or events over an extended period of time”. This method can use qualitative or quantitative data (or both).

The case study’s chain of events is visualized in figure 1. Afterwards, this chain of events gets introduced. Figure 1 also provides the structure for the case study, presented in section 4.

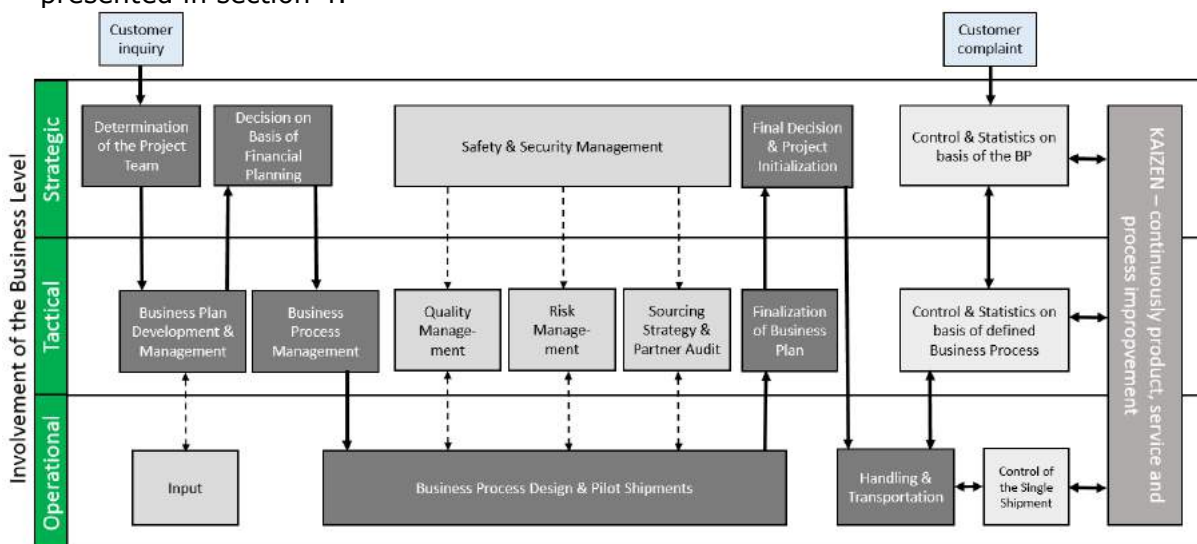


Figure 1: Engineering Process of Supply Chain Robustness

After the inquiry of a potential SXX customer, the strategic management determines a project team. This project team is located at the tactical level. First, the team’s responsibility is to develop a business plan including financial calculations. On basis of these calculations, the strategic management decides to

proceed with or reject the customer's inquiry. After the positive decision, individual business processes get developed. This task is mainly located at the operational, but supported by the strategic and tactical level. Inputs are information and requirements from the department "Safety and Security" and include results from risk management, quality management and business partner evaluation[‡].

By the verification of the business processes, the business plan get finalized and submitted for final decision by the strategic management. Afterwards, the operational business starts. The operational business gets continuously monitored by all business levels: For example, the strategic management controls and monitors the overall business. The tactical business level controls and monitors defined business processes including environmental changes. The operational business level controls and monitors all single shipments. The results of this strict controlling and monitoring as well as customer complaints are the basis for process re-engineering. According to Urs, mathematical computation or optimization methods as enabler for SC robustness are not in use.

3 Theoretical view on Supply Chain Robustness

Organizations face constant challenges. Deming (1998) divides challenges in present and future challenges. He argues: Challenges of "today" encompass the maintenance of quality. Challenges of the future command constancy of purpose and dedication to improvement of competitive position to keep the company alive. To cope these challenges, organizations need to be robust.

3.1 Robustness

Robustness is a main target in transport logistics and supply chain management. According to Mangan et al. (2012), robustness is defined as the capability of an organization to manage regular fluctuations in demand efficiently under normal circumstances regardless of the occurrence of a major disruption. The main idea behind the concept of robustness is to create undisturbed, strong and resistant structures and processes. According to Töpfer and Günther (2009), robustness stands for low probability of errors and defaults and is associated with high reliability of products, services and processes. Reliability describes the behavior of an organization to optimize products, services and processes this robust that it can continue working even though if a disruption takes place. Robustness is wedded with the concepts of quality and constancy (Deming, 1998).

3.1.1 Quality

According to Yang and El-Haik (2009), quality is a multi-linguistic term and can be defined on the easiest level as the ratio of performance to expectation ($Quality = \frac{Performance}{Expectations}$). Quality is related to a variety of concepts (Yang and El-Haik, 2009) which again base on statistical methods. According to Ryan (1998) statistical methods are used to identify unusual variation and to pinpoint the cause of such variation. For example, the concept of statistical process control (SPC) implies to measure and control (internal and external) quality with key performance indicators (KPI)⁶. These KPI's again imply the robustness of a product, service, processes, finance, supplier, etc. They imply: The smaller the variation, the stronger the robustness. Statistical methods are mainly used for quality control and act as the basis for quality improvements.

The most innovative development in quality management is Six Sigma. Six Sigma is a method for business excellence and provides businesses with (a) statistical methods and (b) tools and techniques to improve the capabilities of business processes constancy (Yang; El-Haik 2009). According to Yang and El-Haik (2009), Six Sigma "derives from statistical terminology; Sigma (σ) means standard deviation. For normal distribution, the probability of failing within a ± 6 sigma

⁶ e. g. internal / external failure rates and quotes, rework / post processing, customer complaints, etc.

range around the mean is 0,999966". This means that a Sigma (σ) of ± 6 determines a failure range of 3,4 units per 1.000.000⁷. For example, depending on the industry, suppliers are forced to fulfill specific quality targets. Ford and Volkswagen requires a minimum of ± 4 Sigma (σ) from its suppliers. ± 4 Sigma (σ) determines a 99,38 % failure free delivery. The average quality level in the German industry is about 10.000 defects per million units (Töpfer; Günther 2008). This determines a Sigma level close to ± 4 .

However, as Deming (1998) argues, besides all the most important trigger for quality is the customer. Deming proposes that quality should be aimed at the need of the customer, present and future. This concept is also known as the "Voice of the customer" principle and is determined by the organizational capability of change and adaption.

3.1.2 Process constancy

Deming (1998) highlights, once configured and achieved, quality needs to be constant. Therefore the manager's tasks are to maintain quality and keep it stable and robust. Well-known managerial tools to achieve required process constancy are KAIZEN and Business Process Reengineering (BPR). Both are located at the strategic business level. While KAIZEN is about the continuous, systematic and incrementally improvement of business processes, BPR is the radically redesign of business processes (Hammer and Champy 1999). BPR differs into the American and the European approach. The American approach is a purely top-down process (revolutionary). The European approach is a mix of the top-down and bottom-up strategy. It is an evolutionary approach and tries to combine the approaches of the US-BPR and KAIZEN. An involvement of employees is necessary. Figure 3 visualizes the categorization of KAIZEN and BRP.

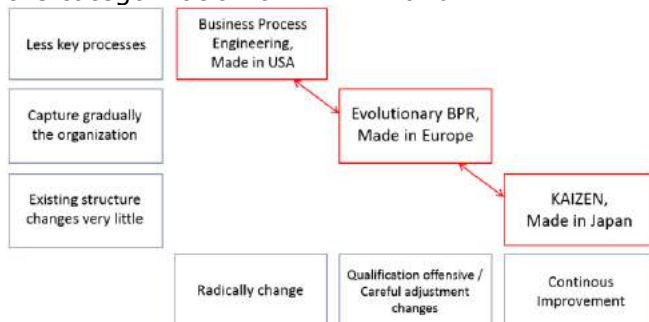


Figure 2: (Re-) Engineering methods (in consideration of (Servatius 1994))

According to Gierhake (2000), Schnetzer (1999) and Becker et al. 2008, the major differences of BPR and KAIZEN are visualized in figure 4.

⁷ 5 σ = 233 failures; 4 σ = 6.210 failures; 3 σ = 66.807 failures; 2 σ = 308.538 failures; 1 σ = 691.462 failures / 1.000.0000 units

	BPR	KAIZEN
Trigger	Requirements for change of a process	Requirements of adaption within a function
Target	radically change; whole businesses processes get restructured	continuously improvement; maintenance and improvement of existing
	redefinition of tasks and processes	focus is on existing tasks and processes
Approach	US: top-down; EU: bottom-up	bottom-up
	innovative, unique change process	incremental, permanent improvement process
	wholistic process view	focus on single process sections
Risk	high	moderate, low
	instable radical change	relative stability in a controlled change
Time and implementation	timely limited projects	unlimited; step-by-step
Expenses	high	low
Persons involved	strategic business level, project team	all employees (incl. Strategic, tactical and operational business level)
improvement proposals	low or no consideration	high consideration

Figure 3: Comparison BRP and KAIZEN

3.2 Resilience

According to Weick and Sutcliffe (2001), resilience is defined as the “capability of a system to maintain its function and structure in the face of internal and external changes and to degrade gracefully when it must”. Woods and Hollnagel (2006) define resilience as the “ability of a system or an organization to react to and recover from disturbances at an early stage, with minimal effect on the dynamic stability” which has, according to Westrum (2006), three major meanings: First, resilience is the ability to (1) prevent something bad from happening, or (2) to prevent something bad from becoming worse, or (3) to recover from something bad once it has happened. For Hiles (2010), resilience engineering “seeks ways to improve robustness, reliability and flexibility of processes and organizations, continually monitoring and revising risk levels. [...] Success in resilience engineering gives the ability to bend before the wind, rather than break – to anticipate that ‘unknown unknowns’ will happen, to adapt, move on and not to fail”.

3.3 Robustness versus resilience

The main idea behind robustness is to create undisturbed, strong and resistant processes. While robustness stands for stability and constancy, maintaining intact structure, low deviation and control via KPI’s, resilience is wedded to organizational agility, adaption and change. Both concepts are important characteristics of a SC. A robust SC is always resilient (and vice versa) or as Madni and Jackson (2009) argue: Organizational survivability and success arises from a combination of robustness and changeability or adaptability (resilience).

4 Case study

SXX is an international transport logistics service provider. Because of the values, sensitivity and emotions of carried products, transport logistics providers for valuable goods have to be more robust than average transport logistics providers. As the main-interviewee Urs highlighted, SC robustness and reliability is a permanently challenge.

4.1 Swissgold’s Robustness Strategy

As Urs said, basically every transport logistics provider defines robustness different and has different strategies. The focus of SXX’ robustness strategy comprises the whole supply chain. To achieve this goal, SXX maintain an intensive cooperation and collaboration with its business partners as airlines, freight forwarders, carriers, etc. †.

In the center of SXX’ SC robustness are mainly quality and statistical figures (about finance, process performance, etc.) †. As in figure 1 visualized, SC robustness at SXX incorporates a subset of business concepts and techniques as business plan development, process management, safety and security management (incl. risk-

and quality management, partner and agent evaluation) and control and statistics. Information and Communication Technologies (ICT) are seen as supporting tools[‡].

4.2 Business Plan Development & Management

At SXX, a business plan is a written document and visualizes the business facts of the customer's transport inquiry. This plan is managed by the tactical level and includes the technical and financial description[‡]:

- The technical description includes the definition of the cargo and its sensitivity, visualization of the import and export relation (transport volumes), needed vehicles to carry, infrastructural requirements for interim storage as well as route optimization (e. g. pick-up place and time, delivery place and time, etc.). This general development is in close cooperation and collaboration with the customer and the operational level.
- The financial description consists of a simulation of the full-cost calculation sheet, the visualization of the business turnover and profit speculation / expectation and the computation of the business' different profit margins (1 – 5). Furthermore, this chapter incorporates a financial future outlook and a sustainability check.

According to Urs, if the financial figures in this plan are not appropriate or the future outlook of the business is not sustainable, it is very likely that the strategic management rejects the customer's inquiry[‡].

4.3 Business Process Management and Design

As Urs said, after the positive decision of the strategic management, business process management (BPM) including business process design and pilot activities starts. Because of the heterogeneity of carried goods, any existing business process can be adapted. BP planning and designing at SXX begins always "Green Field"[‡] and is an operational task^{‡, 8}. The tactical manager has supporting functions and provides continuous information about risk and threats (incl. business continuity management and what/if scenarios), quality requirements and reliable business partners. Defined business processes get documented in Microsoft Office Visio – a further IT tool is not in usage[§].

After the modelling phase, two to three pilot shipments get dispatched. It the center of these pilot actions are the handling of the shipments and the end-to-end delivery. The pilot shipments provides essential information about engineered processes and delivers information about KPI's, quality gaps, bottlenecks and vulnerabilities^{‡ & §}. Only if everything is handled in a safe and secure way, "normal" shipments get dispatched[‡].

4.4 Safety and security

SXX' approach to safety and security is combined with the concepts of quality management, risk management, single sourcing and partner audit. These concepts are controlled by the "Safety & Security" department and executed by the tactical and operational business level.

4.4.1 Quality management (incl. Voice of the Customer)

Quality management, as Urs said, is an essential pillar of SXX' robustness strategy. SXX' quality strategy is about maintaining a consistent or higher process and service quality. For example, SXX follows the "zero-error-principle" and is ISO 9001 certified. Further, in the center is the "voice of the customer principle"[‡].

Every customer get a certain level of quality contractually assured. This level must be kept in the whole supply chain. Therefore, the partners need an equal or higher quality standard as SXX. The internal as well as the external quality get measured

⁸ According to John: business process planning at the operational level is the optimal case

by KPI's. If required quality is not achieved, failed business partner of SXX get a complaint (operational level). In re-occurrence of quality failure, SXX sends quality managers (tactical level) to the partner to discuss the quality gaps and develop appropriate solutions. The last intervention is to quit the business collaboration (strategic level)⁵.

But in the eyes of Urs, the "Voice of the customer" is the most important quality principle in the SXX' robustness strategy. As he said, customer complaints jeopardize SXX' reputation. If a customer complaint arise, the business process get evaluated and discussed with the customer. Afterwards, according to the customer satisfaction, the business processes get re-engineered and changings implemented.

4.4.2 Risk Management (including Business Continuity Management)

Risk management plays a major role to maintain and increase SC robustness⁺. Main task of risk management is to collect and evaluate figures, facts and information about business environments, partners and their infrastructure, etc.

- Tactical and strategic risk management is associated with business continuity management (BCM). According to interview 3⁺ and distributed questionnaire⁹, BCM is recognized as an add-on to risk management. BCM is a very important accompanying process⁺ of daily work. In general, BCM at SXX is subjected to a high organizational acceptance and implementation. According to the participating operational managers, BCM is seen as a process which increases the robustness and reliability of SXX' supply chain. Further, BCM is seen as mixed strategy, where the strategic and the operational level have to cooperate and collaborate equally. Nevertheless, BCM is seen more as a task of the strategic management which has to be implemented top-down.

Question:	Options of answers					Answers				Mean value		
		Likert Scale					Q1	Q2	Q3		Q4	
Safety and security or business continuity management ...												
must be a core process.	I agree	1	2	3	4	5	I don't agree	2	1	2	2	1,75
must be implemented ...	top down	1	2	3	4	5	bottom up	2	2	1	1	1,5
is a task of ... management.	strategic	1	2	3	4	5	operational	2	2	2	2	2
must be ...	centralized	1	2	3	4	5	decentralized	2	2	4	4	3
needs ... processes.	standardized	1	2	3	4	5	empowered	2	1	2	2	1,75
increases efficiency.	I agree	1	2	3	4	5	I don't agree	3	2	2	2	2,25
increases reliability and robustness.	I agree	1	2	3	4	5	I don't agree	3	2	2	1	2
creates a return-of-investment (ROI).	I agree	1	2	3	4	5	I don't agree	3	3	3	3	3

Figure 4: Engineering Process of Supply Chain Robustness

Because of the high susceptibility of ICT to incidents and disruptions, SXX recognizes ICT as an essential part in their business continuity planning. For example, SXX maintain two computer centers, two internet providers (in Swiss), and backup and redundancy strategies⁺.

- Operational risk management is handled via checkpoints. Checkpoints are demanded by the SXX internal control system and implemented in their logistics software system. After every process step (e. g. cargo delivered to the warehouse, cargo delivered to the agent, etc.), the employee has to demand information – either automatically or manually. Basically, the employee is in a pro-active obligation⁺.

⁹ Questionnaire, distributed to all SXX operational subsidiary managers (June, 2013). Return rate: 4 of 6 (or 66,67 %)

A further operational risk measurement is the risk spreading of shipments. For example, SXX never sends a shipment as a whole – they disconnect the shipment into many smaller shipments (e. g. 50 Mio U\$-Dollars into 100 shipments á 500.000 U\$-Dollar). Also, the stock value of SXX' warehouses get continuously monitored and must not exceed a defined financial limit[§].

As Urs said, quality-, risk- and business continuity management also act as interface to the concept of resilience. Both, the concept of robustness and resilience, benefit of the results of risk- and business continuity management (e. g. a detailed risk map*). Identified quality gaps, risks, threats, etc. initializes specific activities for performance engineering and triggers activities to improve organizational resilience[‡].

4.4.3 Sourcing strategy

As Urs said, another important concept in their robustness strategy is their sourcing strategy. SXX has one partner per location/destination. Urs argues that this single sourcing strategy gives SXX stronger power over its business partner. For SXX, it is important to be the focal company: They needs (and wants) to be the coordinating and controlling organization in the SC. It is their obligation in face to the customer[‡], §.

4.4.4 Partner evaluation & audit

As Urs said, an audit differs in audits for new and existing partners. In both cases, the lead question is: "How can we be sure of this partner in delivering constant safety, security and quality as well as process reliability". SXX maintain two partner audits which are:

- New SXX business partners experience a thoroughly and holistically audit. The result of this evaluation is a partner profile about hard and soft facts, process and service reliability and expert opinions. On basis of these results, the SXX' strategic department decides, if the operational level can cooperate and collaborate with this partner. If yes, finally contractual agreements including the level of quality and insurances get established[§].
 - Hard facts for example are the evaluation of the partner's safety and security measures, its location (and environment) and infrastructure. It includes a physical inspection and the assessment of the technical equipment, financial status and liquidity, implementation of business continuity management and plans, etc.[‡]
 - The evaluation of partners' soft facts consists of the examination of trustworthiness, loyalty, valid statements, etc.[§]. For this evaluation, SXX developed a standardized questionnaire where the partner's board of management has to answer carefully.
 - Also an important check is the partner's process and service reliability. For example, a new business partner always has to handle two to three pilot shipments to proof its ability for business collaboration.
 - Additional, opinions and experiences of third parties like insurances, customers and competitors of the new business partner get included[§].

SXX is aware about the fact that countries have different safety and security standards. SXX considers these national differences. But, as Urs said, partners must provide at least a minimum level. The agent's ability of adaption of SXX' safety and security requirements is an essential knock-out (K. O.) criteria. Without a cooperation and collaboration is not possible[§].

- Existing SXX business partners experience an audit every two to three years. As noted above, hard and soft facts get evaluated. But in comparison, this

audit is not as restrictive. Additionally, existing contractual agreements get reviewed, re-worked and adapted[‡].

A further important aspect in partner evaluation is the partner's payment and invoicing behavior. As Urs said, SXX' recognize immediately if a partner takes care about its entrepreneurial obligations, or not.

Excluded of the sourcing strategy and the partner audit are airlines and shipping companies[‡]. According to Urs, there are only few airlines and shipping companies who transport valuable goods. SXX works with them since several years and know their high safety and security standards. Also, as Urs said, SXX has only limited influence on these partners. In comparison to freight forwarders, carriers, agents, etc., SXX only can propose instead of demand safety and security improvements. A change of the airline respectively the shipping provider is possible but not very realistic. SXX rely on these providers[‡].

4.5 Control and statistics

After the finalization of the business plan and the positive decision of the strategic management, operational business starts. Operational business is wedded with thoroughly control and monitoring of (a) the single shipments (on operational level), (b) defined business processes (on tactical level) and (c) defined financial figures in the business plan (on strategic level).

At SXX, each business level have several target figures defined as key performance indicators (KPI) in use. This KPI's are to measure the SXX SC robustness and reliability and are defined in the business plan and the process design. The basic requirement is that a KPI do not deviate from defined or expected result. A deviation, so Urs, implies brittleness – consequently the opposite of robustness.

4.5.1 Strategic control

As Urs said, the strategic business level controls and monitors defined KPI's of the business plan. However, these key performance indicators are mostly financially and are, for example, the turnover, profit, profit margin 1 – 5, etc. If, for example, a transport relation provides good robustness indexes but has only low or no profitable, it is possible that the strategic department decides to stop this transport relation. Further, in the focus of the strategic level's interest are the volumes of shipments per origin, destination, etc. on customer level. But also, on this business level, customer complaints get observed.

4.5.2 Tactical control

The tactical business level controls and monitors defined KPI's of the business process. KPI's on this level are for example the internal and external lead times (e. g. from door-to-door, from warehouse-to-warehouse, etc.), internal and external processing times, disturbances, damages, service quality of partners, damages and delays, etc.[§]. But also, the implementation and application of business continuity plans, safety and security concepts, emergency management, etc. get controlled.

4.5.3 Operational control and monitoring

The operational level controls and monitors each single shipment. Special interests are for example the punctual pick-up and delivery, quality and quantity of delivery, etc. Also, in focus of the operational level are the continuous feedbacks of the partners (manually or automatically (e. g. by track and tracing)). Whatever reason for, if the partners do not send any feedback, the employee is forced to take over responsibility proactively. If irregularities or unanticipated events occur, the employee is challenged to bring in all its competencies to execute existing BC plans or to develop "Plan B".

4.6 KAIZEN – Business process (re-engineering)

SXX maintain continuously statistical reports about key performance indicators. For that, SXX has a separate reporting tool[‡]. The reports can be developed on daily, weekly, monthly, quarterly and yearly basis with a huge amount of combinations

and functions. These reports are the basis for KAIZEN – the continuously process engineering and improvement. Results of these reports discussed regularly and changings and improvements get engineered in regular workshops. As Urs said, further business tools and concepts to maintain or improve SC robustness (e. g. Six Sigma, TQM, etc.) are not in use[‡].

4.7 Information and Communication Technology

According to Urs, ICT is seen as an important tool. Every business process at SXX is underlined with ICT. If, for example, ICT does not work SXX faces serious problems in operational business[‡]. Thus, ICT is highly considered in risk management activities and business continuity planning[‡]. Strategies to maintain IT are redundancies (e. g. SXX uses the service of two different internet and telephony provider[§]), regularly data backups, mobility (laptops instead of desk-tops) and infrastructure (e. g. cloud programming^{*}). At least, if really a disruption hit, SXX maintains the fallback strategy of outsourcing of its operational business to business partners (mainly airlines)[‡].

4.8 Human factor

Basically the human factor at SXX is more important than ICT. As Urs said: "In comparison to ICT, an employee has the competencies to intervene. They have the ability to manage if something goes wrong during the transport process. An employee at SXX has the competencies and power to manage properly if a disruption hit the SXX logistics chain"[‡].

Basically, SXX supports the empowerment of employees and their ability for decision making. For that, SXX provides continuous internal and external employee training courses. Employee training and awareness are seen as contributing parts to increase SC robustness[§].

4.9 Robustness versus Resilience

The concept of robustness is in close relation with the concept of resilience. Urs, for example, said, "if I have robustness, then I also have resilience"[‡]. According to him, robustness is the initial concept of resilience: In the beginning (of a business, process, etc.), robustness is more important. First, it is necessary to make the business (, process, etc.) robust and reliable. Afterwards, it is essential to make it resilient and sustainable. This again stabilizes and improves robustness. Management is always about the equilibrium of these two concepts: Resilience needs a strong robustness. If robustness is challenged by unexpected or unknown events, resilience must be ready. Resilience is about techniques to prevent, response and cope disruptions and keep at least a minimum of business ongoing[‡].

As Urs said, the concept of robustness is located at the strategic and – partially – at the tactical level. Robustness is about "Management by Figures"[§]. In the center of this concept are facts and figures. Emotional things are not of interest[‡]. In comparison, resilience is mainly located on the operational business level. Resilience is about the decentralization of power and empowerment of employees and consequently about leadership.

5 Analysis, Findings & Conclusion

In this chapter, the analysis and the findings of the case and the conclusion get presented.

5.1 Analysis and Findings

The analysis is grouped in three clusters which basing on the research question. The clusters are definition, handling and implementation of SC robustness at an international transport logistics provider. As figure 3 highlight, to concretize the findings, additional the propositions got assigned to the clusters.

Cluster	Proposition
Definition	Maintaining supply chain robustness is an organization as well as a supply chain comprehensive concept
	While supply chain resilience is mainly found and applied at the operational business level, supply chain robustness is established at the strategic and tactical business level
Handling	Supply chain robustness is measurable with (operational) key performance indicators
	IT is an important determinant of supply chain robustness. Nonetheless, supply chain robustness is mainly determined by the human factor
Implementation	Supply chain robustness is a subset of business tools and concepts as control and statistics, quality management, risk management, safety- and security management and Information Technologies (IT)
	Supply chain robustness is wedded with supply chain resilience; supply chain robustness is a part and depends of supply chain resilience (and vice versa)

Figure 5: Framework to present the findings

5.1.1 Analyze: How is SC robustness defined?

Against several literature sources, there does not exist a single definition about SC robustness. As the interviewee said, basically every organization has its own definition and access to this concept. At SXX, SC robustness is an organization comprehensive capability and incorporates the (internal) strategic, tactical and operational business level. The preservationists of SXX' SC robustness are mainly found on the strategic and the tactical level.

- The strategic level coordinates and controls the tactical and the operational level. Their task is to provide a framework including policies, guidelines and standards about quality-, risk- and business continuity management for operational business.
- The tactical level develops (a) the business plan and (b) the process design for each business. Both documents incorporate important target figures and KPI's. The business plan is seen as the basis of decision making for the strategic level. The business process plan incorporates the process design and is influenced and determinate by policies, guidelines and standards by the strategic safety and security department.
- The operational level has a limited, but important role in SC robustness. The operational level contributes important information about business process and operational business. Also, they are responsible for business process planning and operational business management. The strategic management considers that the operational managers and employees are the experts in their particular field of business. The strategic level contributes with a framework.

Additional, SC robustness at SXX is a chain comprehensive capability. In this external view, SXX aims to be the focal, coordinating and controlling organization over its partner organizations. Business partners who want to work with SXX are subjected to a thoroughly audit and evaluation and forced to take over their safety and security requirements.

5.1.2 Analyze: How is SC robustness handled?

Upon closer inspection, the handling of robustness at SXX happens restrictive and is subjected to a variety of safety and security concepts. These concepts build a closed circuit and each concept interdepends in each other.

The restrictive handling of SC robustness at SXX is argued with its direct impacts on income and profit. Brittleness, the opposite of robustness, jeopardizes the SXX

reputation and consequently revenues. However, financial figures are one of many KPI's which imply SC robustness. At SXX, all business levels have their own KPI's. The strategic level focuses on financial indicators. The tactical level focusses on economical business processes indicators as effectiveness and efficiency. The operational level focuses on each single shipment.

ICT is an important support tool. ICT applications help to handle a proper SC robustness with e. g. process-checkpoints, automatically track and tracing, and process standardization. At SXX, basically all business processes are underlined with ICT. Also, ICT has a special role in developing statistical reports about KPI's, business, processes, etc. But nevertheless, SXX does not see ICT as the most influencing component in its robustness strategy. They are still the employees (human factor). According to the interviewees, they imply its employees several competencies as behavior, reliability and ability to judge. Also, in comparison to ICT, an employee can intervene and manage if processes get interrupted. Mathematical (optimization) methods are generally not in use.

5.1.3 Analyze: How is SC robustness implemented?

As the case shows, SC robustness is implemented top-down which means that the higher business level controls the lower level(s). Nevertheless, lower level(s) are encouraged and invited for proactive participation. The participation happens via the concept of resilience. In the ideal process occur bottom-up which means: The operational managers inform the headquarter about vulnerabilities as well as possible solutions. The semi form occur top-down: Recognized vulnerabilities get collected in a strategic risk-map by the strategic level. For a further evaluation and input collection, a first draft gets sent to the operational managers.

According to Urs, the polarization of robustness and resilience is the biggest challenge in SXX' organizational management. On the one hand, robustness determines management (by figures) and includes centralization and controlling. On the other hand, resilience determines leadership and includes decentralization and empowerment. But nevertheless, the implementation of robustness is in close relation to SXX' resilience strategy. As Urs said, after a (new) business is chartered, robust engineering of the business processes is key. After the stabilization, resilience engineering takes place. Resilience engineering focus on SXX' and its SC partners agility, adaptability and ability for change. Resilience at SXX develops response and recovery strategies to cope business and process disruptions. As robustness, resilience is closely related to risk- and business continuity management. Both benefit of the results of risk- and BCM or provide essential information for them. Robustness without resilience (and vice versa) does not exist. It is always about the question about the equilibrium of these concepts. But this is situational and thus changeable.

5.2 Findings

The most important observation made in this case study is the realization that robustness is not a single concept. As the case shows, robustness is an umbrella term and consists of a subset of interdependent business concepts and tools. These concepts for example are business plan management, process management, safety and security management, control and statistics, continuous improvement strategies, etc. Further observations made are the robustness framework, strict handling of internal and external control, process accuracy, interdependent safety and security concepts, the appropriate equilibrium of robustness and resilience and human resources.

- **Robustness framework**
As the case shows, SXX provides a harmonized robustness framework with clear task allocation and work specialization. Every business level brings in its strengths and competencies. The strategic level provides the guidelines

and policies. The tactical level provides the business plan. The operational level develops the business processes.

- (Internal) Control and monitoring
This framework is underlined with a strict, centralized controlling and monitoring process. The higher level controls and monitors the lower level. All key performance indicators (defined in the Business Plan and Business Process Design Plan) get collected, processed in statistics and carefully analyzed. Deviations from the expected results get critically questioned and are the basis for process improvement. The most important indicator observed is customer complaints. Customer complaints threaten the organizations' reputation and consequently the revenues and profit. Also they imply missing process accuracy.
- Processes accuracy
SC robustness underlies thoroughly planned, defined and measurable business processes. The business processes get planned from operational level. The decentralization (bottom-up approach) of the business processes allows including expert knowledge and regional features. The tactical level supports with safety- and security, quality and risk requirements. These requirements must get included in the business planning. Afterwards, the designed business processes get verified by pilot shipments. These pilot shipments act as enabler to detect process vulnerabilities and to localize process improvements. A guideline should be: Nothing can be left to chance because a supply chain disruption is equal to loss of reputation and revenues.
- Interdependent safety and security concepts
The strategic department "Safety and Security" is engaged with the tactical quality-, risk- and BC management. These concepts are interdependent concepts and each concept gain from each other concept's output. For example, quality management specifies the desired and expected quality of service and processes. Risk management estimates the possible disruptions and vulnerabilities. BC management develops plans how specified quality get achieved and maintained, also in case a disruption hit. Continuously partner audits aims to evaluate the business partner. The results again influence the quality- and risk management. Additional, quality management, risk management and BCM concepts are determined by clear targets: zero errors and the voice of the customer. In the center is the customer satisfaction.
- (External) Control and monitoring / Partner audit
As highlighted, a further aspect in maintaining SC robustness is the proactive control and monitoring over business partners. The aim is to preserve and maintain specified external safety, security and process reliability.
- Equilibrium of robustness and resilience
SC robustness is strong relation to SC resilience. As the literature as well as the case study shows, robustness is the basis for resilience. Robustness and resilience are interactively concepts. Each concept depends on the requirements and results of the other concepts. For example, if robustness is threatened, resilience must provide solutions to keep at least a minimum of business ongoing. Vice versa, robustness must provide results as basis for resilience engineering. Therefore, the question is not about a codified mix between robustness and resilience. It is about the situational equilibrium.
- Human Factor

As the case shows, also in times of progressive digitalization, the human factor is still more important as ICT systems. In the concept of SC robustness, humans are encouraged to bring in their behavior and competencies if a supply chain disrupt. ICT systems are seen as important tool to support in decision making.

5.3 Conclusion

In this paper, the definition, handling and implementation of supply chain robustness and performance engineering at an international transport logistics provider for valuable goods get explored and described. As the case shows, SC robustness is an umbrella term and incorporates several business concepts and tools to maintain and enhance SC performance. On the one hand, robustness consists of thoroughly business planning and process designing. On the other hand, robustness is influenced by quality-, risk- and BC management. Internal and external control are important determinants of SC robustness. As the case highlight, robustness is mainly located at the strategic and tactical level and consists of strict controlling and monitoring of the operational level. Also, robustness is in strong connection with the concept of resilience.

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* (Lüthimann 2013)

† (Lüthimann; Simpson 2013)

‡ (Lüthimann 2014a)

§ (Lüthimann 2014b)

LOGISTICS PERFORMANCE MEASUREMENTS – ISSUES AND REVIEWS

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ABSTRACT

Logistics is a backbone for the global supply chains. In Malaysia, logistics are now recognized as strategic industry that positively contribute to gross domestic product (GDP) and performance of logistics is foremost significant. Whereas most of the logistics performance has focused on investigating operational and trade facilitation contexts. Thus, the purpose of this paper is to examine the issues and reviews by practitioners and found 7 key components that translated it into operations performance objectives. It, thus, provided a base for future research to examine the relationships of this context empirically.

INTRODUCTION

Logistics play a key role in both micro and macro perspective. From a micro perspective, logistics service could fulfil the customer's expectations through excellent logistics service provision and from a macro perspective, it drives the economic development of a country. Logistics plays its role as early as in the beginning of 1900s, in distributing the farm products (Lambert, Stock, & Ellram, 1998) and it continues to evolve until today, in which it is regarded as a strategic industry. Logistics could also improve business performance through its flexibility and advanced technology application, thus leading to organisational success (Tracey, 1998). In a global supply chain context, moving goods across borders has been one of its significant role recently. The remarkable expansion in external trade has brought higher demand for an efficient and effectiveness of logistics services (Ali, Jaafar, & Mohamad, 2008).

In the context of Malaysia, the astounding expansion of the logistics industry has led to the formulation of the Logistics Master Plan to enhance the capability of the logistics industry. The strategic direction had identified the development of logistics infrastructure and review of regulations and laws as the components that need to be given priority as countries are moving towards the implementation of trade and transport facilitation. Due to administrative, technical and legal requirements, moving goods across borders has caused several problems (Ling, Goh, & Desouza, 2008). Thus, the combination of both enhancement of trade facilitation measures and implementation of strategic operational performance would make Malaysia more competitive. As such, based on an ongoing study, this study examines issues and challenges faced by the logistics players.

1. BACKGROUND OF THE STUDY

In 2013, it was reported that the Malaysia logistics industry made great contribution to the gross domestic product (GDP), i.e. 13% (Malaysia Logistics Council, 2013). Despite this remarkable achievement, there is still a need to assess performance of the logistics industry. In order to understand the issues and challenges of the logistics performance in Malaysia, it is useful to review the performance measurement in theoretical perspective and components that have been used in previous studies.

a) Theoretical Definitions

i. Logistics Performance (LP)

Overall coordination should be the main objective in logistics (P. Andersson, Aronsson, & Storhagen, 1989). Porter (1990) highlights that upgrading and innovation would result in nation's competitiveness. Therefore, measuring the LP is currently becoming a high priority (Griffis, Goldsby, & Cooper, 2007), thus bringing a challenge to the organizations (Forslund, 2007). From the perspective of LP, it has been commonly discussed as early as in 1985 at a seminar in Netherland by The Netherlands Association for Logistics Management (NAVEM). In this seminar, the performance indicators model was produced and the indicators have been applied in several companies (MCB University Press, 1992). LP is defined as 'analysis of both effectiveness and efficiency in accomplishing a given task' (Mentzer & Konrad, 1991). Other scholar refers LP as a metric used to quantify the efficiency and or effectiveness of an action (Neely, Gregory, & Platts, 2005). This topic continues and LP has been seen as multi-dimensional and is defined as the degree of efficiency, effectiveness and differentiation associated with the accomplishment of activities (adapted from Fugate, Mentzer, & Stank, 2010)

Researchers have always find it difficult to define LP because organisations have multiple and frequently conflicting goals (Chow, Heaven, & Henriksson, 1993). In the context of this study, *efficiency* is a measure of how economically the firm's resources are utilized (Mentzer & Konrad, 1991; Neely et al., 2005). Several critical areas in LP *effectiveness* as described by Langley & Holcomb (1992) are product guarantee, availability and fulfilment time. They also extended the definition of effectiveness by adding *differentiation* as the ability to create value for the customer through the uniqueness and distinctiveness of logistics services.

As mentioned earlier that LP plays a vital role in achieving the organisational's goals. The evaluation is based on how well goal is met (Mentzer & Konrad, 1991) and to what extent the overall productivity and performance would reflect LP (Stabler, 1992). Consequently, LP helps the fulfillment of the organisation's objectives and strategy (Braz, Scavarda, & Martins, 2011) as well as satisfying the customers (Kayakutlu & Buyukozkan, 2011).

ii. Trade and transport facilitation from the perspective of strategic operations performance

Trade and transport facilitation initiatives have direct implications on the management of international logistics and supply chains process (Batista, 2012). Trade facilitation focuses on the movement of goods through ports and more importantly the customs documentation and trade process across border (Wilson, Mann, & Otsuki, 2005), broader context might include regulatory requirements and harmonisation of standard, as well as reformation and the modernization of ports and customs.

Therefore, the function of strategic operations performance, namely efficiency and effectiveness are required to create value in logistics services. Lowering the costs as much as possible as described in efficiency and fulfilling the customer requirement through the delivery of logistics services as defined by effectiveness would create differentiation that is closely related to trade and transport context. Batista (2012) applies the fundamental strategic performance objectives in the context of trade and transport facilitation (Table 1).

Table 1: The Fundamental Strategic Operations Performance Objectives in Trade and Transport Facilitation Context

Components	Trade and Transport facilitation context
Speed	'Automated processes' or speed up the operations
Dependability	Transparency of border processes
Flexibility	Different entrance times
Quality	Quality of transport infrastructure
Cost	No hidden cost

*Adapted from Batista (2012)

Gupta, Goh, Desouza, & Garg (2011) highlight that the differences in the quality and cost infrastructure, policy, procedure and institution would affect the speed and cost of the logistics services across border. However, from the perspective of trade and transport facilitation, most consistent measures are port infrastructure, custom environment, regulatory environment and e-business environment (Appels & Swielande, 1998; Ling et al., 2008; Otsuki, Honda, & Wilson, 2013; Wilson et al., 2005).

b) Logistics industry in Malaysia

It is expected that the Malaysia logistics industry could achieve positive development following numerous initiatives created by the Malaysian Government. The Malaysia Logistics and Supply Chain Council (MLSC) could be one of the initiatives to monitor and the development of the logistics industry.

Ali et al. (2008) emphasise that the logistics issues in Malaysia could be viewed from four different perspectives. The policy has been regarded as the main components that significantly influence and the competitiveness of the industry. Sgouridis (2003) highlights that some procedures and performance indicators could be implemented in Malaysia namely, service times, operating costs, fleet utilization, practicality of issuance certificates as well as high priority of compliances. On the other hand, Zuraimi, Mohd Rafi, & Dahlan (2012), who focuses on the logistics development in the Eastern Region found that the constraints with logistics infrastructure affect the logistics development in east corridor. Several other researchers demonstrate that, logistics cost has also been one of the significant issues affecting the logistics industry (Ali et al., 2008; Zuraimi et al., 2012). However, no detail justifications explaining the factors contributing to these issues.

MIMA (2008) emphasise that to achieve the cost competitiveness attain the economies of scale, many manufacturers outsource their production function. This outsourcing strategy not only satisfy the customers, but it allows competitive advantage to be attained. Third party logistics (TPL) service providers lay a key role in managing outsourcing logistics activities and production. Thus, manufacturers should be able to focus on their core business and maintain the lowest cost possible of production.

2. RESEARCH METHODOLOGY

A preliminary study is conducted to evaluate the feasibility and comprehensive understanding of the identified core LP components among the manufacturers and logistics service providers (LSP). To support the limited To support the limited information with regard to logistics performance study in Malaysia, ten (10) preliminary interviews have been conducted. Each interview took less than one hour. The questions deal with the background of the informants, experience

in dealing with international logistics activity, the issues they encounter in their daily operations and LP (refer Table 2). The informants were selected using the snowball sampling technique.

Table 2: The Background of the Informants

No	Position	Industry	Type of companies	Length of experience in the industry
1	Logistics officer	Automotive	Manufacturer	3 years
2	Manager	Logistics	Forwarding Agent	More than 15 years
3	Manager	Tube mill machinery	Manufacturer	More than 10 years
4	Logistics officer	Agriculture - Fertilizer	Supplier	More than 5 years
5	Regional Manager	Logistics	Forwarding Agent	More than 10 years
6	Logistics officer	Logistics	Forwarding Agent	3 years
7	Network Executive	Logistics	Forwarding Agent	3 years
8	Logistics officer	Semiconductor	Manufacturer	3 years
9	Manager	Logistics	Integrated logistics services	More than 10 years
10	Logistics officer	Insulation materials	Manufacturer	3 years

3. FINDINGS AND ANALYSIS

Based on the findings from the interviews, it was found that despite the positive growth of the logistics industry in Malaysia, there is still a lack of research evaluating the performance of the Malaysia logistics industry (Ali et al., 2008; Sohail & Sohal, 2003). The interview data shows that the issues emerged from from both internal and external factors, which could be classified into of two different categories, the strategic operational issues and trade facilitation issues. It is important to view the the objectives of strategic operational logistics performance in the context of trade and transport facilitation. before further research is conducted.

3.1 Cost

Cost has always been the main indispensable dimension in assessing the logistics performance (Andersson et al., 1989; Banomyong & Supatn, 2011). A few studies only focus on other dimensions such as lead time, quality and flexibility (Andersson et al, 1989). The basic logistics cost consists of transportation and carrying inventory costs (Forslund, 2007; Kunadhamraks & Hanaoka, 2008). Across industry, Logistics cost differs widely among companies (Wallenburg & Weber, 2005), However, numerous issues raised and discussions have been lacking in rectifying various issues on costs. The level of efficiency is influenced by several variables such as cost, time used to deliver the services and levels of risk (M. Andersson & Banomyong, 2010).

3.2 Speed

To boost trade and allow goods to reach their destinations needs efficient infrastructure as well as streamlined customs procedure (Hummels, 2012). Electronics customs process could improve efficiency through the of time spent and cost. In fact, it can also reduce corruption through transparency and harmonization rules (Raus, Flügge, & Boutellier, 2009). Despite the introduction of paperless procedures that improve customs efficiency, the provision of excellent service is still lacking. One of the respondents, who is also a logistics officer claimed that:

'Some of the customs declaration depends on the area and time of declaration . For example, if the customs branch located in major ports, the declaration can be done in less than an hour processing time, as compared to other branch the process could take the whole day and some might take two days '

Two of the managers also highlighted that:

'The level of efficiency of the Malaysia customs are still moderate.'Not much changes or improvement throughout my seven years' of experience.'

3.3 Quality

Logistics infrastructure is important in attracting domestic and international investors in setting up and expand their business activities (Zuraimi et al., 2012). The efficiency of infrastructure enables country to achieve large economies of scales, reducing the average time shipments spent at sea and in ports (Brooks & Stone, 2010). In the context of Malaysia, the logistics infrastructures have improved gradually. With exception to Sgouridis (2003), studies focusing the logistics infrastructure in Malaysia is lacking. Sgouridis (2003) found some delays in the delivery of goods to and from the port. The delay was due to congestion as 95% of the freight transported to and from Port Klang is carried by truck and the railway performance was not adequate. Recently, Zuraimi, Mohd Rafi, & Dahlan (2013), who examine the current logistics infrastructure in East Coast Region of Peninsular Malaysia found that most firms, who have been in the business for more than 10 years rated neutral on the quality of infrastructure.

3.4 Dependability

Customs department is one of the direct authorities involved in border crossing processes. Therefore issues such as delays, complicated form-filling, rules and border clearance checked are highly considered. Logistics players were highly depend on the information technology (IT) and electronic data interchange (Ali et al., 2008). Raus et al (2009) highlight that the usage of IT and EDI, could prevent criminal activities, informal payments and improve cost efficiency. Nevertheless, the transition process is required for a smooth transition from traditional to e-customs process (Raus et al., 2009). Even though it can be seen as sophisticated, it may create some complexity throughout the process. However, not all regulations could be changed electronically, due to problems with the declaration letter, repeated inspections that could affect the users indirectly.

3.5 Flexibility

Different entrance times has been viewed as one of the flexible performance criteria (Batista, 2012) which could enhance the capability of the major ports in

Malaysia to cater import and export containers traffic as well as bulk cargo. Multiple dedicated lanes for import and export as well as other additional multipurpose lane is congested. As indicated by the one of the logistics officers: 'We need to ensure that our containers arrive at the port, according to all relevant data, we entered an e-system provided by port management for smooth traffic flow'. Ability to meet customers' request on entrance times could increase port performance.

3.6 Other issues

Respondents also highlighted that better communication and environment friendly element and practice should promoted in the logistics industry so that better business relationships could be developed in encouraging better partners and long term contracts.

Pazirandeh & Jafari (2013) state that greening transportation procurement have a significant impact on logistics efficiency and effectiveness. According to one of the logistics managers:

'Some transport provider companies have taken some effort to implement eco-driving with sophisticated technology and this has had a positive impact on lower transportation costs and shorter lead time as well'. Most of the respondents indicated that the activities in greening the logistics systems in Malaysia's industry is expanding. However, the practitioners claimed their priority is to deliver goods on time at the lowest cost possible.

3.7 Conceptual Framework

Based on the preliminary interviews and the literature review, the components that has affected the logistics performance has been identified. By categorising the logistics performance into logistics effectiveness and efficiency, the conceptual framework is proposed in Figure 1:

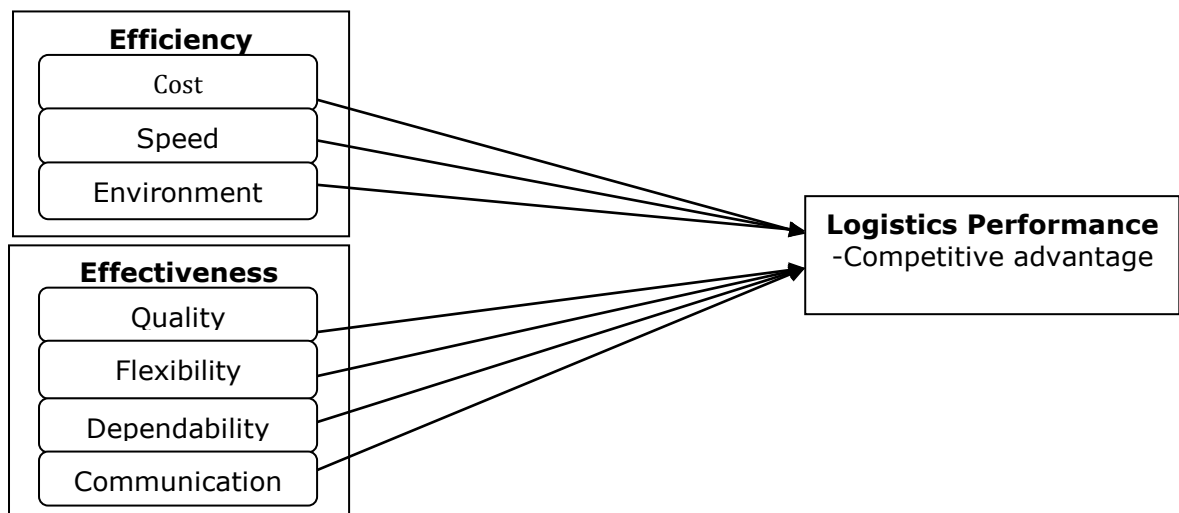


Figure 1 : The structure of logistics performance in Malaysia

4. DISCUSSION AND CONCLUDING REMARKS

The competitive environment and global supply chain provide several insights that affect the overall logistics performance. Even though some issues highlighted did not have empirical evidence, however, it exposes further studies

on the analysis of the relations between operational strategies and the trade and transport facilitation.

First, from a theoretical perspective, this paper bringing some relevant information and interesting knowledge of logistics performance in Malaysia. However, its poor awareness among leaders about logistics performance, especially on the components, measurements and World Bank report of Logistics Performance Index (LPI). Cost and customs efficiency among the most crucial components that informants discussed. The structured perspective of the framework facilitates understanding of complex issues concerning about logistics performance in Malaysia.

Secondly, our logistics industry needs to focus on infrastructure and border management for the growing development, demand for inbound and outbound activities. Customs department requires the difficult task of an effective border management system towards implementing advanced information technology, paperless as well as regulation related to logistics and minimizing of informal payments.

The integration between the strategic operational objectives for trade and transport facilitation (Batista, 2012), potentially relevant to the examination of interdisciplinary review of logistics performance in Malaysia's context.

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ASSESSING THE CHALLENGES OF CREATING SERVICE VALUE IN SUPPLY CHAINS

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Abstract

Purpose of this paper

One of the major challenges organizations face today is the increasing complexity of service value creating process. In order for the organizations to manage the value they are providing for the customers they need to have a holistic understanding of the processes involved and how those attribute to the total value provided. This study gives light to the relevant factors and their nature in value creation in supply chain context as well as evaluates the inhibiting factors that hinder it.

Design / methodology / approach

The study is based on both the integrated literature review and empirical case study evidence. A discovery-oriented approach was applied with literature review based expert group discussion as the primary method of data collection. The expert group session was conducted to privately owned companies in different fields of industry and different natures of value creation. The data was verified following the Delphi method in group discussions.

Findings

This study provides an important, yet sparsely addressed viewpoint to the supply chain management literature by illustrating essential attributes of value creation in supply chain context. The findings of the paper suggest that the value creation in supply chain context requires special attention in terms of the understanding the attributes that both promote and hinder the value creation process. More precisely, the most important factors identified for value provision were related to emotional attributes while most challenging issues in the value creation were related to the internal processes in the organizations.

What is original/of value in paper

The paper provides new information about value creation in supply chain context in two ways: Firstly, presenting the essentiality of different elements of value provision. Secondly, the study gives light to the hindering factors in service provision in different network levels. The presented viewpoint adds new information to the current scientific understanding of value creation and its challenges and therefore can provide opportunities to deal with value creation in supply chain context..

Practical impact

The presented study offers a new viewpoint to be considered in supply chain management. By better understanding the value attributes and their relevance in supply chains, the managers can increase the effectiveness of value creation activities.

Keywords

Supply chain value creation, network, determinants, inhibitors, hindering factors

INTRODUCTION

Transfer from production-based to service-dominant value creation has emphasised the role of the services in the global economy and raised the attention of managers as well as the executive level and CEO's in many organizations (Barlow, 2010). In practise this can be noticed from the estimates of services in the US which state that the value produced by alone services will increase to close to 90 per cent of the total value production in the USA by 2050. Considering the previous development where the value has increased from the less than 40 per cent of the 1950 to the 84 per cent in the 2001 the development seems quite likely (Spohrer, 2010).

Although the value of services have been a popular topic in the scientific literature for several decades studying of them has mainly concentrated on organizational and process level. The first studies taking properly account both the producer and customer perspectives were published in the beginning of the millennium (see e.g. Bowman and Ambrosini, 2000). However, after more than a decade the network perspective to value creation remains still only little researched.

When considering the network perspective and supply chain studies, it becomes obvious that the focus in the previous literature has mainly been on traditional manufacturing rather than services. Indeed, several authors have identified this gap and also discussed about the differing natures between products and services (e.g. Vilko, 2013; Sampson and Spring, 2012; Niranja and Weaver, 2011; Sengupta et al., 2006). The calls for more research starting from a decade ago have however received only little attention when comparing to the extensivity of the traditional manufacturing supply chains research (e.g. Ellram et al., 2004; Demirkan and Cheng, 2008).

Previously, studies have concentrated mainly on product-based manufacturing supply chain (Chen et al. 2013). Although the importance of service supply chains has been identified and discussed by several scholars, the specifics of their management have been addressed by relatively few (e.g. Arlbjørn et al., 2011; Baltacioglu et al., 2007; Ellram et al., 2007). The current studies on service supply chains have, so far, focused mainly on applying the existing SCM models to the service context (e.g. Arlbjørn et al., 2011; Baltacioglu et al., 2007; Ellram et al., 2007), while only a few have developed new frameworks for service supply chain management (e.g. Ellram et al., 2004; Baltacioglu et al., 2007). In doing this, some scholars have noticed that the current supply chain management applications do not work well in service management.

Overall, when considering the importance of understanding the attributes and mechanisms of service value in supply networks, the research in this area seems of importance. One of the major challenges organizations face today is the increasing complexity of service value creating process. In order for the organizations to manage the value they are providing for the customers they need to gain a holistic understanding of the processes involved and how those attribute to the total value provided. This study gives light to the relevant factors and their nature in value creation in supply chain context as well as evaluates the inhibiting factors that hinder it.

DETERMINANTS AND VULNERABILITY OF VALUE IN SERVICE SUPPLY CHAINS

The second section of the study will present the theoretical foundation of the study by first illustrating an overview of supply chain management and services in that context, followed by the determinants which determine value in service supply chains.

Supply chain management and services

The work on traditional supply chain management has dominated the academic literature by comparison with the work on service supply chains in the past. The topic of service supply chains has received some attention regarding its management frameworks, and as a concept service supply chain management has been defined to include the management of information, processes, capacity, service performance and funds from the earliest supplier to the ultimate customer (e.g. Ellram et al., 2004; Baltacioglu et al., 2007). The benefits that service supply chain management provides can include, for example, better coordination of processes, improved performance through process integration and improvement of the customer interface (Giannakis, 2011).

According to Arlbjørn et al. (2011), it is important to differentiate the tasks in service supply chain management, which can be achieved through different types of relationships with customers as well as suppliers (Cho et al., 2012). Ellram et al. (2004), list seven theoretical processes of service supply chains, including: information flow; capacity and skills management; demand management; customer relationship management; supplier relationship management; service delivery management; and cash flow. In further developing the Ellram's model Baltacioglu et al. (2007) proposed a service supply chain framework with an application to the healthcare industry to include the following activities: demand management; capacity and resources management; customer relationship management; supplier relationship management; order process management; service performance management; and information and technology management.

More importantly for our case, even less work has been done to investigate service supply chain risk management. The very limited work conducted by academics aimed at understanding the special features of service supply chain risk management can be illustrated by Internet search results for the concept. A search conducted by the authors with *Google Scholar* for "service supply chain risk management" produced only five results, whereas, for example, *Scopus* returned no results.

Determinants of value in service supply chains

As customer value and value propositions are very complex phenomena, there is no broad-based definition available (Anderson et al., 2006). To gain insight into the distinctive features of service supply chain risk management, we refer to categorization introduced by Rintamäki et al. (2007). They divide customer value to four categories: 1) economical, 2) functional, 3) emotional and 4) symbolic. Each value proposition pursues to create value to the customer in one or several of these areas. Economic value refers to the financial benefits that can be offered to the customer. Functional value is the actual service, which helps to solve a concrete problem, e.g. moving products to one place to another. Emotional value refers to the feelings such as convenience, entertainment or feeling of safety. Finally, symbolic value refers to social status, respect and identity.

In service supply chains, the value creation process becomes more complex when compared to dyad-level analysis between provider and customer. While the functional and economical value creation has been seen as very difficult issue to handle in complicated, multiparty logistics services, the issue is even more pronounced when it comes to emotional and symbolic value. In the following sections, we introduce an empirical study where these challenges in multi-dimensional value creation are assessed.

RESEARCH DESIGN

The study is based on both the integrated literature review and empirical case study evidence. The third section presents the empirical part of the research design applied in the case by first describing the methodology and thereafter the case companies.

Methodology

The qualitative and explorative case research approach was considered appropriate to gain theoretical and empirical insight into the topic because it has not received much previous research attention (Yin, 1994). The case study form was seen to work well in serving the information-oriented focus of the research and discovering causalities of the phenomenon (Yin, 1994, Jensen and Rodgers, 2001)

The empirical part of the study is based on the empirical data mainly received from the the expert group consisting of persons with differing executive positions in the case organizations. The experience and insights of the informants was considered essential in order to make in-depth sense of the phenomena (Eisenhardt, 1989). The experiences and first-hand knowledge of the value provision in different cases were thus the base for the study. The informants participating the expert group were selected on the basis that they would have the best knowledge about their organization and supply chain. The fact that the empirical part of the study relies on the few informants' perspective to the value creation and its challenges does oppose some limitations in terms of generalizability and furthermore includes risks in misjudging the representativeness of the case in term of customer value. However as several industries are under investigation there is a less likelihood that individual opinions will have great impact on the result and as an explorative case study the multi-industry perspective allow wider perspective for the researchers in order to better understand different forms of value (Voss, 2002).

The strategy used for the case selections of the study was information-oriented, where the focus is on maximizing the utility of the information (Flyvberg, 2011). As a multi-industry case study, the case selection was done on the basis of its information content and therefore the research can be considered to have both maximum variation and critical case type elements. More precisely, the case study is argued to have strategic importance to the general problem and the understanding of the phenomenon is done by using several cases with rich information (Flyvberg, 2011).

In a case study research special attention should be taken into the reliability and validity of the study (Yin, 1994). Two different types of triangulation were used in this study: the triangulation of theories and the triangulation of different investigators (Denzin, 1978). Firstly, the scientific literature sources used for the study were triangulated to confirm the validity of the theoretical basis (Cresswell and Miller, 2000). Secondly, in the reporting of the empirical data collaboration as investigator reflexivity was used (Cresswell and Miller, 2000). The reflexivity included researchers from different disciplines, namely from industrial engineering and management and from supply management firstly to carry out the expert group discussions and data collection, secondly to review and comment on the research data and finally, to further analyse the relevance of the findings in Delphi-like group discussions.

Case

The study was conducted as part of a larger study, CUSTOR, which examines vulnerability of value creation in customer-oriented service network. As part of this study, cross-section of companies from different fields of industry were used to in an expert group to identify and analyse the relevant factors to both contributing and inhibiting the customer value creation. The case organizations are presented in Table 1.

Table 1. Case organizations

	<i>Manufacturing supply chain</i>	<i>Service-oriented manufacturing supply chain</i>	<i>Service supply chain</i>
Case 1	Offerings consists of own products with life-cycle service offerings. (B2B)		
Case 2		Combined concrete- and construction service and product offering. (B2C&B2B)	
Case 3		Energy service provision by providing gas product and the related services to the customers. (B2C&B2B)	
Case 4			Logistics service provider with tailored solutions. (B2B)
Case 5			Global Logistics Service provider with integrated supply chain solutions. (B2B)
Case 6		Consumer electronics retailer with enhanced after sales service offerings. (B2C)	

VALUE ANALYSIS

The fourth section of the paper presents empirical findings of the study: Firstly, the most essential value determinants are presented with analysis of their importance. Secondly, the inhibiting sources of inhibiting factors is presented in terms of the supply chains.

Value determinants

Identifying and evaluating the importance of different factors in value creation was conducted in the expert group similarly to the *Six Thinking Hats*® system (de Bono, 1985). During the identification phase of the research process the expert group members were asked to identify the most important factor of the value creation from the own supply chain's perspective. The factors were then recorded and the participants were asked to describe the process in which and how value was seen in the process. By using systematic way to identify the value and its antecedents the researchers could better understand the processes themselves and the underlying causalities behind them.

The evaluation phase of the value factors were done in a group by voting. This allowed the case-specific factor that had no wider impact to be filtered out. As a result from the voting five most essential factors were chosen according to the votes, namely *reliability, price, quality, easiness of doing business* and *flexibility*.

The most important value factors were assumed to determine most of the value in the case supply networks. During every step of the process the participants were allowed to express their opinions and ask questions regarding the determinants. In order to gain better insights to the nature of the value determinants the expert group was asked to measure the relevance of different natures for the determinants from their own supply

chain perspective using the scale 1-4 to functional, economical, emotional and symbolic (see Rintamäki et al. 2007). To gain better visibility to the differences the scores were thereafter scaled similarly to Six Sigma method. The results of the study can be seen from below table 2 below.

Table 2. Factors of value determinants

	Functional	Economical	Emotional	Symbolic
Reliability	6,6	3,4	3	0
Price	1,8	7,8	3,4	0
Quality	5,6	1,6	3,4	2,4
Easiness of doing business	1,2	1,8	9	1
Flexibility	5	3,6	4	0,4
	20,2	18,2	22,8	3,8

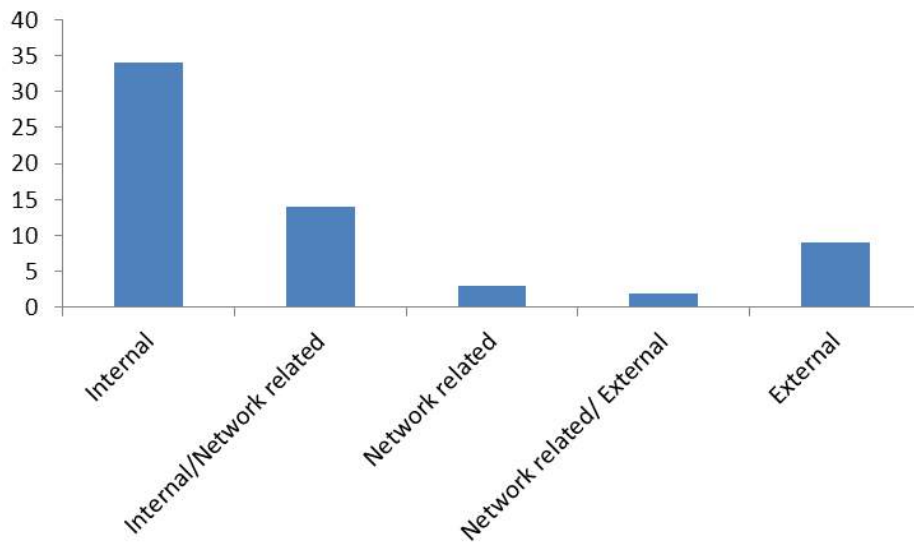
The results of the study showed that the emotional nature of value were considered the most important in the light of the most important determinants. Almost as high was the functional followed by the economical while the symbolic nature did not seem to be relevant in the studied supply chains.

Sources of value inhibitors

The inhibiting factors that affected to the realizations of the offered value were identified and analysed similarly as the value determinants before. However, as with the value determinants the inhibitors seemed to have a multilevel impact where building a clear hierarchy was difficult. To cope with this reality the source of different inhibitors were identified, which allowed better to understand the causalities and their origins in the supply chain. Figure 1 illustrates the sources of the inhibiting factors of value creation.

Surprisingly, the case organizations identified most of the inhibitors coming from inside of their company and 54.8 per cent of all the factors were seen as purely internal. When counting the ones that had both the elements of internal to the organization and inside the supply chain the inhibitors count to 77.4 per cent. Thus only 22.6 per cent of the inhibiting factor were seen to come outside of the case organizations, namely from their network or from external to the network. However, the fact that the typically the visibility to identify the inhibiting factors is best to inside of the organization does explain this result. In that case, the abilities that the organizations have to identify inhibitors outside the company can be considered severely limited.

Figure 1. Sources of the inhibiting factor of value creation



CONCLUSIONS

Services are taking an increasing proportion of supply chain operations. This study provides an important, yet sparsely addressed viewpoint to the supply chain management literature by illustrating essential attributes of value creation in supply chain context. The findings of the paper suggest that the value creation in supply chain context requires special attention in terms of the understanding the attributes that both promote and hinder the value creation process.

The most important factors identified for value provision were related to emotional attributes while most challenging issues in the value creation were related to the internal processes in the organizations. The customer value comprises of several factor from which the emotional, economical and functional value, respectively, were seen as the most important and symbolic value did not seem as relevant. From the inhibiting factors, the most dominant ones were those internal to the organization. The purely network related were the least identified.

Theoretical implications

The theoretical contribution of this study can be considered twofold. Firstly, the determinants of value have great differences in their relevance to the customer. This should be taken into account studying the offerings of service networks. By better understanding the essential determinants of value and how those comprise scholars can focus their efforts better in the further research.

Secondly, the abilities to identify the inhibiting factors that reduce the customer experienced value or increase costs in delivering are severely limited outside of the organizational border. Scholars should focus more research in investigating the limited visibility to identify the inhibitors of value creation and what enables better and agile alignment of the network resources to provide more resilient value provision.

Practical implications

The results of this study enhance the practitioner's understanding about the nature of the service value in supply chains by presenting the most essential determinants with the analysis of the customers' preference on the different elements those comprise. By better

understanding the customer value elements managers can improve the accuracy of using the resources to certain elements of the value and increase customer satisfaction. Furthermore, by understanding the source of inhibiting factors to the customer value, managers can improve the resilience of the value chain offering and limit the exposure to those elements that might endanger the value provision.

Limitations and suggestions for future

The most obvious limitation is in the conceptual nature of the study. There is a need for further empirical studies, as well as for the further refinement of the analysis framework from several viewpoints. In addition, the empirical studies could test the impact and nature of the studied value determinants in several supply chain from same industries to better understand the differences of value creation in different fields of industry and in b2b and b2c environments.

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Section 9: Sustainability in Logistics and Supply Chains

A 'SYMBIOSIS EFFECT' PERSPECTIVE TO UNDERSTAND REVERSE LOGISTICS AND HOUSEHOLD RECYCLING WASTE SYSTEMS

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ABSTRACT

Purpose

This paper discusses a doctoral research study to assess the relationship between the sustainability and effectiveness of household recycling systems and household recycling behavior, reveals how factors associated with household recycling systems affect household recycling behaviour, and how household recycling behaviour affect the provision of household recycling systems by the local authorities. The main objective is to reveal and explain the interaction and symbiosis effects between household recycling system and household recycling behaviour.

Methodology

The theoretical foundation for this PhD research came from an interdisciplinary synthesis of literature drawn from marketing, logistics and waste management (Carter and Ellram, 2008). Case studies were undertaken with staff and residents in two UK local authorities (LAs): the East Riding of Yorkshire and the City of Hull. Empirical data were gathered using three approaches: semi-structured interviews with the LAs and households; an online and postal survey of households; and a focus group with householders and interviews with LAs to follow-up and validate findings.

Findings

The first qualitative research stage supported symbiosis or interdependencies between systems and behaviour and corresponded with approaches in extant literature and previous empirical studies that discussed the element of availability (logistics) and engagement (marketing). Multiple regression analysis in the second quantitative research stage somewhat juxtaposed the existence of interactions between personal factors and situational factors. Finally, co examination between the first and second stages revealed the need to use symbiosis effect perspective in understanding backward movement between householders and household recycling waste systems. The third qualitative research stage is currently being undertaken to increase robustness in the research which will be ready for presentation in order to round-off the study's research.

Research and Practical Implications

This study has found that a 'symbiosis effect' perspective appears to be a robust framework to bring together effective household waste recycling systems and sustainable development considerations to enhance both sustainability and the economy. Further, the study provides empirical evidence examining both situational and personal factors of households and their interactions, which were previously not well-understood. This study has incorporated behavioural aspects in the reverse logistics process that should help improve the LAs' planning processes. Also, LAs may be more adaptive to the changing behaviour of their constituents and more willing to change their waste and recycling strategies to more sustainable methods.

Research Limitations

The study is based on perceptions of two LAs and their local constituents and therefore cannot be generalized to the whole UK population. Also, the third stage of the empirical study is still in process so findings are incomplete.

Keywords

INTRODUCTION

The essence of the problem with waste is that it is by definition something that is not wanted. We argue here that achieving a sustainable solution requires consideration of both regulatory responsibilities and social norms (Deutz and Frostick, 2009). Landfill costs levy a high financial impact on local authorities due to the environmental directives that compel them to collect and recycle household waste. More efficient and effective systems are therefore crucial for local authorities from both a financial and environmental perspective. Thus, householders and local authorities "symbiotically" working together in a natural system could enhance sustainable living (Fennell and Weaver, 2005; Ehrenreich, 2002). This paper reports on the first two stages of a PhD research study project conducted within the two local authorities in the North of England. This research investigates the relationship between the sustainability and effectiveness of household recycling systems and household recycling behavior, reveals how factors associated with household recycling systems affect household recycling behaviour, and how household recycling behaviour affect the provision of household recycling systems by the local authorities. The main objective is to reveal and explain the interaction and symbiosis. In fact, this study has found that a 'symbiosis effect' perspective appears to be a robust framework to bring together effective household waste recycling systems and sustainable development considerations to enhance both sustainability and the economy. Further, the study provides empirical evidence examining both situational and personal factors of households and their interactions, which were previously not well-understood. This study has incorporated behavioural aspects in the reverse logistics process that should help improve the local authorities' planning processes. Also, local authorities may be more adaptive to the changing behaviour of their constituents and more willing to change their waste and recycling strategies to more sustainable methods. The paper is structured as follows. The literature reviews from multiple lenses of multiple disciplines and research design that accessible for interdisciplinary study and the current findings with discussion as well as conclusion that explain and encapsulate symbiosis effect perspective in understanding reverse logistics and household waste recycling system (HRWS).

LITERATURE REVIEW

The waste movement and diversion is closely related to HRWS activities (Deutz and Frostick, 2009; Fuller, 1978) as well as processes that related to reverse logistics (de Brito and Dekker, 2009; Jahre, 1995). Prior studies have ascertained that reverse logistic factors (situational) such as convenience, improved recycling facilities and communication from local authorities tend to lead to higher household recycling levels (Keramitsoglou and Tsagarakis, 2013). Thus, these reverse logistics factors closely refers to accessibility and availability of the situational factors within the HRWS were considered strong predictors (Woodard et al., 2006; Bhate, 2005). However, the studies relatively excluded the potential of "interaction" from the relationship between householders and HRWS. A proposition in this study is that in reality, "interaction" contains as symbiosis effect and is a pre-condition of the actual behavioral change in household recycling patterns. A Local authority's engagement (with) has an effect in household recycling behaviour (HRB) that applies on the accessibility and availability as well as convenience of HRWS at that particular area (Bhate, 2005). There was improvement in many local authorities' HRWS across regions in Great Britain (CIWM, 2013) nevertheless, the recycling rates across the UK local authorities are varied and still below average compare to some our EU counterparts (EUROSTAT, 2013). This quandary cannot be resolved by focusing solely on the technical issues of HRWS (situational factors) but there is a need proper understanding of HRB in the system. HRB depends not only on situational factors but also the householders' personal capabilities and attitudinal factors, which could be referred to as "personal factors" (Barr et al., 2005). Therefore, the study has incorporated multiple theories and frameworks (Carter

and Ellram, 1998; Stock, 1997) in understanding two major factors (situational and personal) and formed conceptual framework (Fig. 1).

The preliminary conceptual framework (Fig. 1) was developed to guide this study and is derived from three existing theories: Theory of Planned Behaviour (Ajzen, 1991), Norm Activation Model (Biel and Thøgersen, 2007) and Environmental Significant Behaviour (Thøgersen, 2006). The dotted arrow in Figure 1 suggests a symbiosis effect emerges when there are interactions between situational and personal factors.

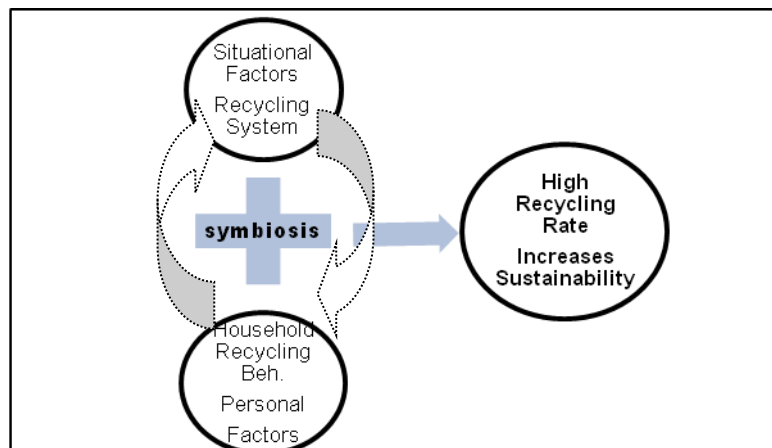


Figure 1: Proposed theoretical framework based on three theories

Furthermore, this theoretical framework has to be accessible in the research design which in this case is the application of mixed-methodology approach was chosen for the whole research framework (Creswell, 2008). The methodological approach for accomplishing the research objectives requires a cross-examination of two data sources (qualitative interviews and quantitative questionnaires) because the recycling systems and household recycling behaviour that can be quantified and observed directly are viewed as reality without the need for subjective interpretation (positivist) (Schrag, 1992). However, this reality is governed by the different attitudes, perceptions and interpretation of the reality by different individuals (interpretive) (Guba and Lincoln, 1994).

RESEARCH DESIGN

The basis of the study design is a sequential exploratory design known as Qual-Quan-Qual (Creswell, 2008; Clark, et al.,2008). Two councils were chosen from the North of England (the East Riding of Yorkshire and the City of Hull). A total of fourteen respondents participated in the first stage of data collection (n=14): two of those were council officers – one each from the East Riding of Yorkshire and the City of Hull. The remaining twelve respondents were demographically diverse and lived or used to live in the East Riding of Yorkshire and the City of Hull. The second stage was a quantitative approach (n=412) which a postal-survey questionnaire was sent to 500 households from each area. In addition to reduce the impact of the low response rate normally associated with postal surveys, an online survey was published via the University of Hull’s social media platforms, the local councils’ affiliated community networks, public community online news network (e.g. ‘this is Hull and East Riding’) and under the discretion of selected companies within the population parameters (e.g. Kingston Communications, East Yorkshire Motor Services, and Jackson’s Bakery).Table 1 provides a socio-demographic profile of respondents.

Item	N	%
Age		
20 or under	21	5.1
21-30	85	20.6
31-40	96	23.3
41-50	59	14.3
51 or older	151	36.7
Gender		
Male	157	38.1
Female	255	61.9
Recycling Experience (years)		
More than 4 yrs	307	74.5
Less than 4 yrs	105	25.5
Living in current property (years)		
More than 4 yrs	286	69.4
Less than 4 yrs	126	30.6

Table 1: Demographic Background (n=412)

The sample was slightly dominated by female respondents (61.9 percent) and the majority of respondents fell in the 51 or older age group. Most respondents have more than four years of recycling experience (74.5 percent) and were living in the same property for more than four years (69.4 percent). Then the final stage of the research design in data collection was a focus group developed to cross validates the subjectivity and objectivity in the foregoing stages. Seven respondents were randomly recruited with a small token for participation (n=7).

RESULTS

Qualitative Finding: Stage 1

Using thematic analysis (Braun and Clarke, 2006) network as mean of interpretation helped to map the main themes emerged from the first stage (Fig. 2). The key themes as emerged in the study were categorized to situational and personnel factors and enablers for the existence of symbiosis effect. Nevertheless, the richness of the qualitative findings led to extending the thematic analysis in using ethnographic analysis: semantic relationship between themes (Roulston, 2010; Aronson, 1994); helped to explain the existence of symbiosis effect between councils and households.

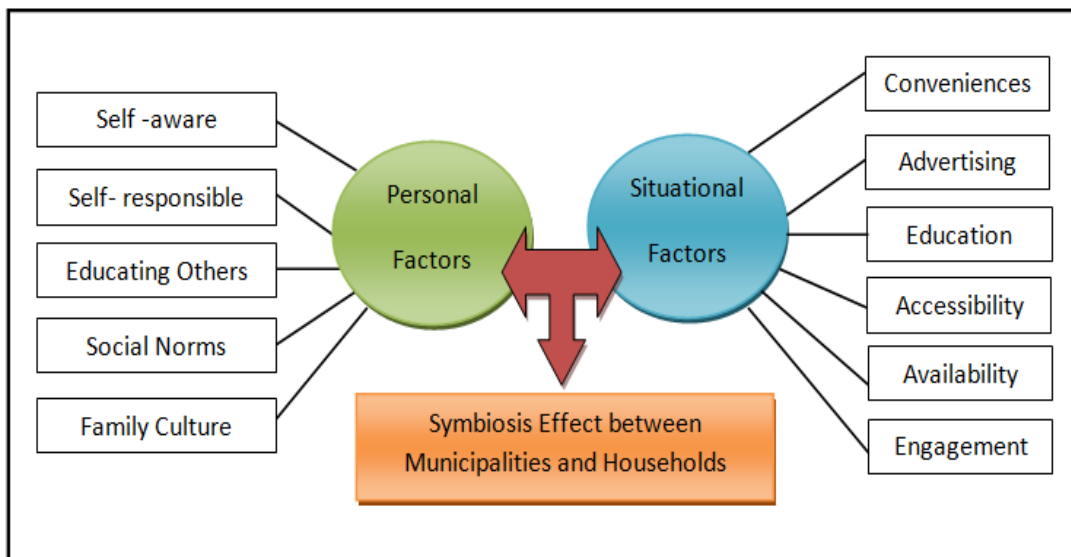


Figure 2: Thematic analysis network of Conceptualization on *Symbiosis Effect* between Local authorities and Households ($n=14$)

The first type semantic relationship existed in this study was the cause and effect (X is a result of Y, X is a cause of Y: X is HRB and Y is engagement of the recycling services by councils). Most respondents had knowledge of recycling, were fully aware of their consumption patterns, and also what they placed in their bins. Those who had experienced the transition from the one bin scheme to a new three bin scheme introduced by the local authorities were initially reluctant to participate due to a perceived lack of effort to engage residents by their local authority. However, over time councils did improve their engagement and communication that lead to HRB increases.

The second type of semantic relationship was rationale (X is a reason for doing Y: X is marketing and logistics initiatives by the councils and Y is recycling). This scenario supported the symbiosis or interdependencies between systems and behaviour. Some of the respondents were from Germany, which has a very systematic waste and recycling management system, and they expressed an affective/emotional motivation that (Burgess, et al.,1998) defined as "guilt" for not recycling as much as they would in their home country . This may be due to the fact that stimuli for recycling behaviour from current local authorities' logistics and marketing initiatives were not as aggressive as they had experienced before.

Quantitative Finding: Stage 2

The frequency analyses showed more than 90 percent of households were clearly aware of why they recycled; the majority of households recycled because they believed recycling improved the environment and a feeling that they should live in an environmentally- conscious society. The study also looked for any differences between the local authorities regarding their reasons for recycling. It found the number of principal reasons (environmentally- concerned) for City of Hull residents was somewhat higher than for those living in the East Riding of Yorkshire (Fig. 3). In the 'others' option City of Hull residents were inclined towards 'up-cycling' such as reusing most of the recyclable items or giving those items to extended families or friends. The East Riding of Yorkshire households were more likely to send their reusable items to various charities.

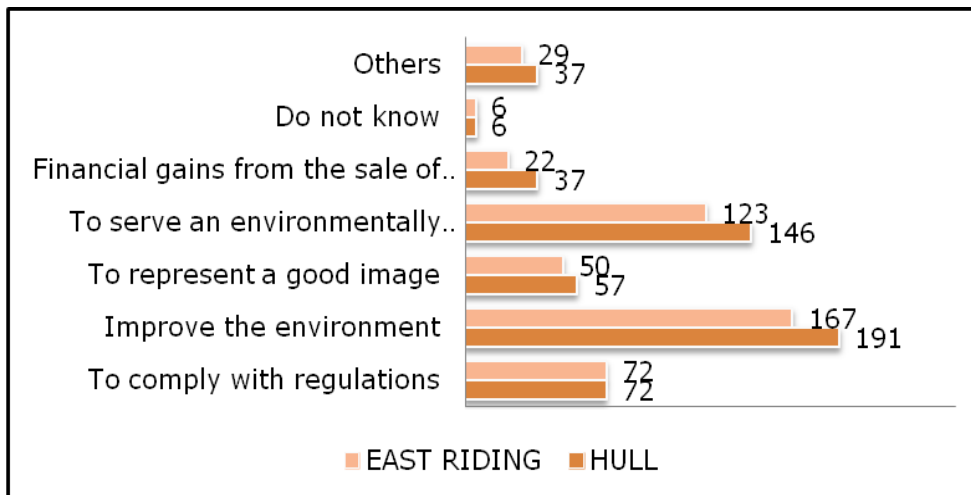


Figure 3: "I recycle because _____" based on local authority (n=412)

This study seeks the reasons behind the householders' recycling initiative by examining confounding variables (demographic factors). Logistic regression was used to test the full model against a constant model. The results from the full model indicate that householders' reasoning for HRB depends on changes in some demographic factors (one unit increase); they are likely to change their reasoning for HRB based on regulation if they are (double occupants: $Wald = 4.48, p < 0.05$ with $df = 1$, or a student: $Wald = 7.76, p < 0.01$ with $df = 1$); as well as reasoning based on environment if they are (living in current address more than 4 years: $Wald = 4.44, p < 0.05$ with $df = 1$, or they started recycling as the scheme was introduced: $Wald = 4.47, p < 0.05$ with $df = 1$) and their reasoning based on self-image if they are (working: $Wald = 4.49, p < 0.05$ with $df = 1$, or unemployed/on benefit: $Wald = 3.99, p < 0.05$ with $df = 1$). The overall model is significant at the 0.05 level according to the Model chi-square statistic. The model predicts reasoning for regulation (65%), environment (86.9%) and image (74.3%) of the responses correctly. The Nagelkerke's for regulation ($R^2 = 0.12$), environment ($R^2 = 0.13$) and image ($R^2 = 0.09$) implied the model is a moderate improvement over the null model with no predictors even though Nagelkerke's Pseudo R^2 is skewed to zero than one.

A Pearson's correlation was used to analyse the relationship between situational and personal factors. Firstly, all items that constituted personal or situational factors were formed into relevant composite factors, and then a statistical correlation was tested between these composite factors including all demographic items. Those representing a more than a 0.05 significance level were omitted from further analysis. Table 2 demonstrates the correlation between these two composite factors. It shows that personal factors have a significant relation to situational factors ($p < 0.01$) and vice versa; with positive correlation ($r(412) = +0.41$). Four demographic items (Table 2) were also found to have positive relation with both factors ($r(412) > +0.07$) and correlation between personal factors with those four demographic items has significant relation ($p < 0.01$). However, household employment has significant influence at ($p < 0.01$) on situational factors, thus households' age and marital status were at ($p < 0.05$) significant level and recycling experiences had no significant correlation with situational factors. The analyses indicate that a socio-demographic profile of a municipal resident has a positive correlation with factors contributing to HRB.

Factors	PEARSON CORRELATION					Sig. (2-tailed)
	Situational	Age	Marital Status	Employment	Number of Year Recycling	
Personal*	0.41	0.24	0.20	0.23	0.15	0.00
Situational*	1	0.10	0.12	0.17	n.s	0.01

*Both factors are formed into composite factors (i.e. Item1 + item2+....)

Table 2: Correlation Table ($n=412$)

Additionally, the study correlated composite personal factors with individual items of situational factors. The results show that the personal factors have significant relation with engagement ($p < 0.01$) with positive correlation ($r(412) = +0.71$); as well as convenience ($p < 0.01$) with positive correlation ($r(412) = +0.44$) and accessibility and availability ($p < 0.01$) with positive correlation ($r(412) = +0.27$). In order to examine whether personal factors interacted with situational factors (engagement, availability and accessibility), the study applied multiple regression analysis to question these assumptions. This analysis is relevant as it addresses assessment of various relationships, using the information from independent variables to improve the accuracy in predicting values for the dependent variable as recommended by Greene and Field (Green, 1991; Field, 2005). These analyses also reveal the existence of confounding variables (demographic items) in association with either personal or situational factors (engagement, accessibility and availability). Thus, when personal factors were predicted; it was found that engagement ($\beta = +0.36$, $p < 0.01$), convenience ($\beta = +0.11$, $p < 0.01$), and accessibility and availability ($\beta = -0.13$, $p < 0.01$) were significant predictors of recycling behaviour (Table 3).

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	15.093	1.851		8.154	0.000
Engagement	0.316	0.032	0.359	9.890	0.000
Convenience	0.156	0.048	0.106	3.225	0.001

Table 3: Coefficients Table ($n=412$)

DISCUSSION AND CONCLUSIONS

The first two stages of this study demonstrate that personal and situational factors interact in promoting HRB. Specifically, the reasoning for HRB indicated that changes in demographic profiles have an effect on householders' intention of recycling. The inference statistical model significantly was the existence of interaction between accessibility and availability as well as convenience and awareness with personal factors were the main predictors. This (what) is consistent with Bhate (2005) in juxtaposing the existence of situational factors to enable HRB and Woodard et al. (2001) to imply that the existence of situational factors without abandonment of the personal factors reflected positive HRB (Barr et al., 2005; Timlett and Williams, 2008). To project or manifest HRB, households must be motivated by the right stimuli such as the availability, accessibility, awareness/engagement and convenience of HRWS in order to increase household recycling rates (Keramitsoglou and Tsagarakis, 2013). In addition, households' knowledge of recycling and how long they have been recycling positively interacted with situational factors and contributed to an improvement in HRB per Thorgesen (1994). The study has shown that symbiosis effect perspective explained vis-a-vis the "hygiene" factors conveying HRB. This means the two factors investigated have to be interaction. In conclusion, this paper has reported on qualitative and quantitative study examining the relationship between householders' behaviour and local authority recycling practices.

The findings indicate that a symbiosis effect exists between the two major factors driving councils' household recycling behaviour. The quantitative analysis demonstrates and validates the first stage finding (i) the higher interactions and engagement will result in increases of HRB; (ii) higher spatial coverage of service provision and availability of recycling facilities will increase the councils' performance in waste and recycling initiatives. Thus, this study was embryonic in nature to investigate this "symbiosis effect" perspective; further investigations should be done in different geographical settings (other local authorities and countries) for the benefit of future research.

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FACTORS AFFECTING MANAGERIAL INTENTION TO ADOPT SUSTAINABLE SUPPLY CHAIN MANAGEMENT IN THAI ELECTRONICS INDUSTRY

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ABSTRACT

Aim/Purpose: This research aims to understand the intention to adopt sustainable supply chain practices in Thailand, focusing on the factors which affect the organisational intention towards adopting sustainable supply chain management.

Design/methodology/approach: Using the theory of planned behaviour, this study categorise common themes, which clarifies the adoption of sustainable supply chain management and developed a hierarchical theoretical model. Fourteen senior executives from the electronics industry in Thailand were selected to participate in this study. Structured Analytic Hierarchy Process (AHP) was applied to analyse and assess the priority weights of factors affecting managerial intention to adopt sustainable supply chain management.

Findings: The analysis shows that subjective norm plays a major role towards the intention to adopt sustainable practices (priority weight= 0.6473), followed by perceived behavioural control (0.2416) and attitude (priority weight= 0.1111). At the factor level, customer influence (priority weight = 0.4254), governmental pressure (priority weight = 0.1660), and financial capability (priority weight = 0.1372) are found to be the most important factors.

Value: This is a unique study which employs the theory of planned behaviour to assess the factors affecting managerial intention to adopt sustainable supply chain.

Research limitations/implications: This study is conducted in the context of Thai electronics industry and therefore the results obtained may not be applicable to other industries.

Practical implications: This research provides a distinctive concept through the identification of the influential factors which help generates an understanding of sustainable supply chain management adoption among electronics organisations in Thailand.

Keywords: Adoption, Analytic Hierarchy Process, Factors, Sustainable Supply Chain, Theory of Planned Behaviour, Thai Electronics Industry.

1. INTRODUCTION

Business enterprises in the past two decades have turned their attention towards the area of environmentally sustainable (Linton, Klassen et al. 2007, Hsu and Hu 2008, Zhu, Sarkis et al. 2008, Diabat and Govindan 2011, Kuik, Nagalingam et al. 2011). Likewise, the sustainable aspect has integrated together with the traditional supply chain practices, developing into the concept of sustainable supply chain management (SSCM) (Hsu and Hu 2008, Zhu, Sarkis et al. 2008, Diabat and Govindan 2011). Nevertheless, the shifting towards environmentally sustainable protocol is quite common but it is not always environment lead, but rather of 'good business', i.e. obtaining profits, internal efficiency and competitiveness (Chan 2007, Srivastava 2007). Likewise, several authors suggest that the beliefs of the high-ranking officials of the organisation can conclude the decision to adopt sustainable innovation (New, Green et al. 2000, New, Green et al. 2002,

Montalvo 2008, Visser, Jongen et al. 2008). In conjunction with these authors, this research will determine the factors which could affect the managerial intention towards adopting sustainable supply chain management. However, none of these studies used the theory of planned behaviour in the field of sustainable supply chain management. By developing a hierarchical model based on the theory of planned behaviour, this study investigates the critical factors affecting managerial intention to adopt sustainable supply chain management in Thai Electronics Industry.

The rest of the paper is organised as follows. Section 2 presents a brief review of literature on factors affecting managerial intention to adopt sustainable supply chain management and suggests a hierarchical conceptual model. This is followed by an outline on research methodology and background of the sample organisations and respondents in section 3. Analyses, results and discussion are presented in section 4. Finally, conclusions are drawn in section 5.

2. LITERATURE REVIEW

2.1 Factors of Sustainable Supply Chain Management Based on the Theory of Planned Behaviour

Sustainability was defined as the ability to utilise resources to meet the present demands and needs without compromising resources for the future generations (Brundtland Report 1987). While the concept sustainability has been interpreted in various ways, the initial sustainability considers environmental to be the fundamental dimension, however as time passes, the focus shifted towards the triple bottom line approach (Elkington 1994, Elkington 1997, Ahi and Searcy 2013). The theory of planned behaviour (TPB) is an extension of the traditional theory of reasoned action (TRA), providing a more sufficient model beyond those under volitional control (Ajzen 1991, Madden, Ellen et al. 1992, Conner and Sparks 1996, Hankins, French et al. 2000). Likewise, TPB suggested that human intention can be determined through the antecedents of attitude, subjective norm and perceived behaviour control (Ajzen and Madden 1986, Ajzen 1991). Through extensive literature review and adapting TPB we have identified factors affecting sustainable supply chain management and developed a conceptual model. A brief description of each factor is given below.

2.1.1 Managerial beliefs

There is a correlation between environmental management and personal incentives (New, Green et al. 2000), such as the founders or the owner of an organisation. Montalvo (2008), Visser, Jongen et al. (2008) believed that the sustainable implementation greatly depends on the personality and position of the high-ranking officials. Hence to create a successful sustainable supply chain requires a proactive top management that recognises the relationship between sustainability and the organisational commitment (Pagell and Wu 2009).

2.1.2 Environmental pressure

There are three types of environmental management which an organisation can adopt proactive, reactive and value-seeking (Kopicki, Berg et al. 1993, van Hoek 1999). Revealed above, value-seeking environmental management approach endeavours for the integration of environmental value into the pre-existing supply chain (Ashby, Leat et al. 2012). It was suggested by van Hoek (1999), Testa and Iraldo (2010) that reactive organisations may reply upon the observation of partners and/or competitors. Lastly, organisation which utilises the proactive approach would pre-emptively take responsibility regarding the environment (Kopicki, Berg et al. 1993).

2.1.3 Economic pressure

Additionally, the motivation to implement a sustainable policy correlates with the positive supply chain economic expectation i.e. reduction in operating costs and enhancing efficiency (Montalvo 2003, Ramus and Montiel 2005). Likewise, the incentive to reduce costs is the fundamental of sustainable supply chain management development (Chan 2007, Walker, Lucio et al. 2008). Likewise, in addition to cash, costs may also include efforts such as waste produce and resources utilisation (Walker, Lucio et al. 2008).

2.1.4 Spiritual pressure

It was mentioned by Hicks (2002) that the spiritual beliefs of a leader/manager within an organisation can create a affect employees within an organisation. Likewise (Fry and Slocum 2008), noted that the spiritual beliefs of a leader can influence the overall organisation towards the triple bottom line (people, planet and profit). Moreover, Fry and Slocum (2008) that although it is difficult to accentuate the ethical aspect of leadership, the process and employees without compromising the revenue growth, it is not entirely impossible.

2.1.5 Market influence

The escalating of environmentally pressures are forcing organisations to contest in the area of environmental development (Tseng, Divinagracia et al. 2009, Tseng 2011). To seize this opportunity, 'front runner organisations' in development and innovation many find opportunity to enhance their businesses through sustainable supply chain, additionally these organisations may obtain competitive advantages and admiration from other firms (Vachon and Klassen 2007).

2.1.6 Customer influence

With the advancement in technology information are more accessible as well as customers are more educated than ever and are demanding 'green' performances/environmentally friendlier products (Georgiadis and Vlachos 2004). Likewise, the buying firm often sees green purchasing as a significant aspect of environmental compliance, thus suppliers is often required to have the ISO14001 certification (Min and Galle 2001).

2.1.7 Community pressure

The society in this modern day plays a crucial role in provoking sustainable innovations, as such organisations must be accountable for their actions which may impact customers and society as a whole (Mann, Kumar et al. 2010, Gupta, Abidi et al. 2013). For example the non-governmental organisation (NGOs) can intimidate organisations to increase their environmental awareness as well as exposing any unwanted/green-washing/phony environmental schemes (Walker, Lucio et al. 2008).

2.1.8 Governmental pressure

Government legislation are the greatest driver of green practices with no other alternatives (Mann, Kumar et al. 2010). Government regulation can be general (i.e. environmental laws) or specific (i.e. end of life), likewise legislation can be triggered by many other factors i.e. mandated product recall (Mann, Kumar et al. 2010). Organisations may comply with the imposed regulation with little to no guarantee that the environmental performances will actually be improved (Ramus and Montiel 2005).

2.1.9 Financial capability

Without the necessary financial flows organisation may cease to exist, which contradicts the 'sustainable' notion, becoming 'unsustainable' (Dyllick and Hockerts 2002). To be competitive within the market, organisation has to offer high quality products at a lower price, however, it can be extremely difficult for organisations without the right financial resources to participate in the sustainable development and still remain competitive, especially for those smaller organisations (Walker, Lucio et al. 2008).

2.1.10 Technological capability

The perceived technological control depicts how well the organisation can control technological factors that may facilitate or restrain the sustainable procedures (Zhang, Yang et al. 2013). There is a systematic dependency of specific technological innovation among the high level of manufacturing aggregation (Nill 2008). Although, this may not seem like a major obstacle for a larger organisation, however it is a crucial setback for small and medium enterprises where little research and development are widely spent (Rathi 2003).

2.1.11 Internal strategy

To successfully introduce a sustainable structure, organisation must consider their current internal strategy i.e. how they view the concept of sustainability, how can such concept incorporate with the existing strategic decisions, the effect on the organisational behaviour, market and structure (Gupta and Palsule-Desai 2011). In relation to internal strategy, facilities and transportation also plays a significant role in sustainable supply chain management. There are many aspects of facility that impact the environment i.e. energy usage, internal transport, transport to and from facilities and operations (Dekker, Bloemhof et al. 2012).

2.1.12 Strategic collaboration

To effectively evaluate organisation's sustainable commitment is to evaluate their suppliers and other partners within the supply chain network (Miemczyk, Johnsen et al. 2012). It was also mentioned by Krause, Vachon et al. (2009) that an organisation is as sustainable as its suppliers. The collaborative behaviour with suppliers and customers are a fundamental component of building an environmental sustainable supply chain (Zhu and Sarkis 2004).

Based on these factors we proposed a conceptual model which is shown in Figure 1.

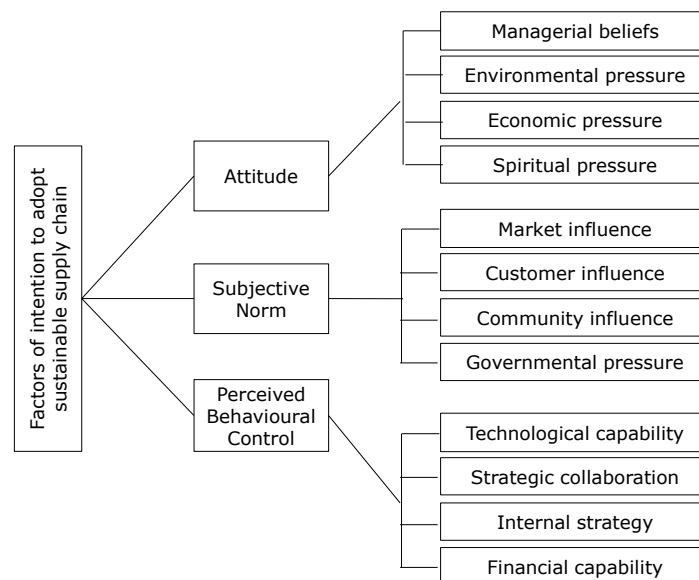


Figure 1: Hierarchical Model of Factors Affecting Sustainable Supply Chain Management Adoption

3. RESEARCH METHODOLOGY

3.1 Method of Analysis – Analytic Hierarchy Process

This study employs a multi-criteria decision-making method called the analytic hierarchy process (AHP) method for analysis. With AHP complex decision problems can be decomposed into a set of manageable decision-making problems. AHP has been applied in a wide variety of contexts including six sigma implementation (Laosirihongthong et al., 2007), supplier risk assessment (Wang et al. 2012), supplier selection (Xu et al. 2013) and green supply chain management implementation barriers (Govindan et al., 2014). The modelling process of AHP involves following four steps:

Step 1: Identification of key factors.

Step 2: Structuring the problem as a hierarchy.

Step 3: The next step is the application of the prioritization procedure to determine the relative importance of criteria (factor-categories and factors) in each level.

Step 4: The fourth and final step of AHP is the determination and synthesis of normalized weights.

Besides providing the consistency in managers' judgement, the main benefit of AHP in relation to other methods, such as obtaining managers preferences through Likert scales, is the fact it is in line with the basic idea of the trade-off concept (Skinner, 1969). It

forces managers to make explicit comparisons between priorities. This results in relative importance weights for each priority factors. Moreover, the AHP analysis not only illuminates the ranking of the priorities, but also assesses how much more/less important a given priority is.

3.2 Respondents

There are a total number of fourteen respondents for this research. Given the type of method employed for analysis, a sample of fourteen respondents is considered adequate (Saaty, 1986). The respondents positions within their organisations and working experience is provided in Table 1. As shown in Table 1, position of the each respondent varies (i.e. from Engineer to assisting managing director), with an average of ten years of work experience between all respondents. However, the work experience in green supply chain area varies from two years to ten years, with an average of six years in total among all the respondents.

Respondent	Industry	Position	Work Exp (Yr)	Working exp in Green operations (yr)
1	Electronics	Asst.Managing Dir	6	5
2	Electronics	Design Engineer	9	6
3	Electronics	General Manager	8	5
4	Electronics	Process Engineer	13	8
5	Electronics	Senior Engineer II	13	3
6	Electronics	Engineer	9	9
7	Electronics	Design Engineer	8	8
8	Electronics	Supply Engineer	7	2
9	Plastic Elect/Auto	QMR/EMR	13	8
10	Electric Equip Assbly	Asst. S/C	3	3
11	Electric Appliance	Manager	25	10
12	Electric Appliance	Engineer	5	5
13	Electric Appliance	Engineer	5	5
14	Electronics	Sr Prod Contr Super	9	9

Table 1: Respondents profile

4. ANALYSIS, RESULTS AND DISCUSSION

The software called Expert Choice® was used to analyse data. First, the analysis was conducted taking data from all fourteen respondents together based on a scale of 1-9. These results are shown in Table 2. Then respondents were grouped into three clusters based on their experience with green supply chain activities. Respondents with the experience up to three years were classified as cluster I, respondents with an experience between four and six years were classified as cluster II and lastly, respondents with more than seven years of experiences were classified as cluster III. The purpose of such analyses was to investigate the relationship between work experience with green supply chain and their behavioural attitude towards sustainable supply chain. These results are shown in Table 3 and Figure 2.

From the analysis, it is clear that subjective norm is the most influential factor of intention (weight = 0.6473). From this, it is clear that the notion of social pressure can place a huge implication for organisations to consider adopting sustainable practices. The next influential factor is the perceived behavioural control with weighs = 0.2416 (see Table 2). The results indicate that managerial attitude such as beliefs and spiritual pressure play a limited role.

The factor level analysis shows that managerial beliefs (weight = 0.3877), customer influence (weight = 0.6572) and financial capability (weight = 0.5678) are top influential factors for attitude, subjective norm and perceived behavioural control factor categories respectively (Table 2). Thus, indicates that the perception of the high ranking managers does in fact contribute to the organisation as a whole towards sustainable development. Weighing only 0.0071 is it clear that spiritual pressure perspective does not play any role in the decision to engage sustainable supply chain adoption.

From the perspective of subjective norm it is clear that customer influence plays the most important role in the decision making (weight = 0.6572). Thus, indicates that organisation holds customers' demands to be the heart of their decision making.

Governmental pressure weighs 0.2565 which is the second influential factor. Likewise, this suggests that organisation maybe obligated to engage in sustainable protocol due to mandatory legislation/laws.

Factor Category	Relative weight	Factor	Relative weight	Ranking	Overall weight	Ranking
Attitude	0.1111	Manager's beliefs	0.3877	1	0.0431	6
		Environmental Pressure	0.2347	3	0.0261	9
		Economic Pressure	0.3705	2	0.0412	7
		Spiritual Pressure	0.0071	4	0.0008	12
Subjective Norm	0.6473	Market Influence	0.0192	4	0.0125	10
		Customer Influence	0.6572	1	0.4254	1
		Community Pressure	0.0671	3	0.0434	5
		Governmental Pressure	0.2565	2	0.1660	2
Perceived Behavioural Control	0.2416	Technological Capacity	0.0357	4	0.0086	11
		Strategic Collaboration	0.2690	2	0.0650	4
		Internal Strategy	0.1275	3	0.0308	8
		Financial Capability	0.5678	1	0.1372	3

Table 2: Relative weights and ranking of factors based on all respondents (CR ≤ 0.01)

Factor	Cluster I		Cluster II		Cluster III	
	Weight	Ranking	Weight	Ranking	Weight	Ranking
Managerial beliefs	0.0222	10	0.0146	12	0.0453	9
Environmental Pressure	0.0635	8	0.0575	8	0.0330	10
Economic Pressure	0.0682	7	0.0467	10	0.0632	7
Spiritual Pressure	0.0221	11	0.0263	11	0.0237	12
Market Influence	0.0786	6	0.0743	7	0.0625	8
Customer Influence	0.2180	1	0.2026	1	0.2242	1
Community Pressure	0.1542	2	0.0964	4	0.0914	5
Governmental Pressure	0.1322	3	0.0975	3	0.1502	2
Technological Capacity	0.0189	12	0.0511	9	0.0255	11
Strategic Collaboration	0.0854	5	0.1501	2	0.1089	3
Internal Strategy	0.0461	9	0.0904	6	0.0727	6
Financial Capability	0.0905	4	0.0924	5	0.0995	4

Table 3: Relative weights and ranking of factors in three clusters of respondents (CR ≤ 0.01)

Financial capability is the most influential factor within perceived behaviour control. Weighing 0.5678 financial capabilities is almost as high as customer influence in the subjective norm factor category. It is clear that without the capability to fund the innovation, organisation may find it difficult and/or not engage in sustainable adoption. The second most influential factor is strategic collaboration (weight = 0.2690). Overall, the top five factors which influence managerial intention to adopt sustainable supply chain management in Thai Electronics industry are customer influence, government pressure, financial capability, strategic collaboration, and community pressure.

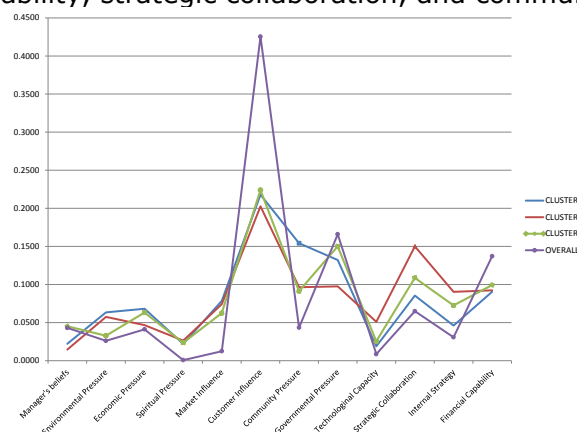


Figure 2: Comparison of relative weights of three clusters of managers

The results of the three clusters of managers are shown in Table 3 and Figure 2. It is interesting to notice that the results are almost identical. They ranked customer influence as the most important factor followed by government pressure and strategic collaboration. Factors such as technological capability, spiritual pressure, and managerial beliefs are found to be the least important factors.

5. CONCLUSIONS

This research aimed to investigate the factors affecting managerial intention to adopt sustainable supply chain practices in Thailand. Through extensive literature review and adapting the theory of planned behaviour factors were identified and developed a hierarchical theoretical model. Fourteen senior executives from the electronics industry in Thailand were selected to participate in this study. A multi-criteria decision making method called Analytic Hierarchy Process (AHP) was applied to analyse data. At the factor-category level, the analysis shows that subjective norm plays a major role towards the intention to adopt sustainable practices, followed by perceived behavioural control and attitude. At the factor level, the top five factors which influence managerial intention are customer influence, government pressure, financial capability, strategic collaboration, and community pressure. Whereas, factors such as technological capability, spiritual pressure, and managerial beliefs are found to be the least important factors to adopt sustainable supply chain management in Thai Electronics industry. This study is unique in a sense that to the best of our knowledge, so far no such study has been conducted using the theory of planned behaviour. Since, this study is conducted in the context of Thai electronics industry and hence, the results obtained in this study may not be generalised for other industries.

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SUSTAINABLE LOGISTICS MANAGEMENT IN UK COMPANIES

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Abstract

This study investigates aspects of CO₂ emissions reduction associated with the logistics activities in a number of large UK companies. Data were collected from in-depth interviews with logistics managers in 15 companies across different commercial sectors. The research identified the main drivers and barriers for CO₂ reduction initiatives in these companies. Key findings include: a) Despite a long-standing awareness by these companies and logistics managers, most CO₂ reduction initiatives have only started in the last 3 to 4 years, and are mainly operational and tactical in nature. b) There have been fewer *strategic* changes, such as adoption of lean logistics, and changes to fleets and infrastructure. c) Even in large companies with significant resources, CO₂ emissions monitoring of logistics activities is far from fully embraced. d) A major driver for companies to adopt CO₂ emission initiatives has been the link between emissions reduction and cost reduction. e) The main barrier cited has been lack of resources, particularly in the case of manufacturers. The study sheds light on the current state of UK logistics operations regarding the reduction of CO₂ emissions and contributes to a better understanding of how company strategies are formed in response to environmental pressures.

Keywords: logistics; CO₂; emissions; reduction; initiatives

1. Introduction

Logistics is the transport, storage and handling of products as they move from raw material source through the production system to their final point of sale or consumption (McKinnon, 2001). The transport, as a key part of logistics, is a substantial contributor to CO₂ emissions.

The 1997 Kyoto Protocol agreement set targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions (UNFCCC, 1997). Since then there has been an increasing public and government concern for the environment, and companies have been under mounting pressure to reduce the environmental impact of CO₂, including logistics activities. Emissions of CO₂ from various logistics activities have been started reducing significantly (Kahn-Ribeiro and Kobayashi 2007; Doherty and Hoyle, 2009).

In terms of economic activity, a report from DHL (Ehrhart, 2010) estimated that the logistics industry generates about 9% of the world's GDP, while in Europe it accounts for about 10% of GDP. As the pressure mounts on global supply chains to produce enough food, goods and services to meet the needs of growing population, the logistics industry is expected to continue to grow, and so will its energy consumption and CO₂ emissions unless change is introduced (Beamon, 2008). With the forecasted growing rates of the shipping industry and with reduction of emissions by the rest of the national economies by an average of 50%, the total emissions from the logistics and shipping industry are expected to be around 15-30% of the CO₂ total world emissions by 2050 (McKinnon, 2010). These are worrying figures as they even considered a 33-50% improvement in energy efficiency by 2050. For this reason many authors (e.g. Dunn, 2002; Aronsson and Brodin, 2006; EUROSTAT, 2010) have emphasized the need for decoupling the growing rates of transportation volumes and the emission this produces.

In light of these facts, a wide variety of initiatives to reduce CO₂ emissions are being currently used or actively considered in UK logistics operations, especially by the larger

firms which have the available resources and capability. There are now a number of studies and reports regarding such initiatives, and in the UK useful reports have been produced by the Department of Energy and Climate Change (DECC), the Department for Environment, Food and Rural Affairs (DEFRA), the Carbon Trust, the Chartered Institute of Logistics and Transport (CILT), and the Social Research Council (SRC).

The research presented here examines the initiatives that are currently being implemented in selected UK companies to reduce CO₂ emissions in their logistics activities. We also examine the main drivers and barriers affecting the implementation of these initiatives. Our research will be based on detailed content analysis of a series of in-depth interviews that were carried out over 14 months with 18 logistics managers from 15 large UK companies that have significant amount of logistics activities. In Section 2, we explain the background study of this research. Section 3 describes the methodology and data analysis. Section 4 presents discussion of research findings from the analysis and finally Section 5 concludes with main findings and future research opportunities.

2. Background study

There have been an increasing number of studies that look at the environmental impacts of logistics activities. Topics studied included: CO₂ auditing (Piecyk, 2010); environmental impacts of freight transport (Cullinane and Edwards, 2010); the environmental impact of warehousing and distribution (Marchant, 2010); reverse logistics and waste management (Cherrett et al., 2010); and the environmental costs of logistics (Piecyk et al., 2010). Specific practices that have an impact on CO₂ emissions include: the use of 'green' criteria to choose suppliers and transporters (Edwards et al., 2010); consolidation of shipments and selection of cleaner transport modes (Eglese and Black, 2010, McKinnon and Edwards, 2010); the use of environmentally friendly packaging, recuperation of materials for reuse, and the disposal of waste (Cherrett et al., 2010).

Doherty and Hoyle (2009) identify some of the more significant and commercially-feasible opportunities for the decarbonisation of logistics and transport. These include the use of 'clean' vehicle technologies; de-speeding the supply chain; enabling low-carbon sourcing; optimised logistics networks; energy efficient logistics buildings; packaging design initiatives; training and communication; modal switches; reverse logistics; increased home delivery; and reducing congestion. These initiatives in combination, according to the authors, have the potential to reduce global logistics and freight transport emissions by 1,400 million tonnes of CO₂ in the medium term, i.e. 50% down from current levels.

The importance of alignment between the dynamics of a company's external environment and the corporate strategic decision process has been noted in several studies (Fredrickson and Mitchell, 1984; Priem et al., 1995; Harris et al., 2010). Miller and Friesen (1983) suggested that the increases in environmental dynamism are accompanied in general by greater levels of rationality in the planning processes of high-performing firms. The authors noted that in order to achieve superior economic performance, such firms had to be critically aware of the changes in the market environment, and hence to rapidly make the necessary adjustments. It is recognised that a successful logistics strategy, if aligned with the corporate strategy and with the resource capabilities of the firm, will coherently unify activities, functions and objectives that otherwise would become conflicting (Rushton and Saw, 1992, LaLonde and Masters, 1994).

There are basically two types of strategy formation in the face of changes in the external environment: deliberate strategies, generally set by top management, and emergent strategies which are patterns or consistencies realized regardless of, or in the absence of, intentions, as a response to changes in the environment (Mintzberg, 1978; Mintzberg and Waters, 1985). Strategic renewal as a result of the latter enables firms to set and achieve new objectives which allow the firm to seize and take advantage of the opportunities and overcome threats (Fabbe-Costes and Colin, 2003). The integration of these 'renewal'

activities within the corporate strategy reflects their importance in the company's operations.

However, one environmental concern that is now changing the pressure associated with logistics systems is the need to reduce CO₂ emissions, which over time will require a fundamental redesign of logistics systems (Harris et al., 2010). It can be postulated that this change is likely to require significant involvement by logistics companies in the formulation of corporate strategies in order to progressively reduce CO₂ emissions in the years to come.

3. Research methodology and data analysis

To achieve the set objectives, a number of research methods were considered, including questionnaire survey, case study, and qualitative interviewing.

A key criterion for selecting the UK companies to interview was that they had significant logistics operations. Contacts were established primarily via the Chartered Institute of Logistics and Transport (CILT-UK), where this included personal contacts at CILT events, direct e-mails, and a general e-mail requiring collaboration in the research sent to the selected members on the CILT membership database.

A total of 18 logistics managers from 15 large UK companies were finally interviewed. The interviews covered a period of 14 months between October 2010 and November 2011. The profile of these companies and the managers include operational, tactical and strategic levels from road, rail, water and air transport.

A questionnaire with 16 questions was sent to the respondents two weeks before the agreed date for interview to allow time for thought-out responses. The interviews lasted up to an hour and were taped with the interviewee's agreement, and subsequently transcribed. All companies were guaranteed anonymity to help yield more meaningful replies. The interviews were semi-structured, and based around the questionnaire, but were deliberately 'open-ended' to allow interviewees to elaborate on issues that seemed to them particularly important.

The transcribed interviews were analysed using NVivo. Eight themes were chosen from the interview questions, and the quotations extracted from the interviews related to these themes, with each relevant sentence or phrase tagged according to the theme or sub-theme judged most appropriate. These were then reviewed by the research team, and some responses were also subsequently cross-checked with the interviewees to check accuracy. The result was thus a detailed thematic qualitative analysis of these interviews.

4. Discussion of research findings

4.1 Awareness and initiatives of CO₂ reduction in logistics activities

Interviewees were asked if their companies were aware of the need to reduce CO₂ emissions. Not surprisingly, given the initial selection of companies involved, all the 15 companies investigated were aware in general terms of the need to reduce CO₂ emissions from their logistics operations. In particular, the managers from the three logistics operators showed a high degree of awareness. The latter mentioned that logistics is the core of their business and as their activities involve an extensive use of fuel and energy so they are in the spotlight when dealing with the topic with customers and other stakeholders.

The logistics managers at the six different manufacturing companies indicated that CO₂ reduction in logistics activities are included as part of the corporate commitment to reduce their total emissions within their environmental agenda their core manufacturing operations. The two logistics practitioners from the retailer investigated were clear that the majority of the CO₂ their company generates is based on their transport and

distribution activities. They were also very aware of the need to reduce the emissions of logistics if the company wanted to achieve its environmental targets.

All the interviewees stated that their companies have already started, or planned to make, changes in their logistics activities in order to reduce their CO₂ emissions.

Analysis of interview transcripts clearly stated that the changes and initiatives aimed at reducing emissions in logistics operations have been mainly implemented at the operational and tactical levels, with less focus on large and expensive strategic changes such as network optimisation, centralisation, localisation, change in information systems, or changing a large proportion of the fleet to greener vehicles. However, it is worth mentioning that there had been a general increase in the use of multimodal transportation, changing to train or waterways when the infrastructure and capacities were appropriate for such change.

Another important change at the strategic level was the increased number of cases of collaboration between companies, even when they are direct competitors. However, an important finding from these interviews was that even in these large companies, with significant resources and capacity, the issue of CO₂ reduction in logistics operations had not been embraced as extensively as might be the case, particularly in the important area of monitoring and reporting CO₂ reductions achieved. Moreover, despite a long-standing awareness of the issue by the logistics managers and by the companies themselves, most initiatives to reduce CO₂ emissions specifically in logistics had started only in the last 3 or 4 years.

4.2 Drivers for implementing CO₂ reduction initiatives

An important area to explore was the factors that are influencing companies in their decisions for taking CO₂ reduction actions. One can speculate as to a wide variety of drivers, and it is important to know which are predominant. Drivers can include, for instance, a concern over the risks posed by climate change; the need for compliance with existing legislation; anticipation of new government legislation; cost and benefit considerations; requirements imposed by suppliers or customers; or simply a wish by the company to appear green – “green-wash”.

<i>Other drivers</i>	<i>Key points from the interviews</i>
The influence of the end-customers	The logistics and infrastructure operators in particular mentioned that their corporate customers are increasingly considering environmental aspects of their operations when they submit tenders for their services.
Desire to improve public image	Some considered that implementing CO ₂ reduction initiatives gives their companies a better image as being ‘green’.
Legislation	A number of the companies were taking a proactive approach in order to be prepared for current and future legislation.
Increasing fuel prices	The increasing price of fuel was an issue that has also driven companies to adopt CO ₂ reduction initiatives, and look for alternatives to current fuel use.

Table 1: Other drivers for implementing CO₂ reduction initiatives (in order of importance)

The interviewees were asked therefore about the drivers of the change towards low CO₂ logistics operations. Answers from participants were very diverse, which was understandable, as their companies were also diverse in nature and with different operational characteristics. Nevertheless they agreed on one fundamental driver: CO₂ reduction is frequently linked with cost reduction. For this reason cost benefits were mentioned by all the interviewees as a driver for implementing CO₂ reduction initiatives, with some differences between the levels of importance they gave to this.

The other main driver highlighted by the majority of the interviewees was corporate social responsibility, which was engrained in the values and principles of most of the companies interviewed. But they suggested that any effort to reduce emissions in logistics had to balance financial, social and environmental factors, in order to guarantee the sustainability of their businesses. Other drivers mentioned by a number of interviewees, in order of importance, are listed in Table 1.

4.3 Barriers for implementing CO₂ reduction initiatives

While there are drivers for companies to implement CO₂ reduction initiatives there are also barriers which delay the changes being carried out. When analysing the interviews it was noted that according to the nature of their business, companies face a wide variety of such barriers, reflecting the differing function of logistics in their operations.

<i>Other barriers</i>	<i>Key points from the interviews</i>
The complexity of logistics responsibilities	Due to increasing services being supplied to the customers (e.g. online orders, home deliveries, customized deliveries), logistics practitioners have been assigned more and more responsibilities which reduce the opportunities for green initiatives.
Unsettled technologies	CO ₂ reduction technologies have not yet settled and are continuously changing, which is a barrier to making investments.
Belief in CO ₂ emissions issues	There are still people quite sceptical about climate change and the consequences of not reducing CO ₂ emissions in human activities, and at times it is difficult to make everybody go the same way.
Commitment to meet customer services requirements	Some customer requirements for deliveries go against the willingness to reduce CO ₂ emissions. Two logistics operators pointed out that dealing with different customers who require different services could make it very difficult to balance the services with the CO ₂ reduction initiatives these operators might have. The retailer had started its new online service which delivers goods more frequently than before, and it is very challenging when trying to fit this service within the CO ₂ reduction strategy of the business company. FEM asserted that the choice of transportation mode was not always in their hands. While the company would like to send the freight by sea or rail, the client might want to have it sent by air.
Lack of control from the use of third party logistics (3PL)	Some manufacturers find it difficult to implement initiatives in their logistics when they work with 3PL. They had to rely on the commitment of their logistics partners in CO ₂ measurement and work together on initiatives for introducing new technologies and practices in their transport and manufacturing operations.
Lack of significant incentives from the Government	For international companies such as FM2, the implementation of successful CO ₂ reduction initiatives in one country could be delayed or not financially feasible in countries with less subsidies and grants such as the UK. A logistics operator (LO2) revealed that some of the financial incentives for green initiatives offered in the past were cut under the current government and without them it would be difficult to engage or continue with CO ₂ abatement initiatives in logistics.

Table 2: Other barriers for implementing CO₂ reduction initiatives

Not surprisingly the most frequently mentioned barrier was lack of resources. Many respondents mentioned that capital had been an issue, especially since the start of the economic crisis in 2008, and companies had prioritised investments in activities that added more value to their products. Three of the food manufacturers indicated that because

logistics is a support function and not the core of their business, it had not received the same attention, and it had been difficult to channel additional resources to implement initiatives. Since logistics is not their biggest CO₂ emitter it had also been lower on their priority list for potential CO₂ reduction. Not only the lack of financial resources has been an issue, but time resources had also affected and delayed the implementation of CO₂ reduction initiatives in logistics. Other barriers mentioned by several respondents are listed in Table 2.

Despite of the barriers discussed above, surprisingly one of the most frequent responses was that there were 'no major barriers for implementing initiatives to reduce emissions in logistics'. This is an encouraging finding for those wishing to see CO₂ reductions continue to be taken forward. Almost a third of the respondents agreed that because all of these initiatives come together with logistics efficiency and cost benefits, everybody is on board from top management to the lower levels of management.

More than half of the respondents agreed that the main contribution from the senior management was to set the direction for being 'green'. Interviewees said that senior management is there to guide and encourage employees in following a sustainable direction. They said it helped when senior management comes up with achievable targets for reducing CO₂ emissions, and stressed that the top management should always be refreshing the environmental strategy, pushing and guiding all the employees to achieve the CO₂ reduction challenges.

5. Summary and Conclusions

This paper reports the findings from an investigation into the awareness of the environmental impact of CO₂ from logistics activities of a number of UK companies, the initiatives taken to tackle this, the drivers and barriers affecting these initiatives. Key findings include:

- (1) Despite a long-standing awareness of the CO₂ issues by the companies and the logistics managers within the companies, most CO₂ reduction initiatives only started in the last three to four years, and these have been mainly operational and tactical rather than strategic.
- (2) There is a positive correlation between most CO₂ reduction initiatives and cost reduction, and this link has been a major driver for the adoption of CO₂ reduction in the companies investigated.
- (3) A key barrier cited for the adoption of CO₂ reduction initiatives in logistics has been the lack of resources. Other barriers include the countervailing pressures from new business demand, such as online retailing, and the fact that CO₂ reduction technologies are not yet settled, so investment is still considered risky.
- (4) The role of the logistics manager has been expanding, as they now need to contribute significantly to the generation, evaluation, and implementation of CO₂ reduction initiatives in their company's logistics activities.

The study has confirmed the awareness by UK companies of the need to reduce CO₂ emissions in logistics activities and thus has led to a wide range of autonomous logistics initiatives being adopted or being considered for adoption. The findings have also confirmed the statement that the need to implement logistics initiatives to reduce CO₂ emissions has led to an increased role for logistics managers, especially in companies where logistics is a support function, as opposed to companies where logistics is a core business. The study has highlighted the fact that logistics management is an increasing challenging role, as there is a need to balance the pressures to achieve customer satisfaction with the undeniable need to reduce the emissions of logistics operations.

In conclusion, it is hoped that this study can assist logistics managers in the development and implementation of initiatives and strategies to reduce CO₂ emissions, and to embed these into corporate strategy.

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SUSTAINABLE CAPABILITIES IMPROVEMENT: COLLECTIVE PRACTICES FRAMEWORK DEVELOPMENT THROUGH MULTIPLE CASE STUDIES

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ABSTRACT

Conflicting requirements from different stakeholders encourage firms to achieve a better Triple-Bottom-Line (3BL) performance. Thus, sustainable practices including lean, green and social practices (LGS) are being widely implemented by firms. However, the mere imitation of "best practice" may not necessarily result in enhanced 3BL performance; firm capabilities also matters. In using LSG practices to solve specific problems, firms develop higher levels of capabilities which ultimately result in an improved 3BL performance. Based on case studies conducted with two Chinese automotive companies, we develop a sustainable capabilities framework incorporating LGS practices, capabilities and 3BL performance. Propositions are generated for quantitative test.

INTRODUCTION

Chinese manufacturers are facing pressures from various stakeholders to embrace sustainability. According to Zhu, Cordeiro and Sarkis (2012), both domestic and international coercive, normative and mimetic pressures are forcing firms to achieve their diverse objectives of sustainability. Stakeholders such as government agencies, consumers and competitors all have different expectations on companies that cannot all be met by the financial performance (the bottom line) only. As a result, firms need to find ways to concurrently uplift their performance in economic, environmental and social aspects. These three performance indicators are collectively referred to as the Triple-Bottom-Line (3BL) performance (Elkington, 1998). The 3BL is considered as one of the best ways to measure a firm's performance in the context of sustainability (Gimenez, Sierra and Rodon, 2012).

Lean, green and social practices have been proven to have positive effects on firm performance in economic, environmental and social aspects, respectively (Iwata and Okada, 2011; Yang, Hong and Modi, 2011; Lioui and Sharma, 2012; Mahoney and Roberts, 2007). These practices are collectively referred to as LSG in this study. Till now, however, LGS practices have only been studied in isolation, with existing studies either focused on environmental issues (Iwata and Okada, 2011; Yang, Hong and Modi, 2011) or CSR-related problems (Lioui and Sharma, 2012; Mahoney and Roberts, 2007). For sustainability to be studied in a more comprehensive sense, these streams of literature need to be simultaneously considered.

In applying LGS practices to problem solving, however, firms develop unique capabilities which facilitate performance improvement (Wu, Melynk and Swink, 2012). Despite the increasing significance of capabilities in strategic management research, to our best knowledge, it is not well studied in the context of sustainability.

This study has two major contributions. Firstly, based on existing literature, this study collectively investigated the impacts of LGS practices on firm 3BL performance, contributing to the comprehensiveness of sustainability. Secondly, the role of capabilities was initially studied as mediator in the LGS-3BL relationship. To our best knowledge, this study is among the early attempts to apply the concept of capabilities to sustainability research. A sustainability capabilities framework incorporating LGS practices, capabilities and 3BL performance was proposed for quantitative tests.

LITERATURE REVIEW

The common practices found to have significant impacts on firm 3BL performance are lean production, green practices and social practices (Hajmohammad et al, 2013; Yang, Hong and Modi, 2011; Waddock and Graves, 1997).

Lean Practices

Lean Production, also known as Toyota Production System (TPS), is bundles of practices aimed at reducing or eliminating all forms of non-value-added activities from firms' manufacturing operations (Yang, Hong and Modi, 2011). These bundles of practices are inter-related and mutually facilitating, whose goal is to increase profitability by systematically minimizing wastes and increasing efficiency (Yang, Hong and Modi, 2011).

Green Practices

Companies are becoming increasingly concerned about the environment. This concern is best illustrated in their adoption of green practices. Green practices are activities aiming to reduce negative environmental impacts (Wagner and Blom, 2011). Green practices can take two forms, namely, activities that are aimed at lowering any negative impacts on the natural environment, and those which can prevent the pollutions from happening.

Social Practices

Corporate Social Responsibility (CSR) refers to companies' obligation to protect social welfare both today and the future, taking into account of all the stakeholders (Lin, Yang and Liou, 2009). The definition of CSR is believed to be vague and people from different areas have been making efforts to properly define it (Dahlsrud, 2008). By analyzing 37 definitions, Dahlsrud (2008) identifies five common dimensions of CSR, namely, social, stakeholder, economic, voluntariness and the environmental dimension.

Triple-Bottom-Line (3BL) Performance

A suitable way to assess the sustainable performance of the firm is the Triple-Bottom-Line (3BL) concept developed by Elkington (1998). Instead of focusing on the bottom line (financial performance) only, the 3BL concept simultaneously takes financial, environmental and social aspects into consideration, providing a complete picture regarding sustainability.

Practice-Performance Relationship

Two streams of literature regarding the relationships between LGS practices and 3BL performance identified are presented below.

Stream 1: Lean/Green Practices – Firm Environmental/Financial Performance Relationship

According to Yang, Hong and Modi (2011), lean manufacturing was found to be positively associated with firm financial and marketing performance. In terms of the relationship between environmental management practices and firm performance, they found that the direct and immediate impact is negative because of the resources required which may negatively affect other projects of the firm. However, in the long run, the negative impact will be gradually reduced by enhanced firm environmental performance.

Wagner and Blom (2011) suggested that the influence of environmental management practices on firm financial performance depends on the financial development of the firms, which means there is a mutual influence between financial performance and environmental management practices. Environmental management practices make good firms better and bad firms worse (in terms of financial development).

Hajmohammad et al (2013) found that the impact of lean management on firm environmental performance is mediated by environmental practices such as pollution prevention, recycling of materials, waste reduction and ISO 14001 certification.

Stream 2: CSR/CSP-Social/Financial Performance

In this context, researchers have empirically investigated the relationship between corporate social practices and firm financial performance (Lin, Yang and Liou, 2009) while others made empirical findings about the relationship between corporate social performance (CSP) and corporate financial performance (CFP) (Waddock and Graves, 1997).

Waddock and Graves (1997) found that there is a mutual facilitation between CSP and CFP, which means the improvement in CSP will cause an improvement in CFP and vice versa.

Besides, in the Taiwanese context, a positive relationship between CSR and firm financial performance was identified by Lin, Yang and Liou (2009).

A Capability Perspective

Organizational capabilities are defined as "firm-specific sets of skills, processes, and routines, developed within the operations management system, that are regularly used in solving its problems through the means of configuring its operational resources" (Wu, Melynk and Swink, 2012). Different from operational practices which are standard and transferable, capabilities are tacit and imitable. Despite the rich evidences on the positive impact of LGS practices on firm economic, environmental and social performance respectively, it is believed that the mere imitation of "best practice" have limited ability to bring the firm with an enhanced performance (Wu, Melynk and Swink, 2012). When adopting any operational practices, firms should have the capabilities to fit them well in their existing operations systems and form unique ways of solving problems based on them. This process will facilitate the further improvement of the capabilities, which, ultimately result in uplifted performance.

The best illustration of the importance of capabilities in facilitating operational practices in achieving better performance can be seen from the case of Toyota. Overseas competitors have been trying to imitate the set of superior lean practices from Japanese automotive giant, Toyota, but not every company has gained the same benefits. The reason is that Toyota developed inimitable capabilities from digesting superior practices in its existing systems (Wu, Melynk and Swink, 2012).

To sum up, despite the rich evidence on the relationship between LGS practices and 3BL performance, the role of capabilities has, to some extent, been overlooked. In applying practices to specific problem solving, firms develop unique capabilities which act as a mechanism in the practice-performance relationship. Moreover, both practices and performance have been studied in isolation in terms of sustainability. It is believed that future research should combine these streams of literature, and include the role of firm capabilities.

METHODOLOGY

A case study approach is adopted for the current research. Case study as a useful research method refers to an in-depth study of one case (or more cases) using whatever methods seem appropriate (Punch, 1998, p. 150). Compared with quantitative research, case studies can provide more detailed and in-depth understandings of the phenomena being investigated. Despite the popularity of case study approach among social science researchers, there are inconsistent opinions on the number of cases sufficient for a single study (Eisenhardt, 1989; Dyer and Wilkins, 1991). Contrary to Eisenhardt's (1989) idea that a case study should be composed of at least 4-10 cases, Dyer and Wilkins (1991) believe that researchers can obtain more detailed understandings of the phenomena and the context in which it happens from smaller number of cases even single case study.

We selected two automotive companies operating in China for this study. The sampling was based on the companies' ability to represent and availability for the study.

Currently, China is the world's largest automobile producer and consumer. The automotive sector is one of the pillar industries for China's economy. It is expected to experience the largest growth than any other industries in the future (Zhu, Sarkis and Lai, 2007). The sustainable development of the automotive sector will therefore play a significant role in ensuring the healthy development and safety of the national economy. As a result, we chose Chinese automotive sector for this study.

Case Companies and Respondents Profile

The case companies are labelled as **Company A** and **Company B** in the remainder of the paper due to confidential reasons. A description of characteristics of both companies and respondents is presented below.

Company A

Company A is an important Chinese local automotive company operating mainly in southern mainland China. It is a whole-car assembler and a producer of engines and transmission systems. The company is in existence for two decades, and has achieved significant success in products and innovations domestically and internationally. It is also one of the major whole-car exporters in China. Company A is implementing lean, green and social practices, and it has certifications such as ISO 14001 and other sustainability initiatives. The interviewee from Company A is employed in the Department of Production and Logistics. The respondent showed great confidence and sufficient knowledge for the questions during the 1.5-hour interview.

Company B

Company B is a joint venture of a Chinese local company and an internationally renowned automotive giant. Operating in Northern China for more than 10 years, company B has managed to achieve rapid development and an increasing market share (6%-7%). It is famous for a high level of lean production, and part of their plant is open to the public for visiting. For green and social practices, it also can be considered as at the leading level. Company B is ISO 14001 certified. The interviewee is working in the Department of Production Management. He has been working in the company for 4 years and has a good knowledge about production in every aspect.

Data Collection

Semi-structured interviews were conducted with the respondents from both companies. Questions on LGS practices, 3BL performance, capabilities as well as challenges they are facing to be more sustainable were asked. After the initial contacts, data was organized and follow-up questions were identified. Later, more interviews were carried out through phone calls. In addition to the primary data, secondary data including company CSR reports, annual reports, and websites information were also used.

Results

Table 1 presents an overview of LGS practices and 3BL performance of both companies.

DISCUSSIONS

This study was built on the operational capability framework developed by Wu, Melnyk and Flynn (2010).

Operational Improvement and Operational Innovation

According to Wu, Melnyk and Flynn (2010), operational improvement capability refers to "differentiated sets of skills, processes, and routines for incrementally refining and reinforcing existing operations processes" while operational innovation capability refers to those "for radically improving existing operations processes or creating and implementing new and unique operations processes" (Wu, Melnyk and Flynn, 2010). These two capabilities have the same function of improving the existing operational process but in different ways (incremental and radical). In this study, we group them into one category based on nature. From the interviews, lean practices especially improvement practices (Table 1) have found to be positively related with these two kinds of capabilities. By empowering and motivating the employees, both firms have become more efficient in variance- and waste-identification, thus developed the capability to improve the operations process constantly. As the respondent from Company A expressed in the interview:

"Valuable suggestions from employees are highly rewarded and implemented at the company level. There are several programs we are implementing that were initially proposed by our employees, and they have been proven to be good ones which brought

the company with significant financial benefits. They are great innovations". Statistics show that from 2009 to 2012, the number of employee proposals of Company A increased from 91,358 to 331,200, which means that employees are greatly motivated to take the responsibility of improvement. This capability is believed to be mainly associated with firm performance in the financial aspect.

	Company A	Company B
Lean		
Improvement	<ul style="list-style-type: none"> ✓ Work station stop buttons. ✓ Two reports each month to present wastes identified. 	<ul style="list-style-type: none"> ✓ Work station stop buttons.
Maintenance	<ul style="list-style-type: none"> ✓ Maintenance activities are mainly conducted at holidays. ✓ There are equipment experts ready for emergencies. 	<ul style="list-style-type: none"> ✓ Maintenance activities are mainly conducted at holidays or equipment breakdowns. ✓ There is a Maintenance Department available for emergencies.
Pull System	<ul style="list-style-type: none"> ✓ Production is driven by customer demand. ✓ Predictions and plans are made once a month based on historical sales records from 4s shops. 	<ul style="list-style-type: none"> ✓ Production is driven by customer demand. ✓ Predictions and plans are made once a month based on historical sales records from 4s shops.
Inventory	<ul style="list-style-type: none"> ✓ 3-day inventory. 	<ul style="list-style-type: none"> ✓ 1-4-hour inventory for local parts ✓ 45-day inventory for home country imported parts
Layout	<ul style="list-style-type: none"> ✓ Cell production 	<ul style="list-style-type: none"> ✓ Cell production
Others	<ul style="list-style-type: none"> ✓ Jidoka rate 86% (highest) 	<ul style="list-style-type: none"> ✓ Program x (for supply management) ✓ High Jidoka rate with the highest being 100%
Green		
Raw material reduction	<ul style="list-style-type: none"> ✓ Avoiding harmful but legal raw materials in production. 	<ul style="list-style-type: none"> ✓ Materials have passed legal tests. ✓ The reduction of solid wastes and recyclability are also considered.
Recycling	<ul style="list-style-type: none"> ✓ Cooling water. 	<ul style="list-style-type: none"> ✓ Part of sewage purified and recycled. ✓ High rate of solid waste recycling (nearly 100%).
Reduction of emissions, discharges and solid wastes	<ul style="list-style-type: none"> ✓ Part of fuel equipment has been replaced by natural gas equivalent. ✓ Employees are required to save water, paper, electricity etc in daily work. 	<ul style="list-style-type: none"> ✓ Reduce of CO2 and VOC emissions by replacing fuel heating facilities with lighter natural gas ones and installing U shaped ovens, etc ✓ Reduce solid wastes by improving raw material selection, packaging, sorting, and enhancing cooperation with third-party organizations.
Take-back	<ul style="list-style-type: none"> ✓ Not involved. 	<ul style="list-style-type: none"> ✓ Not involved.
Social		
Employees	<ul style="list-style-type: none"> ✓ Regular company level training programs 	<ul style="list-style-type: none"> ✓ On-line learning account assigned to employees. 30 credits
	<ul style="list-style-type: none"> ✓ Mentors for new staff Working Conditions ✓ Fuel forklifts were replaced by electric ones. ✓ Heat-proof materials installed on the roof. ✓ Electric fans. ✓ Safety hats and other protection supplies. Welfare ✓ Better accommodation. Satisfaction ✓ Questionnaires distributed regularly 	<ul style="list-style-type: none"> every year required. ✓ Multi-functional workers developed by rotation activities. Working Safety ✓ Shop-floor employees are equipped with protection supplies. They cannot enter the plant without protection. Welfare ✓ There is a salary increase for each employee every year. Satisfaction ✓ Boxes placed at the canteens to collect employees' voices. HR department makes improvement based on the information.
Customers	<ul style="list-style-type: none"> ✓ "Caring for every detail" program. ✓ Center for technological support established to provide professional and responsive solutions. 	<ul style="list-style-type: none"> ✓ Customer Service Department established to collect customer information and deal with customer problems.
Business partners	<ul style="list-style-type: none"> ✓ The company purchases the same kind of auto parts from different suppliers to increase competition. ✓ Production information is sent to suppliers a week in advance of the purchasing activities. 	<ul style="list-style-type: none"> ✓ The company cooperates with business partners in a transparent and fair manner based on formal procedures. ✓ It believes that the best way to facilitate the development of suppliers is to raise the standard.
The community	<ul style="list-style-type: none"> ✓ Establishing schools and universities ✓ Providing funds for impoverished students. ✓ Donating money to disastrous areas. ✓ Launching community services (free vehicle checking, public lectures, etc). 	<ul style="list-style-type: none"> ✓ Supporting education, ✓ Donating to disastrous areas and ✓ Sponsoring sports events as well as theme activities (such as Environmental Protection Summer Camp).
3BL Performance		
Financial	ROA=6.5%; ROS=8.3% (2012)	ROA=9.8%; ROS=12.2% (2012)
Environmental	The green image has been improved in recent years. However, the exact amounts of raw material reduction, emissions, discharges etc are neither recorded nor revealed.	Energy use, GHG emissions (per unit), air pollutant emissions, water use (both fresh and recycled), hazardous chemicals used, VOC emissions as well as product environmental certification are clearly recorded, most of which have been declining.
Social	Measured in terms of social awards: <ul style="list-style-type: none"> ✓ 7 social awards since 2007 issued by major media and government agencies. 	Reported in four aspects: <ul style="list-style-type: none"> ✓ Customer satisfaction (slightly decreased) ✓ Employee training expenses & time (per person) (increasing) ✓ Payment for materials and parts purchased (increasing) ✓ Social contribution expenses (slightly decreased)

Figure 1: Data Overview

Operational Customization

Wu, Melnyk and Flynn (2010) defined operational customization as "differentiated sets of skills, processes, and routines for the creation of knowledge through extending and

customizing operations processes and systems". Lean and green practices are found to have the most obvious contributions to the development of this capability. As shown in Table 1, Company B has its unique way of supply management program (x). x is crucial in quality management for Company B. Realizing that even the smallest problem in the auto-parts can cause serious consequences in the vehicles, Company B decided to control every link of the supply chain. Any changes the suppliers make to their products need to be reported immediately, and Company B will have these changes assessed by experts. Should there be any possibility that quality might be negatively affected, the contract with this supplier will be ceased. x has been regarded as the most rigid supply management system in the industry. However, it does contribute to the quality control of Company B.

Green practices also facilitate the improvement of firm operational customization capability. By adopting energy-saving and cleaner production activities, Company A has developed a unique production process called "The green way of development". This new way has successfully contributed to profits by saving costs and penalty expenditures. Companies can achieve better performance not only financially, but also environmentally and socially by being perceived as ecological and socially-responsible.

Operational Cooperation

Operational cooperation is defined as "differentiated sets of skills, processes, and routines for creating healthy and stable relationships with people from various internal functional areas and external supply chain partners" (Wu, Melnyk and Flynn, 2010). According to both respondents, social practices have brought their companies with a higher operational cooperation capability. As shown in Table 1, both companies have clear procedures for internal and external communications, among which training is one of the most effective ways. Both companies are launching regular training programs targeting at staff, suppliers, customers as well as the public. Internally, both companies have cross-functional activities such as cross-department experience sharing sessions and friendly competitions. Externally, in addition to training, the companies also have different ways to communicate with supply chain partners. They established specialized departments for customer feedbacks and conduct regular communications with suppliers through phone calls and emails. All these activities ensure the companies healthy and stable relationships internally and externally. The way the companies maintain these relationships, on the one hand, makes business activities more efficient; on the other hand, the social images of the firms as responsible corporations are.

Operational Responsiveness and Operational Reconfiguration

Operational responsiveness capability refers to "differentiated sets of skills, processes, and routines for reacting quickly and easily to changes in input or output requirements" while operational reconfiguration is defined as "differentiated sets of skills, processes, and routines for accomplishing the necessary transformation to re-establish the fit between operations strategy and the market environment, when their equilibrium has been disturbed" (Wu, Melnyk and Flynn, 2010). These two capabilities are combined in this study because both of them are about the speed and ease of firms to respond to changes. The only difference is that operational responsiveness deals with internal changes while operational reconfiguration addresses the changes in the broader environment.

LGS practices have been found to be facilitating for the development of firm operational responsiveness and reconfiguration capabilities. As shown in Table 1, Company B have been emphasizing heavily on quality management through two of its famous programs, x (for supply management) and high Jidoka rate. Its products are famous for high quality. These practices have developed company B a capability of continuous improvement in quality, which forms part of its responsive and reconfiguration capabilities. As the respondent from Company B indicated:

"Through studying consumer preference, we have learned that consumers' demand on products' quality has been and will be rising. As we have this continuous improvement of quality, we can respond perfectly to their changing demand".

According to Table 1, both case companies are strict in raw material selection. Company A even developed a marketing strategy based on this. One of the features of their products is the "Superior interior air quality", which is the best demonstration of its material selection strategy. This strategy has successfully attracted the attention of customers because nowadays people care about health and safety more than anything else. According to the respondent, the sales were embracing a rapid growth after this idea was promoted in the market.

In addition to the significant facilitation of lean and green practices on the development of operational responsiveness and reconfiguration capabilities, social practices are also found to be contributing. As the respondent from Company B expressed:

"We consider consumer demand as the priority. We have a department called Customer Service which is responsible for collecting consumer information in various aspects such as satisfaction, reference, etc. The information collected plays a significant role in strategy- and decision-making. As a result, our company is able to react to any changes rapidly and accurately because we know what the changes are".

The result of improved operational responsiveness and reconfiguration capabilities is an overall enhancement of 3BL performance. Both companies embraced a rapid growth in sales, as well as uplifted green and social image.

Based on the above discussions, we propose the following map illustrating the ways in which LGS practices are related with operational capabilities and 3BL performance. However, the relationships are not exclusive. More case studies are absolutely needed to make the picture comprehensive.

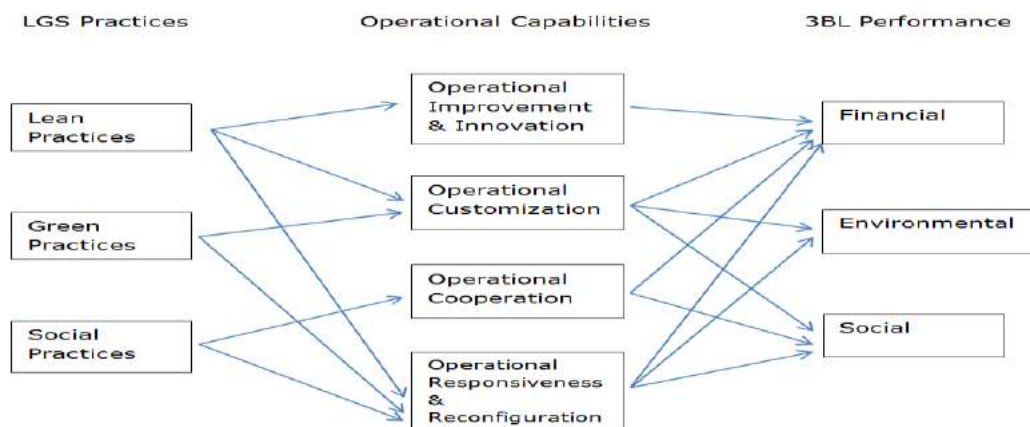


Figure 1: Relationships identified from case studies

Based on the above, the following conceptual framework and propositions are generated for test:

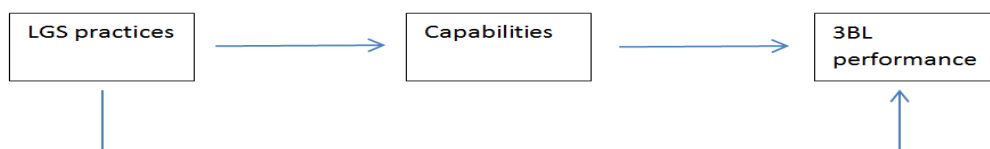


Figure 2: Conceptual Framework

P: Firm capabilities mediate the impact of LGS practices on 3BL performance:

- a) Using LGS practices in specific problem-solving relates positively with firm operational capabilities development;
- b) Firm operational capabilities improvement is positively associated with 3BL performance.

CONCLUSION

Under the pressure from various stakeholders, companies are embracing sustainability by simultaneously addressing economic, environmental and social problems. LGS

practices are the most widely adopted practices for this purpose. In addressing specific problems using LGS practices, firms develop operational capabilities which ultimately enhance firm 3BL performance. Based on evidence from case studies conducted among Chinese automotive companies, this study proposes that firm capabilities act as the mediator in the relationship between LGS practices and 3BL performance. The conceptual model needs future tests with larger sample sizes.

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ROLE OF OPERATIONAL CAPABILITIES IN BUDGET HOTEL SERVICE DESIGN: AN EMPIRICAL STUDY IN THE CHINESE CONTEXT

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Abstract

The paper studies the role and influence of operational capabilities required for developing service design in the Chinese context. Based on resource based view the study develops an operational capability service design model that meets the external requirements to satisfy customer and differentiates itself from their competitors. We captured the importance of operational capabilities in service design using three sub models i) operations capabilities required for customer satisfaction ii) competitive priorities based on market characteristics and iii) match between competitive priorities and customer satisfaction. We carried out an empirical survey to validate our service design model and hypotheses. We found operational capabilities aspects such as physical product, staff attributes and service have positive relationship with customer satisfaction. In terms of competitive priorities budget hotels have to concentrate on location and image. Finally we found that budget hotel can be successful if it concentrates on operational capabilities that improves customer satisfaction and matches with competitive priorities.

Introduction

Competition in Chinese hospitality industry has intensified in recent years. Hotel has to focus on combination of treatment, task and tangibles in designing service to satisfy customer. Especially in a budget hotel developing a service design with a combination of tasks, treatment and tangibles with numerous constraints and to be heterogeneous is a big challenge. In addition to the above, operation of a budget hotel in matured economy is standardized whereas in developing economies with various customer requirements becomes a serious issue. Hence, it is vital for a budget hotel in developing economies to build its operational capabilities to differentiate them from their competitors and to satisfy their customers.

The tourism and hospitality industry growth is tremendous, China will soon be the largest potential tourist destination spot for the world travelers in 2020 (Pine, 2002). In addition, domestic travelers for business and other purpose growth is similar to international travelers and it fetches revenue of \$29.3 billion in 2013, which is 14% higher than 2012. It is predicted that there is no match between China's existing accommodation growth and demand. Furthermore, the total number of budget hotels in China is 7% while in developed countries it is 70% of the whole hospitality industry market share (Inntie, 2012). Therefore, China's hospitality industry will usher into a large-scale expansion in the next few years. In addition, budget hotels are becoming increasingly popular in the Chinese lodging industry because of the high demand and high return on investment (ROI) in China.

Budget hotels encounter difficulties such as fierce competition, personalized and diversified customer expectations, difficulty in satisfying customers and offering unique services (Pine, 2002). With continuous growth of China's hospitality industry and market segmentation, the budget hotel will be more diversified under the pluralistic China's hospitality industry structure. The main task of budget hotel is to meet the needs of targeted consumers, and then improve service and product, in order to accelerate the customers' satisfaction, strengthen the market competitiveness and increase the revenue. To attain competitive priorities, the hotels have to align their capabilities with customer demand. The hotel should provide satisfied products and services to meet customer demand, ultimately capture the customer satisfaction. This is the way forward for hotels to retain customers and to generate more profit for the stakeholders.

This study aims to focus on the role and influence of operational capabilities required for developing service design in budget hotel sector. Based on resource based view, budget hotels are possible to obtain a relative advantage via competitors when hotel's manager can forecast the prospective value of operational capabilities (Coltman & Devinney, 2013). The paper aims to study how operational capability meets the customer requirements and differentiates itself from their competitors to gain competitive advantage. This study attempts to address the following research questions:

a. How do operations capabilities affect the customer satisfaction in the budget hotel sector?

- b. Based on the market characteristics, what factors influence competitive priorities?
- c. What is the relationship between competitive priorities and customer satisfaction?

2. Literature Review

2.1 The resource-based view theory (RBV)

The resource-based view of the firm (RBV) states that the success of a firm mainly depends on resources and it accelerates the firm to achieve sustainable competitive advantage (Andersen and Kheam, 1998). Resource-based theorists consider the firm as a special set of resources and assets can create competitive advantage if uses resources in a distinctive way (Hall, 1992). The distinctive resources and capabilities can lead to different market performance (Barney, 1991; Wernerfelt, 1984). Furthermore to be successful, the firm's competitive advantage should be hard to imitate by the competitors (Barney, 1991).

RBV describe firms as a bundle of capabilities and resources needed for market or product competition. Resources are human capital, physical capital, and organizational capital controller by the company that can be used to implement strategies, in addition, capabilities reflect the ability of a company integrate resource (Barney, 1991). RBV highlights the organizational capabilities, one step further, RBV suppose that resources are different and to some extent constant (Colotta, Shi, & Gregory, 2003). RBV and operational capabilities are inseparable, because a firm's strategy relies on internal resources and capabilities (ibid, 2003).

2.2 Operational capabilities

Cepeda et al. (2007) describe the definition of operational capabilities is that in order to uninterrupted transforming inputs into outputs, organizations purposefully combine the internal resource. This paper concentrates on operational capabilities that are subset of organizational capabilities (Wu, Melnyk, Flynn, 2010). Operational capabilities are crucial in maintaining firm's competitive advantage (Cepeda & Vera, 2007). Operational capabilities nurture firm's resources and practices into unique features (Coltman & Devinney, 2013). Managers have to choose how best to utilize capabilities in a specific task and should examine its impact on service design (Coltman & Devinney, 2013). Hotels have to cater to customers through physical product, staff, and service (Wu, Melnyk, Flynn, 2010). Moreover, the vital operational capabilities cannot be easily copied from other hotels (ibid, 2010).

2.3 Competitive priorities

Parnell (2006) argue that competitive priorities can give arise to higher profits and sales. Kathuria (2000) define competitive priority as a bundle of objectives for manufacturing to compete and gain competitive advantage. Competitive advantages as the capability of a firm bring more value to customer than product itself (Kroes & Ghosh, 2010). Most scholars agree that competitive priorities should be classified into four basic components: price/cost, quality, on-time delivery and flexibility (Kavitha, Karthikeyan, Devi, 2013). Recently, small firms put flexibility in the first place, as the same time, maintain high performance on quality, on-time delivery, and price/cost (Kroes & Ghosh, 2010). However, some authors consider new elements such as innovation, customer service, human resource, and marketing elements (Kathuria, 2000; Galbreath, 2005; Lashley, 2008). Based on pervious literature, this paper adds some recent factors such as word-of-mouth behavior and after-sales service to classical competitive priorities.

2.4 Customers satisfaction

Cardozo (1965) first defined the concept of customer satisfaction and suggested that it can lead to the repurchase behavior. Higher customer satisfaction can build strong competitive advantage and increases the market share (Fornell, 1992). Cardozo (1965) expressed customer satisfaction as a feeling of pleasure and disappointment by individuals after comparing the expected and the actual service. From an economic point of view, ChurChill & Surprenant (1982) defined customer satisfaction as a result of purchase, which results to the customer cost-benefit (money, time and research information).

Moreover, the operational capability affects the satisfaction in the budget hotel. In terms of service design providing high quality services improves customer satisfaction in the lodging industry (Barsky & Nash, 2003; Oppermann 1998). The main function of hotels is to deliver service to the consumers (Brotherton, 2004). Service quality is defined as how to satisfy the guest's demand, and how well the service satisfy the guest's expectations (Barsky, 1992; Brotherton, 2004). The better service the hotel provide, the greater the

customer satisfaction. In the fierce competitive hospitality industry, a larger amount of hotels offer homogeneous services, under this situation, each hotelier should be satisfy customers better than their competitors to achieve competitive advantage (Johnson & Fornell, 1991; Eggert & Ulaga, 2002).

3. Conceptual models

3.1 operational capabilities and customer satisfaction

Operational capability is the ability of firm to align its resources and technologies to meet a set of objectives based on customer focused value propositions (Cepeda & Vera, 2007). In order to achieve high level of customer satisfaction, firms should provide high value to customers. Hotel's attributes are considered as the decisive by customers to evaluate the quality of the hotel, such as price, location, service, physical products, security, reputation, appealing image, and opportunities for relaxation, which leads to high level of customer satisfaction (Cadotte & Turgeon, 1988; McCleary et al., 1993; Chan et al, 2009).

This paper proposes a new model to analyze operational capabilities and customer satisfaction. In budget hotel sector, operational capabilities can be recognized in three aspects: physical product, staff attributes, service attributes. Physical product as most important hotels' attributes is one of the criteria by customers evaluate hotel service (Qing, 2007). Staff is the main body of the hotel service, customers who feel unfair treatment of staff will decrease customer satisfaction (Pablo, Teresa & Miguel, 2013; Hunt, 1977). Service is considered as a dynamic process that hotel deliver the core capability and additional capability to customers (Hung, Ho, Liao & Wu, 2012; Smith & Bolton, 1988). Based on the above argument we posit

In the budget hotel, physical product (H1), staff attributes (H2), and service attributes (H3) have a positive effect on customer satisfaction as shown in Figure 1.

3.2 Competitive priorities based on market characteristics

Competitive priorities are used to describe firm's unique achievement. As mentioned before, competitive priorities are classified into four basic components: price/cost, quality, on-time delivery and flexibility (Kavitha, Karthikeyan, Devi, 2013). At the same time, according to budget hotel, this paper chooses three main factors: location, price, and image. The factor of location refers that the hotel has convenient location, convenient transportation with signs, and geographic coverage of hotel network. Price mainly refers to the monetary value that customers pay for the hotel service (Chan et al,2009). With the rapidly development of the hotel market, various budget hotel brands emerging, the budget hotel market competition is further intensified. Different brand has different interior and exterior hotel design, especially in color part. Hence we posit the following

In the budget hotel, location (H4), price (H5) and image (H6) has a positive effect on the Competitive priorities as shown in Figure 2.

3.3 The relationship between competitive priorities and customer satisfaction

Customer satisfaction as an evaluation process of services or products is viewed as the most effective method to measure the level of customer satisfaction. The high customer satisfaction can bring strong competitive advantage, and then catch high market share (Fornell, 1992). Customers form an attitude toward consuming based on a prior experience. Customer satisfactions have an effect on competitive priorities. He we propose the following

Customer satisfaction has a positive effect on competitive priorities as shown in Figure 3.

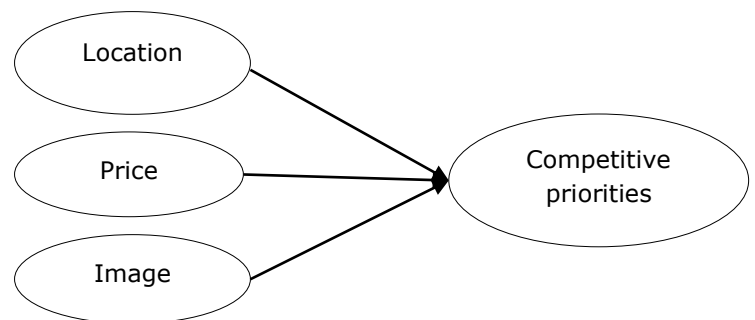
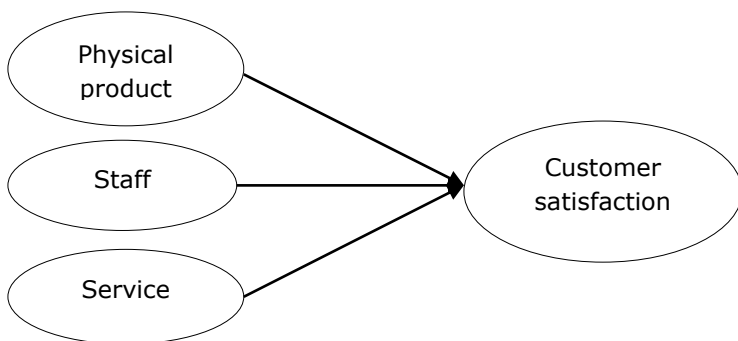


Figure 1: The operations capabilities required for customer satisfaction (Model 1)

Figure 2: Competitive priorities based on market characteristics (Model 2)

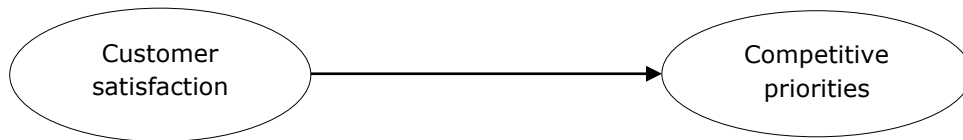


Figure 3 Customer satisfactions on Competitive priorities (Model 3)

4. Study method

4.1 Survey instrument

This study carried out an empirical survey to test our service design model and hypotheses. Questionnaire with standard measurement scales was used to collect the data. The questionnaire includes: operational capabilities, competitive priorities, customer satisfaction, and basic information. The first part focuses on operational capabilities and market characteristic, including six aspects (33 items) physical product, location, staff, service, price, and image as presented. The second part concentrates on customer satisfaction involving 5 items as present. The third part focuses on the competitive priorities involving 4 items. All these items were measured on five-point scale from 1 (strongly disagree) and 5 (strongly agree). The last part is the basic information of consumers, including gender, age, income, professional etc.

4.2 Data collection

In total 290 questionnaires were distributed to the budget hotels in three areas of China: Zhejiang, Shanghai, Anhui in the summer 2013. Considering the diversity of customer groups, choosing two international brands: Ibis and Super 8; four national chain hotels: Home Inn, Motel 168, Seven Days Inn, and Green Tree Inn; one local brand Tianfu hotel in Anhui. Those consumers can represent the Chinese consumers to some extent. These questionnaires were put at the checkout counter in each hotel. The lobby manager distributed questionnaire randomly. To encourage customer's active participation, some gifts were given to customers who filled in the questionnaire. In order to increase the sample diversity, we also used other channels Internet such as Email, QQ, online survey and MSN etc. to distribute the questionnaire. Among the 220 questionnaire returned (75.8% response rate), we found 21 questionnaires with missing they were excluded from the analysis. Therefore, in total we found 199 questionnaires were useful for analysis.

5. Study findings

5.1 Profile of respondents

In this survey, the sex ratio was quite balanced among 199 respondents. The two main age groups were between 16-25 years of age and 26-35 years of age, which account for 32.7% and 44.7%, respectively. In addition, 17.6% were 36 to 45 years of age, and those over 46 years old accounted for the remaining 5%. There are two possible reasons that the age distribution is below 35 years of age. First, the main customers of the budget hotel are young people in China. In consequence, young people prefer to stay in the budget hotel. Second, in the actual investigation, the two age groups are more willing to cooperate. The majority respondents (92%) of sample has at least bachelor degree, this can reflect the customers of budget hotel have higher education level. Based on the Census of China in 2011, China had a population of more than 1.33 billion with 89.3 million, and had at least 5.3% people who have college education. Several reasons may contribute to this phenomenon. People who have a college education easily accept budget hotel and rational when making purchase decision. Among the 199 respondents, 189 respondents had income of RMB below 7,000, which is more than the average income for an urban resident according to the Census of China in 2011. Businessman and students evenly accounted for 29.5%. As mentioned before, the mass tourism has becoming more and more popular. Furthermore, an increasing number of businessmen prefer to select the budget hotel in China.

5.2 Structural equation modeling (SEM)

This paper validated the conceptual models using SEM analysis. We developed path model using AMOS based on the result of exploratory factor analysis (EFA) and confirmation factor analysis (CFA). That is, operational capability involving physical product, staff, and service may have significant effect on customer

satisfaction. Furthermore, the characteristics of hotel market including location, price, and image may have effect on competitive priorities. In addition, there is a possible relationship between customer satisfaction and competitive priorities. EFA results of the three models are shown in Table 1, 2, 3, respectively. Furthermore, researchers generally adopt the value of Cronbach's Alpha to test the reliability of the items. The higher score of Cronbach's Alpha, the higher the overall internal consistency. According to Tabachnick & Fidell(2007), Cronbach's Alpha is higher than 0.7 then it indicates the higher reliability of items. Composite reliability of each construct is also shown in the table and it's above the suggested cut-off value 0.7 (In our case it ranges from 0.75 to 0.83).

Table 2 Exploratory factor analysis of items model 1

Constructs		Variables	Factor loading	Composite reliability	Cronbach's Alpha	Number of Items
Physical product	P1	Standardized hotel design	.638	0.81	0.897	10
	P2	Proper size of guest bedroom	.771			
	P3	Good comfort level of guest bedroom	.644			
	P4	Good hygiene and cleanliness	.735			
	P7	Proper color of hotel exterior and interior	.756			
Staff	S1	The staff treat the customer with full respect	.798	0.80	0.827	3
	S2	Professional appearance of staff	.765			
	S3	The staff is friendly towards the guests	.813			
Service	Servic3	Efficiency of guest service	.710	0.78	0.827	7
	Servic4	Good guest security and safety	.766			
	Servic6	Speed of guest service	.774			
Customer satisfaction	C1	Satisfied with the services provided by this budget hotel	.764	0.83	0.857	4
	C2	The overall feeling I got from the hotel put me in a good mood	.862			
	C3	The hotel give me pleasure and feel relaxed	.826			

Table 3 Exploratory factor analysis of items model 2

Constructs		Variables	Factor loading	Composite reliability	Cronbach's Alpha	Number of Items
Price	Price 1	Value for money accommodation	.756	0.82	0.774	3
	Price 2	Consistent pricing policy	.773			
	Price 3	Low guest bedroom prices	.808			
Location	L1	Convenient location	.660	0.77	0.814	3
	L2	Geographic coverage of hotel network	.589			
	L3	Size of hotel network	.611			
Image	I1	The hotel is popular	.595	0.75	0.757	4
	I2	High reputation of hotel	.485			
	I3	Strong brand differentiation	.593			
Competitive priorities	B1	I would like to come back to the hotel in the future	.775	0.77	0.768	4
	B2	I would like speak highly of this hotel and recommend to my friends and colleagues.	.701			
	B3	I would more frequently visit the hotel	.813			

Table 4 Exploratory factor analysis of items model 3

Constructs		Variables	Factor loading	Composite reliability	Cronbach's Alpha	Number of Items
Customer satisfaction	C1	I satisfied with the services provided by this budget hotel	.764	0.84	0.832	4
	C2	The overall feeling I got from the hotel put me in a good mood	.862			
	C3	The hotel give me pleasure and feel relaxed	.826			
Competitive priorities	B1	I would like to come back to the hotel in the future	.775	0.78	0.768	4
	B2	I would like speak highly of this hotel and recommend to my friends and colleagues.	.701			
	B3	I would more frequently visit the hotel	.813			

Table 4 summarizes the fit indices of three models. The result shows that all three models are appropriate because they are better than the threshold value. Therefore, the three conceptual models provide a reasonable explanation among the constructs.

Table 4 The fit index of three models (Source: Shah and Goldstein, 2006)

Fit index	Criteria	Model 1	Model 2	Model 3
Chi-square/df	0.002-4.80	2.409	2.402	2.521
IFI	0.88-1.00	0.905	0.904	0.968
CFI	0.88-1.00	0.908	0.900	0.967
RMSEA	0.00-0.13	0.084	0.084	0.087

Model 1 has four constructs involving physical product, service, staff and customer satisfaction. There are 14 observed variables including P1, P2, P3, P4, P7, S1, S2, S3, Service3, Service4, Service6, C1, C2, and C3. Figure 4 shows the structural equation path model on customer satisfaction that supports hypothesis H1, H2, and H3. Physical product, service and staff all have a positive impact on customer satisfaction. Physical product has more effect on the customer satisfaction when compared to others.

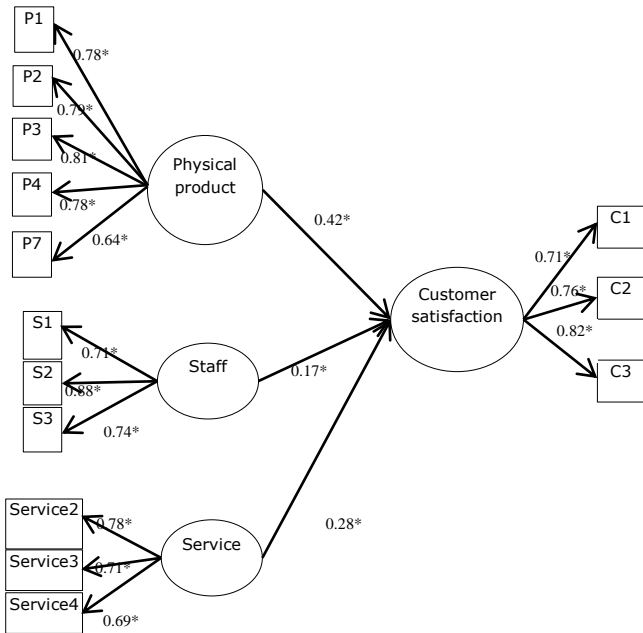


Figure 4: Path analysis of model 1

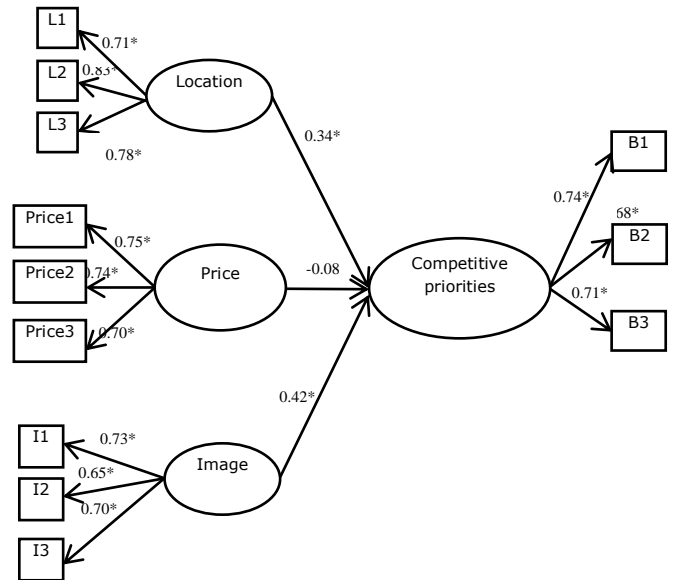


Figure 5: Path analysis of model 2

Model 2 has four constructs related to location, price, image and competitive priorities. There are 12 observed variables including L1, L2, L3, Price1, Price2, Price3, I1, I2, I3, B1, B2, and B3. Figure 5 presents the structural model results and it reveals that all estimated loadings of the indicators except price are significant at the 0.05 level. Thus, H4 and H6 were supported. The relationship between competitive priorities and location is positive. In addition, image has the high influence on competitive priorities. Moreover, the item of price is not significant at the 0.05 level in model. Thus, H5 is not supported.

Model 3 has four unobserved constructs involving location, price, image and competitive priorities. There are 6 observed variables including C1, C2, C3, B1, B2, and B3. It reveals that the estimated loadings of the indicators are significant at the 0.05 level. Figure 6 presents the structural model results for the model. The relationship between competitive priorities and customer satisfaction is positive. The result supports H7 and indicates that customer satisfaction has a strong positive impact on competitive priorities.

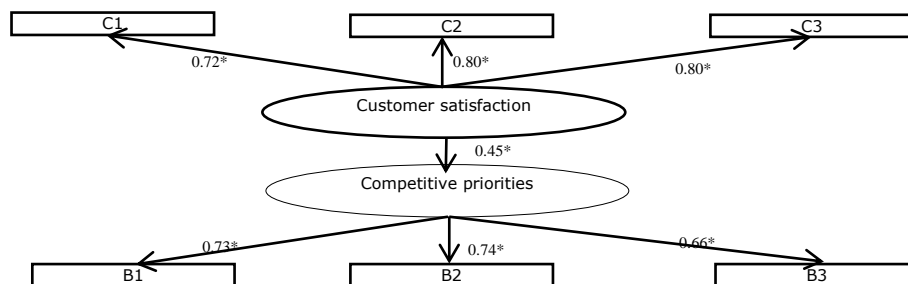


Figure 6: Path analysis of model 3

6 RESULTS

The purpose of this paper is to understand the role of operational capabilities in budget hotel service design. The paper presents the evidence examining the effect of operational capabilities on customer satisfaction and competitive priorities in the budget hotel sector. This study found operational capabilities aspects such as physical product, staff attributes and service have direct impact on customer satisfaction. Out of the above three, our analysis suggest that physical product including proper size of customer bedroom, standardized hotel design, good comfort level, value-added facilities, good hygiene and cleanliness, layout of the room facilities and the design of room influences customer satisfaction.

In terms of competitive priorities budget hotels have to concentrate on location and image. Establishing brand images and sustaining the superiority of their own brand is the key for the budget hotel. Furthermore, most the Chinese budget hotels are located at business districts such as sub-downtown area main streets, downtown central business districts (CBD), and high technological development areas. Location is a vital factor for competitive priorities. Finally we found that budget hotel can be successful if it concentrates on operational capabilities that improves customer satisfaction and matches with competitive priorities.

This paper offers a comprehensive view for budget hotel to achieve the competitive advantage on how customer responds to consumption experience. This paper helps hotel operators to understand what value of the products and service they should offer. Furthermore, the conceptual model built for this study is tested from hospitality industry. This study will facilitate budget hotel operators to adjust the marketing strategies to satisfy guests' demands and desires, ultimately to win customers.

There are several limitations in the research. First, data for this study were gathered from few guests of budget hotels, results cannot be generalized to the overall Chinese budget hotel scenario. The sampling size of customer survey could be improved. Furthermore, conducting a convenient sampling method may exactly represent the situation. Therefore, future studies should encompass more respondents from more provinces with data collected during longitudinal time period to understand the evolution of matching capabilities.

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DOING FIELD MANAGEMENT RESEARCH: RESEARCH CULTURE AND ENVIRONMENT IN VIETNAM

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ABSTRACT

Purpose

Management research in the field of emerging market economies is an area of considerable interest to scholars. The research journey can be messy and fraught with complex relations and interests, logistical hurdles, and delicate negotiations. Guidelines for overcoming these obstacles and more generally for doing fieldwork in developing countries are not readily available. This paper addresses this gap by explaining the process and procedure for conducting field management research in Vietnam, and more generally in other Asian emerging market economies.

Design/methodology/approach

This paper, which derives from six months of fieldwork spread over four extended trips to Vietnam, presents the processes and procedures for conducting field management research in that country.

Findings

The paper reflects on the strategies adopted in the research approach, the management of complex relationships with research partners and participants, and the handling of constraints on sample selection and data collection. Finally, the paper offers lessons on how to overcome these challenges.

Originality/value

This paper offers one of the first "inside views" of how to do field management research in Vietnam.

Keywords

Emerging Market Economies; Field Research; Research Methods; Vietnamese Management

INTRODUCTION

Emerging countries are no longer solely suppliers of cheap labor. Instead they are becoming hotbeds of innovation by redesigning entire business processes to do things better and faster than their rivals in the West. Increasingly, then, companies in the developed world will find much to learn from their Asian rivals' management ideas and practices. The access and understanding of these practices will come from doing field management research defined by Edmondson and McManus as "systematic studies that rely on the collection of original data in real organizations" (2007: 9-10). By studying real people, real problems, and real organizations, field researchers generate new knowledge and insights into the application of theories, concepts, and techniques in different settings. Moreover, by conducting field management research in different geographic regions, especially emerging countries where companies are advancing new techniques, studies can highlight differences and variations in best practices that may be of considerable importance to both practitioners and management scholars the world over. Unfortunately, field management research in Southeast Asia is not easy and guidelines for carrying it out are not readily available. This paper helps fill this breach by recommending strategies to new researchers planning to carry out fieldwork in Southeast Asian emerging countries, and in particular in Vietnam.

Vietnam is one of the fastest growing economies in Southeast Asia, offering foreign investors low-cost production sites, a domestic market of over 92 million consumers. With sixty percent of the population under the age of 35 it has a strong and vibrant workforce that has powered the country's rapid growth and emergence onto the global stage. All this notwithstanding, academics have focused little research on management in Vietnam, and what research has been conducted does not analyze or discuss the process of doing management fieldwork there, though its specific challenges have been noted (see e.g., Dinh *et al.*, 2006; Scott *et al.*, 2006; Nguyen and Bryant, 2004). Likewise, researchers have explained the difficulties of doing social science fieldwork in China and Japan (Heimer and Thogersen, 2006; Bestor *et al.*, 2003; Johl and Renganathan, 2009), and more broadly, the limitations of doing management fieldwork in emerging market economies (Hoskisson *et al.*, 2000). Given the obstacles to western-style research noted by these scholars, exploring and understanding ways to negotiate the specific hurdles encountered in Vietnam, will not only help those hoping to work there, but also open the door for similar research in all of Southeast Asia.

This paper, which derives from six months of fieldwork spread over four extended trips to Vietnam, responds to these problems by explaining the processes and procedures for conducting field management research in that country. This fieldwork was part of an ongoing multiyear research project to study the state of continuous improvement (CI) in Vietnam, in particular the mechanisms that Vietnamese organizations use to improve their quality and productivity. This research included in-depth case studies at twelve of Vietnam's leading companies, and interviews with over 400 business leaders, academics, and expatriates who have worked and lived in Vietnam for over 40 years.

The paper begins with an overview of the current research environment in Vietnam, and then describes the challenges of doing field research there. The subsequent sections reflect on the strategies adopted in the research approach, the management of complex relationships with research partners and participants, and the handling of constraints on sample selection and data collection. Finally, the paper offers lessons on how to overcome these challenges.

OVERVIEW OF RESEARCH CULTURE AND ENVIRONMENT

Following the *Đổi Mới* (renewal) market-based reforms of the mid-1980s and the subsequent influx of foreign investment, Vietnam is emerging as a fierce player in the global business stage. One of the youngest workforces in the world, a literacy rate of over 90 percent, and abundant low-cost labor underpin Vietnam's attraction as a global manufacturing center. In 2010, Intel completed a new \$1 billion facility in the country's southern business hub that is expected to generate up to \$15 billion per annum in export revenue when it reaches full capacity (Boudreau, 2010). Nike, the largest employer in Vietnam, indirectly employs 150,000 workers in thirty-five contract factories. But despite the international business community's immense interest in Vietnam and even though the United States is a major investor and its largest export market, Vietnam remains one of the least-researched countries in Asia.

This lack of management research in Vietnam is an acute problem for the country. Indeed, Vietnam has no research culture of any kind. And there are good reasons for this. The socialist education system maintains its influence through the older generation of academics, who were trained in the former Soviet Union, are generally comfortable in their state jobs, and uninterested in academic research or new ways of doing things (Scott *et al.*, 2006; Overland, 2008). This makes it extremely difficult for new academics to do research in Vietnam. According to a survey by the International Foundation for Science (IFS), low pay is the most debilitating problem for academic researchers. With an average monthly pay of

\$70 to \$100 (Overland, 2008), potential academic researchers are forced to supplement their income by doing other work including teaching evening classes at private schools, consulting, and running their own small businesses (Zink, 2009). Moreover, because a career as an academic and researcher does not guarantee a sufficient income to support a family, those who choose it find themselves at odds with fundamental Vietnamese social and cultural expectation that people will marry and have children. This is a major problem for men, and even more so for women because according to the IFS female grantees earned 50% less from their research than male grantees (Zink, 2009).

Vietnamese faculty members are also hampered by the requirement to get government permission to publish their work in international journals (Napier *et al.*, 2008). Many practices accepted in international research institutions are viewed as new and controversial by Vietnamese academics, including (1) choosing one's research topics instead of being assigned them by government ministries; (2) choosing one's collaborators rather than being assigned to a project; (3) conducting analytical rather than descriptive research; and (4) jointly contributing to research instead of having a few individuals do the work with little to no acknowledgement (Napier *et al.*, 2008: 810). To make matters worse, a September 2009 government directive, known as Decision 97, has restricted research in Vietnam to 317 approved topics, has banned all public discussions of unsanctioned subjects, and has forced the country's only independent think-tank to disband (Stocking, 2009). Heimer and Thogersen (2006) have observed similar restrictions in China where the Party defines which topics academics and informants can and cannot talk about.

Another explanation of the shortage of management research is that it is generally difficult for academics, particularly foreigners, to investigate conditions in Vietnamese companies. The country's culture of corporate secrecy makes it hard to access reliable data without powerful and influential contacts and endorsements (see e.g., Dinh *et al.*, 2006; Gainsborough, 2007). Access depends on the support of a host institution. This can only be achieved through government channels (Ashwill 2005) and after lengthy negotiations with host agencies and research subjects (Scott, Miller, and Lloyd 2006). Foreign researchers have also been discouraged by the lack of a shared language, which prevents them from connecting with most Vietnamese (Simonet, 2008; Napier, 2006).

The lack of a research culture in Vietnam is equally evident in the limited research and development (R&D) conducted in industry. Aside from R&D centers in large state-owned corporations and in foreign-invested enterprises, most Vietnamese companies do little or no R&D (Harvard Vietnam Program, 2008). Furthermore, disseminating research so that it can be widely beneficial is difficult as there are few connections among universities, research institutes, and industry in Vietnam. The lack of collaborative links further inhibits research in the country.

LESSONS FOR DOING FIELDWORK

While field management research in emerging market economies is an area of considerable interest to scholars, the research journey can be messy and fraught with complex relations and interests, logistical hurdles, and delicate negotiations. Researchers must manage relationships with host institutions and gatekeepers, negotiate mutual benefits for research participants, request data, and deal with the language barrier. Navigating fieldwork requires a good understanding of, and sensitivity to, Vietnamese cultural principles – kinship, reciprocity, harmony, and face. Recognizing these would help researchers appreciate the subtle ways people communicate and how easy it can be to misunderstand or offend people.

Lesson 1: Partner with a Host Institution

In Vietnam, the kinship system has strong patrilineal elements, and strict attention is paid to hierarchy and seniority (Haines, 2002). An individual is expected to defer to anyone of higher status as determined by kinship, descent, gender, and age (Do *et al.*, 2007). Every person has a place within the family, the village, and in the wider society, and that place determines duties, responsibilities, and privileges (Borton, 2000). Right relationships underlie social dynamics, and are omnipresent in the work setting in Vietnam. In fact, relationships are critical in getting things done in Vietnam. Access to companies, managers, and officials depends on whom one knows and the relationships one has with those individuals. Joy (2001) has observed a similar situation in Chinese society, where access to goods, services, and people is contingent on whether an individual is an insider versus an outsider. Furthermore, Heimer and Thogersen (2006) have found that good contacts are often a necessary prerequisite for fieldwork in China. Similarly, Hardacre (2003) found that researchers in Japan generally form an affiliation with a local university whose faculty can give advice and provide crucial introductions.

In Vietnam, it is extremely important for researchers to gain the support of a host institution. The study of social sciences is still in its early stages in Vietnam, so researchers and respondents have difficulty establishing trust (Scott *et al.*, 2006). Due to Vietnam's lack of a research culture, most top managers are unsure of how frank and open they should be with researchers. In addition, Vietnamese managers and executives are highly unlikely to answer a questionnaire unless they know the researchers and understand how the information will be used (Nguyen and Bryant, 2004; Dinh *et al.*, 2010). Many have a policy of not responding to questionnaires at all (Le and Truong, 2005). Therefore, host institutions are instrumental in providing high-level official endorsement of the research and its goals, in helping to gain access to case companies, and offering an empowering environment that encourages managers and employees to participate and respond candidly.

I made my first connection with my host institution through a serendipitous event in 2007. At the time, I was a Ph.D. student interested in studying Vietnamese business and management, and therefore eager to go to Vietnam for fieldwork. My Ph.D. advisor suggested that I find a host institution that would provide me with administrative support and research guidance. Since I was not familiar with any Vietnamese business schools, I typed "business schools in Vietnam" on Google search engine, and my host institution was the first on the list of results. After learning about its programs and people, my advisor and I contacted the Dean of the Business School and arranged to visit. It is not, of course, a requirement to have one's Ph.D. advisor present the first time one visits the host institution, but I found that my advisor's presence established the importance of my research and gave me the academic credibility that I was lacking as a student. His physical presence accorded with the Vietnamese tradition of "*gửi gắm*" (entrusting) someone who is in your care to another person. This was a powerful gesture because the faculty of the host institution were being asked to take my advisor's place in his absence. As a result, they took me under their wings and helped me make the right connections. Because they introduced me to members of the business community and its leaders, I gained access to the majority of my case firms and received positive responses when I asked them to participate in the research.

Lesson 2: Cultivate All Contacts – Professional and Personal

While academic introductions are helpful in many aspects of field management research, it can be useful to supplement these with professional and personal contacts. This is especially important if the researcher is still a student, when access cannot be secured by trading on one's credentials as a scholar and teacher, but may be gained by meeting members of the local community and telling them of one's research objectives. People met in this fashion may not be well positioned to aid in setting up company participation, but they can help the

researcher establish informal associations that may eventually produce necessary connections to the organization's headquarters and leadership.

For example, I had several interviews and discussions with people knowledgeable about Vietnam including directors of associations, directors and affiliates of government agencies, local and foreign consultants and trainers, and prominent members of the expatriate community who have lived and worked in that country since the 1960s.

Through Lady Borton, who is a well-known figure in Vietnam and has published several books on the experiences of the Vietnamese people, I was able to meet leaders of the Vietnam Chamber of Commerce and Industry (VCCI), and through them gained access to a number of my case companies. In another example, my contact at Nike Inc. introduced me to a Vietnamese consultant at LeanTek, who in turn introduced me to Toyota Vietnam, also one of my case companies. During one of my research trips to Ho Chi Minh City, I had a chance meeting in my hotel elevator with the Vietnamese-American President and CEO of a U.S. consulting company. I told him that the biggest challenge to my research into continuous improvement practices in Vietnam was that companies were reluctant to participate because the research demanded access to production facilities and offices and extended amounts of time with respondents. He immediately offered his help, and referred me to a subsidiary of a large Japanese-owned company in Ho Chi Minh City. His nephew was a manager there and would be able to let me study the company.

These professional and personal contacts not only helped me connect with case companies; they also sharpened my understanding of Vietnam's business environment and prompted me to think more critically about various elements of my research. Furthermore, they helped me build the "right" relationships.

Lesson 3: Build Right Relationships through Mutual Trust

Introductions are necessary to gain access to case companies and develop a more extensive network of relationships, but they are not sufficient. Developing mutual trust with executives, managers, and informants at the case companies is equally important. Either through unstructured interviews, interactions with managers and staff members, and/or attendance at meetings and events, in Vietnam these informal contacts and conversations are vital for two reasons. First, they let the company representatives and the researcher establish understanding and clarify expectations about the benefits of the research. Second, they give the researchers the chance to build the right relationship that is so critical for achieving the mutual trust and ease of communication necessary to gather more information. Similarly, Wei (2006) found that Chinese respondents were forthcoming only after mutual trust has been developed between her and the respondents. In addition, Bestor *et al.* found that introductions in Japan "involve the standard Japanese cultural practice of borrowing trust from other people in order to gain access to a new situation, which carries complex obligations to act responsibly and not misuse or damage the trust" (2003: 14).

For me, developing mutual trust in Vietnam revolved around eating and drinking. For example, I often met with managers who were my contact at the case companies at coffee shops for casual conversations and discussions on the purpose of my research. I also had meals with informants such as local consultants and expatriates to talk about the business environment in Vietnam and to gather their input about the direction of the research. During these meetings, we drank Vietnamese beer and ate local and exotic dishes. By sharing my interest in food and drink with my contacts, I showed that I sincerely cared about their lives and work. According to Borton (2000), Vietnamese people build relationships and trust with their counterparts through casual conversations, and only after this has been accomplished can any discussion of business begin.

Lesson 4: Find Immediate and Concrete Benefits for Research Participants and Partners

Research partnerships in emerging market economies ideally should offer opportunities for mutual benefits such as reciprocal learning and the advancement of management theory. While host institutions, agencies, and gatekeepers in Vietnam share these expectations, they may be interested in more immediate and tangible benefits. After all, the priority for many institutions and agencies in Vietnam is some measurable contribution to economic development.

For host institutions and agencies, desired benefits may involve the researcher offering classes, seminars, or training to their executives and managers in exchange for sponsorship of the research project and introductions to local business leaders. Since Western knowledge and skills are sought after in Vietnam, lectures, seminars, and training are highly welcomed. Vietnamese executives and managers are interested in building their knowledge and skills in areas such as human resources, marketing, and operations management. Within the field of operations, topics such as project management, quality management, continuous improvement, statistical process control, forecasting, and inventory management are invaluable to managers in Vietnamese organizations. For host institutions and agencies whose purpose is to bring talent and experts from overseas to help local firms apply world-class management practices, bringing academics from the U.S. and Europe gives them 'international brand' recognition within Vietnam.

The exchange – of knowledge or more concrete benefits – are expected in many aspects of Vietnamese social and professional life. The culture of reciprocity is summed up in the Vietnamese saying: “*Có qua có lại mới toại lòng nhau*” (Reciprocity brings contentment). Therefore, researchers who can offer know-how, services, and/or formalized recommendations may be extremely welcomed.

Lesson 5: Overcome the Language Barrier

The lack of a shared language may prevent foreign researchers from connecting with locals and communicating with Vietnamese managers and employees who are not proficient in English. The language barrier could also pose a challenge for *Việt Kiều*: a Vietnamese term that means Overseas Vietnamese and refers to Vietnamese people – like myself – living outside the country in the Vietnamese diaspora. Vietnamese is spoken differently by those inside and outside of the country. Many terminologies I use are foreign to my colleagues in Vietnam. For example, I would use the word “sáng kiến” to translate “innovation,” but many of my colleagues use the term “sự đổi mới” which identifies the renewal/renovation of market-based reforms of the 1980's. On the other hand, there are many new vocabularies in Vietnam that have been created in the last two decades to compensate for the previous lack of business terminology. Until recently the Vietnamese language had no words for concepts such as “innovation,” “customer service,” or “entrepreneurship” (Napier, 2005). This is similar to the findings of Bestor *et al.* in Japan, “Even a researcher with the highest level of language training will find it necessary to master new terminological terrain; indeed, the specialized vocabularies and semantic domains of any Japanese institution or setting provide an enormous amount of basic social and cultural data that a fieldworker will need to master in order to understand the ethnographic site and the phenomenon under study” (2003: 9-10).

To obviate the language issue, I hired two local research assistants. They accompanied me to most company visits and interviews. In addition, the research assistants helped me to navigate through sensitive situations. Like many other Asian cultures, the Vietnamese care passionately about “face”: that is, the respect they receive from others (Jamieson, 1995).

According to Ashwill (2005), the Vietnamese value face highly because it helps maintain respect and harmony in interpersonal relationships. While *mất mặt* ("loss of face") is severe in any society, it is unbearable in Vietnam as evidenced by the Vietnamese expression: "Better die than to lose face" (Borton, 2000: 24). Thus, for example, during interviews the assistants and I avoided any phrases or dialogue that would expose respondents to the risks of losing face. The research assistants could push through sensitive topics such as the efficiency of their managers without scaring off the interviewees from being candid. Yeh (2006) has observed a similar situation in Tibet: researchers who stay in the country long-term have to adopt certain patterns of behavior, dress, and speech to help them blend in or live in greater harmony with their host communities.

Fluency in Vietnamese is not a requirement for doing fieldwork in Vietnam but being able to speak some Vietnamese is advised. The level of language competency depends on the linguistic abilities required by the project and the interpretation of data. First-time researchers with limited Vietnamese language skills may need to tailor their research goals to fit their language limitations. Research assistants and translators who speak the native language and understand the culture can help at this stage. Doing fieldwork in itself provides a powerful opportunity to improve one's language skills and cultural understanding of the host country. Even researchers who speak the language well will find it necessary to master new "terminological terrain" and to learn cultural sensitivities.

Lesson 6: Access Multiple Methods and Data Sources

The challenges of doing research in Vietnam, particularly the problems of data collection and reliability, are exacerbated by the country's lack of a research culture. Just as Hoskisson *et al.* (2000) have observed in other developing countries, Vietnam's data sources can pose many problems of interpretation: online or publicly available data may not be accurate; centralized (governmental) data sources may be outdated due to rapid economic growth and frequent policy changes; firm data collected by different government departments and levels may not be consistent; and financial reporting may not be based on conventional market standards. To obviate these problems, the researcher could adopt a multiple-methods approach using both quantitative and qualitative data.

My research data were collected from surveys, face-to-face interviews, and direct observations. Through the survey, I was able to capture a broad group of respondents (490 respondents from six case companies). The face-to-face interviews (over 60) enabled me to ask the respondents more in-depth questions. The semi-structured format of the interview questions provided focus as well as encouraged some consistency, but was open-ended to allow respondents more freedom to express their opinions. While the survey data complemented the interview data, the plant observations verified and clarified the interview responses, and facilitated visual checks and comparison of each firm. Additional information, when available, was gathered from company documents and secondary sources such as websites and newspaper articles. They included continuous improvement/quality reports and copies of employee improvement ideas amounting to more than 600 pages of information, charts, and pictures. All of these data put together painted a fuller picture of continuous improvement practices in Vietnam.

Data of any kind is difficult to access in emerging market research, in particular in Vietnam. The use of mixed methods permits triangulation and complementary overlapping examination of the phenomena. Furthermore, the combination of quantitative and qualitative data can be useful in obtaining novel, relevant, and reliable insights as well as broadening the researcher's understanding of the issues being studied.

CONCLUSION

To gain a better understanding of Vietnamese management, we must build a stronger base of empirical observations and so we need more field-based studies. But western researchers who hope to contribute to this endeavor will find considerable educational, governmental, social, and cultural differences that constrain their ability to get the information they need. Learning about those differences and the strategies others have used to handle them is useful preparation for fieldwork in Vietnam, and also in many other countries of Southeast Asia. The experiences and solutions described in this paper are offered as help and encouragement to investigators seeking to discover more about business in this expanding and dynamic region.

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THE U.S./CANADA KEystone XL PIPELINE: LOGISTICS, ENERGY, ENVIRONMENTAL, AND POLITICAL ISSUES

by

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Abstract

Purpose of this paper

The Keystone XL Pipeline project is currently a logistics, energy, environmental, and political issue in the United States and Canada. So far, government approvals of the project have been delayed for a variety of reasons. In our paper we give a historical perspective on the XL Pipeline project and how it has been impacted by energy issues in the U.S., environmental hurdles in both Canada and the U.S., the growth in domestic U.S. oil production, and finally the demand for oil in Asia and eastern Canada. Information involving all of these issues will be presented. Finally, we offer some recommendations regarding the Keystone XL Pipeline.

Design/methodology/approach

This paper is descriptive in nature. The history leading up to the current pipeline impasse will be included, along with discussions of the pertinent issues.

Findings

In 2008, energy company TransCanada proposed the Keystone XL crude oil pipeline, extending from Alberta, Canada to the Texas Gulf Coast. Because this energy project proposal crossed the U.S. border, a U.S. Presidential permit was required. Environmental opposition in Canada and the U.S. remains high. In 2012, TransCanada began constructing a major portion of the pipeline on the U.S. side, from Cushing, Oklahoma to the Texas Gulf Coast. Since TransCanada's original application in 2008, the Bakken formation in North Dakota has seen rapidly growing crude oil production, which has impacted overall demand in the U.S. for imported oil. Additionally, the state of the U.S. economy has improved since 2008 which has impacted the job-creation argument for the pipeline.

The initial pipeline route through Nebraska caused a number of approval delays due to environmental impacts from a potential pipeline spill on the Sandhills areas of Nebraska. The 2012 proposed Keystone XL pipeline route avoids the environmentally sensitive areas in Nebraska. On the Canada side of the border however, environmentalists are concerned that extracting oil from tar sands requires open-pit mining and high levels of greenhouse gas emissions to process the heavy oil.

Practical Implications

Regardless of the environmental concerns, operators continue to develop the Canadian oil sands and the U.S. Bakken shale oil fields. Producers are turning to alternative transportation methods such as rail and truck hauling, a much more expensive shipping solution. Canada may seek other markets for their oil, including China and other Asian countries which have expressed interest. U.S. President Obama has had many political battles with the U.S. Congress over this issue, and it has been suggested that he approve the Keystone XL Pipeline in exchange for concessions on budgets and his controversial health care plan. Recently, the U.S. State Department published a report supporting the Keystone project.

Value of the paper

To date, there have been few papers discussing all of the issues surrounding the Keystone XL Pipeline. This paper discusses all of the issues from the Canadian and U.S. perspectives and seeks to approach the issues in an unbiased manner.

Purpose

The Keystone XL Pipeline project is currently a hot economic, environmental, and political issue in the United States and Canada. In 2008, energy infrastructure company TransCanada proposed the Keystone XL crude oil pipeline, extending from Alberta, Canada to the Texas Gulf Coast. Because this energy project proposal crosses the U.S. border, a U.S. Presidential permit is required. So far, U.S. President Obama has delayed approval of the project for a variety of environmental and political reasons. Environmental opposition in Canada and the U.S. has remained high.

In 2012, TransCanada began constructing a major portion of the pipeline on the U.S. side, from Cushing, Oklahoma to the Texas Gulf Coast. Since TransCanada's original pipeline application in 2008, the Bakken formation in North Dakota has seen rapidly growing crude oil production, which has impacted overall demand in the U.S. for imported oil. Additionally, the state of the U.S. economy has improved since 2008 which has impacted the job-creation argument for the pipeline. It has been argued though, that the pipeline project will create many thousands of U.S. jobs in construction and manufacturing in both the short and long term. It is also estimated the pipeline will generate over US\$5.5Billion in tax revenues over the operating life of the pipeline.¹

This paper presents a historical perspective on the XL Pipeline project and how it has been impacted by energy issues in the United States, environmental hurdles in both Canada and the U.S., the growth in domestic U.S. oil production, and finally the demand for oil in Asia and eastern Canada. Information involving all of these issues is presented here. Finally, we offer some conclusions and a recommendation for the XL Pipeline.

Design

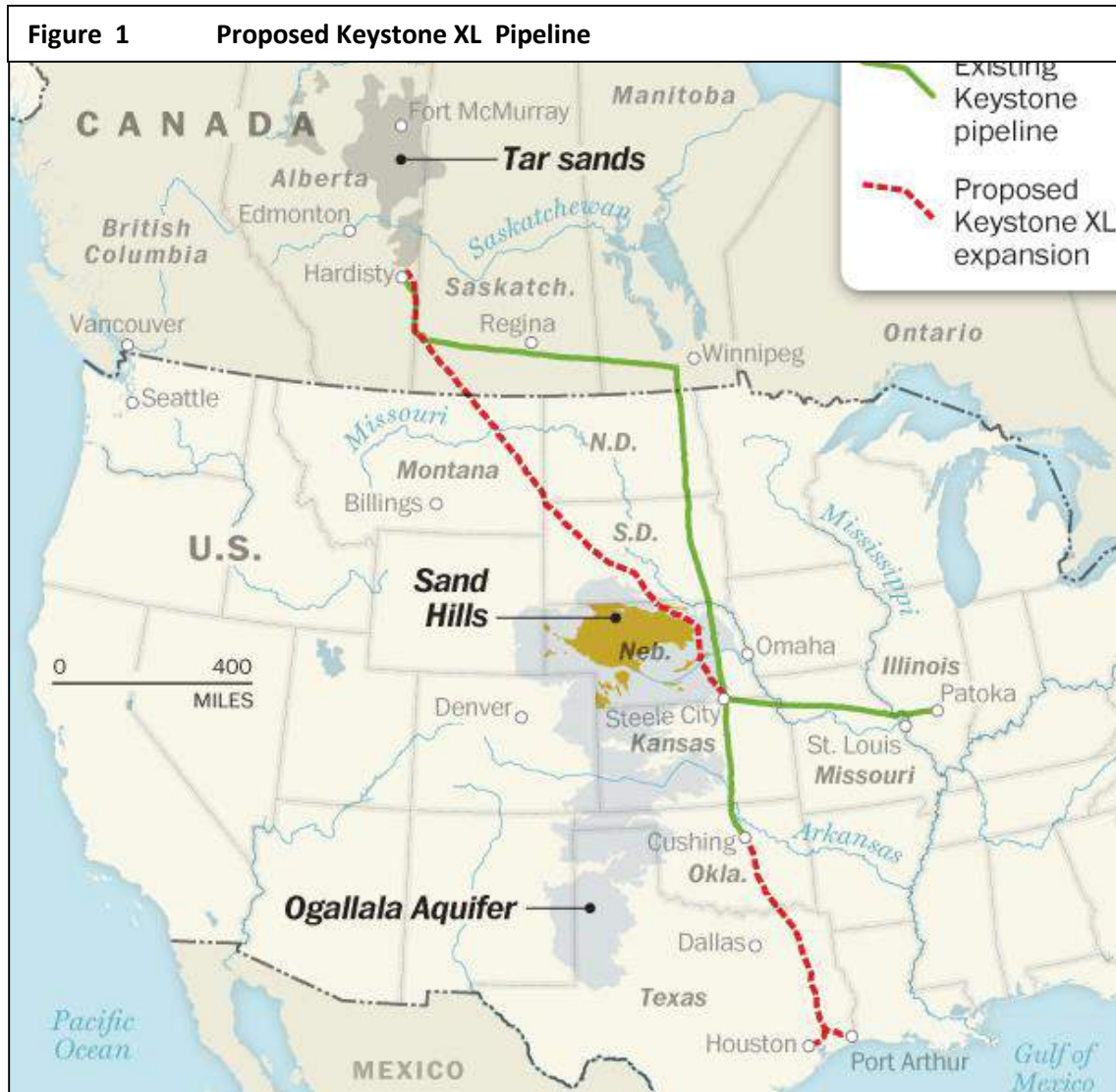
This paper presents a historical perspective of the Keystone XL Pipeline. Specifically, the current literature is reviewed, relating to the logistics, energy, environmental, and political perspectives, and a discussion of the implications regarding future scenarios follows.

Historical Perspectives

In 2009, TransCanada Corp. and Conoco Philips completed the 2148 mile Keystone Pipeline which transports bitumen-based crude oil from Canadian oil sands in northern Alberta to the US Midwest (see Figure 1). Its current capacity is approximately 435,000 barrels/day. It actually began delivering oil sands crude to the U.S. in 2010. In 2008, TransCanada announced plans for the U.S. Gulf Coast Expansion Project (the XL Pipeline), which was to expand the system's total capacity to 1.1 million barrels/day by 2012. The XL Pipeline includes 1980 miles of additional 36 inch pipeline at a cost of over US\$12Billion. The XL Pipeline will terminate at Port Arthur, Texas refineries with an additional lateral to Houston, Texas.² Today, TransCanada is sole owner of both pipeline projects.

The central reasons necessitating the Keystone XL Pipeline project are the further development of Canadian heavy oil sands along with the shale oil fields in Montana and North Dakota. The initial proposed XL Pipeline route through Nebraska caused a number of approval delays due to environmental impacts from a potential pipeline spill on the Sandhills areas of Nebraska. The currently proposed 2012 XL pipeline route avoids these environmentally sensitive areas in Nebraska (see Figure 1). On the Canada side of the border however, environmentalists are concerned that extracting more oil from tar sands

requires further open-pit mining and high levels of greenhouse gas emissions to process the heavy oil.



Logistics Issues

Until a resolution is reached regarding the XL Pipeline, producers are turning to alternative transportation methods such as rail and truck hauling (a much more expensive shipping solution) and additional pipelines to the Canadian west coast and to refinery areas in eastern Canada. One pipeline alternative is the Enbridge Inc. Northern Gateway Pipeline, which is proposing to take over 500,000 barrels per day from the Alberta oil sands to the British Columbia west coast which will give Asia access to the oil. Native Canadians are fighting this proposed pipeline in order to protect crucial salmon-bearing tributaries and wildlife habitats.³ Another pipeline option seeking approval is the Kinder Morgan Trans Mountain Expansion. The Kinder Morgan line would expand an existing Trans Mountain line, between Edmonton, Alberta and Burnaby, British Columbia. This expansion, once completed,

would expand capacity from 300,000 to 890,000 barrels per day.⁴ Yet a third pipeline project is the conversion of TransCanada's mainline natural gas pipeline to oil, which currently supplies Canada's eastern markets. The oil would be supplied to refineries in New Brunswick, which currently import about 600,000 barrels per day.⁵

In terms of cost, the US\$12Billion estimated cost for the XL Pipeline is not that large. For example, BP PLC and Conoco Philips are building a 4-billion cubic foot/day natural gas pipeline from Alaska's North Slope to Canadian and US markets at an estimated cost of US\$20Billion.⁶

Energy Issues

There are a number of companies already mining and producing oil from the Canadian oil sands. French oil company Total has purchased other smaller oil companies in the area. Other companies include Suncor Energy, Teck Resources, and UTS Energy. Estimated oil sands reserves in Alberta are over 170 billion barrels of recoverable oil, about 11 percent of the world's proven oil reserves.⁷ As a matter of fact, in 2010, the Canadian oil sands became the single largest supplier of oil to the US. It is estimated that by 2035, bitumen oil from Alberta could account for 35 percent of US oil imports.⁸ In 2011, Canadian oil sands exports to the US were about 1.3 million barrels per day. So far, oil companies have invested about US\$160Billion in oil sands development, and as of 2013, total production amounts to 1.7 million barrels per day.⁹

Environmental Issues

In March 2010, Canada's National Energy Board approved TransCanada's Keystone XL project, giving TransCanada the green light to begin construction. Additionally, TransCanada received a permit in March 2010 from the South Dakota Public Utilities Commission to operate the South Dakota portion of the pipeline.¹⁰ A November 2010 report by the Natural Resources Defense Council stated that the XL Pipeline would carry "toxic bitumen" to the Texas Gulf Coast, "effectively transporting pollution from Canada to the United States." Additionally, the report stated the project would "generate a massive expansion of the destructive tar sands oil operations in Canada."¹¹ Reports like these are all too common, even though the XL Pipeline represents a total increase of less than 40 percent of current oil sands exports to the US. In 2010, oil sands production created about 6.8 percent of Canada's greenhouse gas emissions, or about the same amount as Canada's electric power industry.¹²

Two recent environmental incidents involving oil are at the center of the environmental approval problems TransCanada faces with its XL Pipeline. The BP oil disaster in the Gulf of Mexico began in April 2010 and was finally stopped in July 2010, discharging 8.9 million barrels of oil. Extensive damage was done to marine and wildlife habitats and to the fishing and tourism industries along the coast. Oil cleanup crews continue working to this day.¹³ Also in 2010, Enbridge Inc., another Canadian energy company, was responsible for the largest and costliest inland oil spill in U.S. history, when a pipeline ruptured, sending over a million gallons of tar sands oil into the Kalamazoo River system poisoning wildlife for miles around. Almost three years later the river remains polluted despite Enbridge spending nearly \$1 billion on the cleanup.¹⁴

However, Canada has made progress in improving the carbon footprint of oil sands production. More than 80 percent of the water used to extract and refine the oil is now

recycled. Additionally, tailing ponds (those containing refuse from the oil extraction process) are being reclaimed as green land and replanted with hundreds of thousands of trees and shrubs.¹⁵

Another set of environmental concerns revolve around ground water, specifically the Ogalalla Aquifer. This is a shallow water table under the Great Plains area of the U.S. Water plays a strong role in politics in the western U.S., and it has for many years. There are concerns in the Great Plains states that the Keystone XL project will alter water tables in the area and that oil could seep into the water supply.¹⁶

Native Americans in the Keystone XL pipeline area also claim that an 1800's treaty gives them veto power over the project in those lands. This would have to be determined in the court system, but could add significant delays to construction. In fact, both Native Americans and ranchers rode horses into Washington, D. C. in April, 2014 to protest the project.¹⁷ The Native Americans claim that this is just one more federal project that degrades the Native American reservations.

Economic Issues

The first thing proponents of the pipeline mention is jobs, especially with the U.S. unemployment rate hovering close to seven percent. However, critics contend that the estimated number of new jobs is greatly overstated.¹⁸ Various estimates of construction jobs are in the 10,000 to 20,000 range. Some of these are seasonal jobs as the construction would have some seasonality associated with it. Permanent jobs might be far less, but that's the nature of pipelines; once they are constructed they essentially run themselves.

Another somewhat hidden economic issue is that of eminent domain. In the United States, governments have the right to take land away from owners for various projects. Typically this is done at the state/local level but the principle has been upheld by the U.S. Supreme Court. With regards to the pipeline, there have been lawsuits in both Nebraska and Texas over the eminent domain issue. It is ironic that landowners in Nebraska and Texas may lose their land to a foreign (Canadian) corporation. The eminent domain process was facilitated in Nebraska by passage of a state law that enabled the governor to decide eminent domain cases for pipelines. In Texas, the Railroad Commission of Texas facilitates the process. At least one case has been decided in favor of the property owner thus far.¹⁹

Political Issues

Henry Waxman, chairman of the House Energy Committee, has voiced strong opposition to the Keystone XL Pipeline, saying there has been a failure to analyze the most significant environmental impacts of the project, specifically the impact on U.S. transportation fuel carbon intensity.²⁰

Regardless of the environmental concerns, operators continue to develop the oil sands and the Bakken shale oil fields. U.S. President Obama has had many political battles with the U.S. Congress over this issue, and it has been suggested that he approve the Keystone XL Pipeline in exchange for concessions on budgets and his controversial health care plan. Recently, the U.S. State Department published a report supporting the Keystone XL project. However, it is also possible that the pipeline will be further stalled until the election of the next president in 2016.

As a presidential candidate in 2007-2008, Barack Obama vowed to “end the tyranny of oil.” His supporters constantly remind him of this in 2014. So far he has managed to delay any decisions with a variety of maneuvers, such as commissioning the U.S. State Department to study the issue, since the pipeline would cross the U.S./Canada border. This resulted in a massive study of eleven volumes which generally supported building the pipeline.²¹ The study concluded that the pipeline was unlikely to increase greenhouse gases. Another finding of the State Department study was that rail transportation of the oil would result in 30-40 percent more emissions than the pipeline. An interesting twist is that the current U.S. Secretary of State, John Kerry (U.S. Democratic candidate for President in 2004) has historically been a critic of climate change. Major contributors to the Democratic Party now feel some level of betrayal from both Obama and Kerry.

There have been attempts in the U.S. Senate to wrap the pipeline in a more comprehensive energy bill. The energy bill considers many more issues, including efficiency guidelines and tax incentives for such efficiency. Various senators have used procedural measures to block amendments to the bill. Republican supporters had initially preferred a straight up/down vote on the pipeline, which polls show a majority of U.S. voters favor.²²

A further political consideration is the possibility of immigration reform in the United States. It turns out that some of the states with the most interest in this topic are also affected by the pipeline. It has been suggested that a way for President Obama to approve the pipeline, yet placate his supporters, is to wrap both issues into one political bundle that a variety of lawmakers could support. In general, Republicans in the U.S. Congress support the pipeline but not immigration reform, although House Speaker Boehner disputes that.²³

Conclusion and Recommendation

This issue has already been debated extensively. It is time to move the project along. Despite the opposition from various groups aligned with President Obama and his promises to them, the job and tax benefits of the XL Pipeline appear to outweigh the costs. Currently in the United States, this seems like just one more thing that the government can't get done. Polls in the U.S. show a very unfavorable view of the Congress, and a desire to build the pipeline. Canada has actually started advertising in Washington, D.C. supporting the project.²⁴ Additionally, Canada is proceeding with alternative pipelines which may erase any desire to move this oil through the XL Pipeline. In other words, the oil will indeed be produced, regardless of the XL Pipeline situation.

An escape for President Obama would be to structure a deal accepting the Keystone XL project along with wide-scale immigration reform. This would give other groups something they want. Immigration reform has been hopelessly stalled in the U.S. Congress and is of vital importance to many groups for a variety of reasons. Also, many of the states impacted by the pipeline are keenly interested in immigration reform. For example, Texas has roughly 2 million undocumented immigrants and a 1,200 mile border with Mexico.

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MODEL OF VALUE CREATION FOR GREEN SUPPLY CHAIN STAKEHOLDERS¹

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Abstract

Purpose of this paper

The value creation for stakeholders is the ultimate goal of networks, supply chains and individual companies. For this it is important to identify appropriate expectations, opportunities and obstacles faced by the actors in this field. Green supply chains by definition should look for value in other areas than those traditionally conceived, so it is necessary to create a dedicated model for this supply chain.

The purpose of this article is to create a theoretical basis for the construction of a model of value creation for stakeholders in a green supply chain. It is significant as well as the possible sources of value creation, which take into account the effects of actions and conflicts occurring in the field of increasing the value added for different beneficiaries. The authors of the study will be based on the following thesis: in the literature there is no model of value creation, which is dedicated to green supply chain. Construction of the model can help to better identify the areas and tools that add value. Theoretical basis of the model can be used for various stakeholders and can be used in practice in different areas. The idea is to create a model, not only indicating the possibility of getting the value chain participants, but also for other stakeholders. The aim is also to examine correlations between perception, expectation, the exploitation and disruption in the creation of green supply chain of different groups of stakeholders (participants, customers, regulators, competitors).

Design/methodology/approach

To achieve the objective of the research will be conducted the structured review and study of primary and secondary literature and documents. Then the conceptual arrangement and presentation of theoretical aspects of model building. The end result of the work will be the value creation model of green supply chain with the identification of factors that influence positively and negatively, both in the creation of added value and its impact on the functioning and performance of green supply chain for different groups of stakeholders.

Findings

The application process will be preceded by a phase of analysis and research. The basic element of this Paper will be presentation of cause-effect model. The results will be the basis for both scientific discussion and practical verification of the model. It will provide a foundation for the start of the study and the confrontation of theory with business practice.

What is original/value of paper

In literature hasn't been presented to the model of value creation green supply chain for all types of stakeholders. This paper developing an original, modern and systematic approach to the subject. So far, the authors were involved in developing the methodological bases and practical verification of the creation of value-added in traditional supply chain or derived considerations to individual participants. Adoption of the issues related to creating value in a green supply chain is new approach. In view of the growing interest in the activities in this area and research for opportunities to increase efficiency, but also the

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functionality of green supply chain, initiatives of this kind are extremely needed. The presented model can contribute to finding areas that haven't been seen as adding value or not to play a greater significance.

Keywords

Green supply chain, value creation, stakeholders, model of value creation

1 Introduction

The considerations of the thesis will be adopted on the fact, that the construction of green supply chain brings all kinds of added value for different types of stakeholders. The value and advantages are dependent on many factors and not for each of the Stakeholders are equally important. The authors divided the additional positive effects it brings structure of the supply chain into 3 areas (economical, social and environmental). Through the effect of different areas of different groups of stakeholders will form the basis to created and presented the model of value creation. Considerations are the first stage of the research, therefore, the aim of this work is only to identify linkages between the different stakeholders and identified the value of green supply chain, and to present a model of such relationships.

2 Green supply chain – background of literature review and methodology

The essence and the fundamentals of green supply chain interested researchers for many years. Managing of new form brings tangible benefits for the different stakeholders for example: participants, customers, and external beneficiaries in. Its form to develop to form scientific studies and literature on green supply chain management. The point of view of scientific topics and defining the concept of the above range occupy the following authors: Srivastava, Zhu et al., Gilbert, Hwa, Nunes, Zsidisin, Siferd, Davies, Hochman, Rettab, Brik, Zhu, Sarkis, Rao, Holt, Skjoett-Larsen, Vachon, Klassen, Beamon. Defining the green supply chain management must assume that the GSCM is integrating environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life [Srivastava 2007]. Such way indicates that the traditional processes within the supply chain must include integrated thinking and actions that do not end with the final product delivered to the customer. In fact, each process should include green aspects. Schematic approach presents a figure No. 1. In the past, the classic view of the supply chain not included interest in the environmental aspects, external costs and the impact of the supply chain on the environment. It does not have interest or implemented of ecological aspects in the chain can bring value or not. Today, environmental issues are becoming increasingly important and are a major problem in most global supply chains [Kuik et al., 2010a]. The literature review allowed the identification and assessment of the current state of research. Undertaken of a well drawn on the foundation of theoretical conclusions indicated the basis for the construction of the model. The research methodology is based on a review of available literature and on the basis of the conclusions drawn regarding the identification of the value added in the green supply chain. Made the classification and grouping of elements that add value, also indicate to whom and to what extent it has a meaning. In the first phase of research, which is the result of following the publication. The authors have selected stakeholders, various elements and added value to explore depending form, the basis for the construction of the model. Leading the discussion of the green supply chain indicate what elements constitute the "otherness". The easiest way to tell the greening processes and their implementation (especially logistics) to their side effects were

the least burdensome to the environment. Construction of the chain, but also the search for added value can be achieved by the adjective green begins at the design stage of the whole chain and its various processes. Note the authors has focused on areas where the greatest value can bring aspects including ecological approach.

It is said about: designing of products, production, material purchase, packing, warehousing, logistics and reverse logistics.

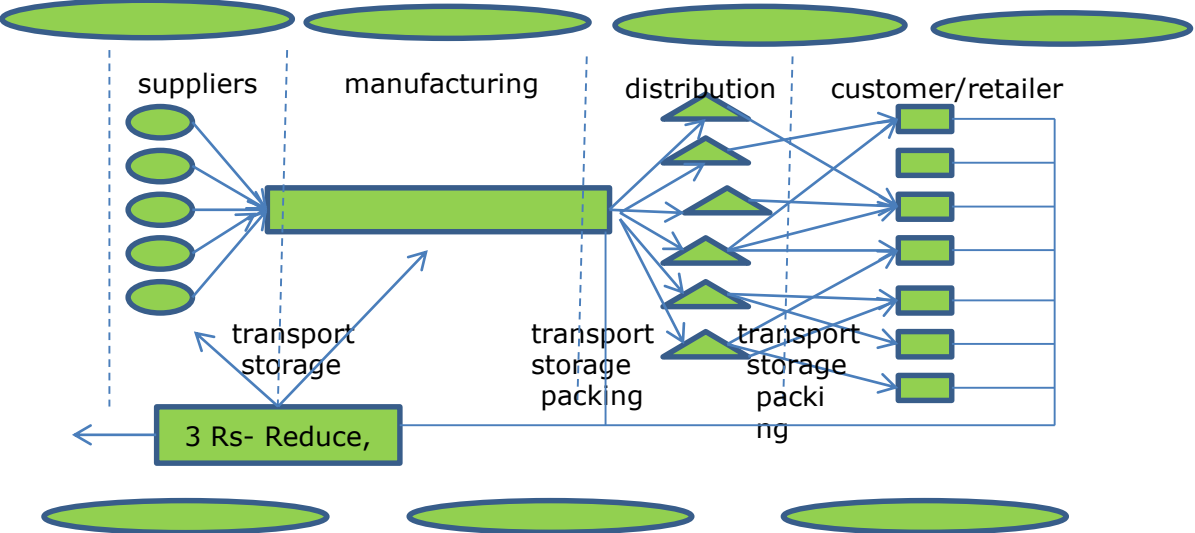


Figure 1. Green elements of supply chain
Source: own elaborations.

3 Value identification of green supply chain

The essence of green supply chain by definition is a value, and this elements are not included in the traditional supply chain management. Here you can talk primarily about the environmental aspects and their impact on the design, but also understanding the entire chain. Green supply chain give they stakeholders many benefits and value. The most frequent positive effects include: improve efficiency, quality improvement, customer satisfaction, reduction of cost, risk reduction, reduced resource consumption and reducing CO2 emissions in logistics processes. For a growing number of managers are environmental aspects and the green chain is increasingly important [Capgemini Consulting’s 2011]. Interestingly it is not talked directly about the benefits in the form of competitive advantage. Therefore, identification of the individual elements that add value is important to determine which of the stakeholders for what it can be. For example, you can indicate the shareholders and owners of the companies involved in the chain will have different objectives and expected a different value than external stakeholders (e.g. living areas through which the streams of goods chain). Their greater extent will be depend on the reduction of external costs and not on improving the image of the chain (which may be of value for the owners). Speaking about the superiority of the elements of GSC should be considered: identify costs, determine opportunities, calculate benefits, and decide, implement and monitor [EPA2000]. Some studies suggest an advantage for buyers [Carter & Carter, 1998; Hall, 2000]. Nevertheless the idea of green supply chain is almost exhaustively described in the literature. However, there are little of (few) publications where the elements of value included. Therefore, more attention should focus on identifying precisely the values and examination for which the beneficiaries of what it

means. In this paper will be presented the initial stage of wide-planned research, and the base model. Based on the analysis of literature, as well as follow-functioning supply chains, it was concluded that in the simplest terms, the search for the green supply chain can take place on three levels. You can talk about the financial, environmental and social. Necessarily and explicitly entails the principles of sustainable development. Selected elements of green supply chain presents a figure No. 2.

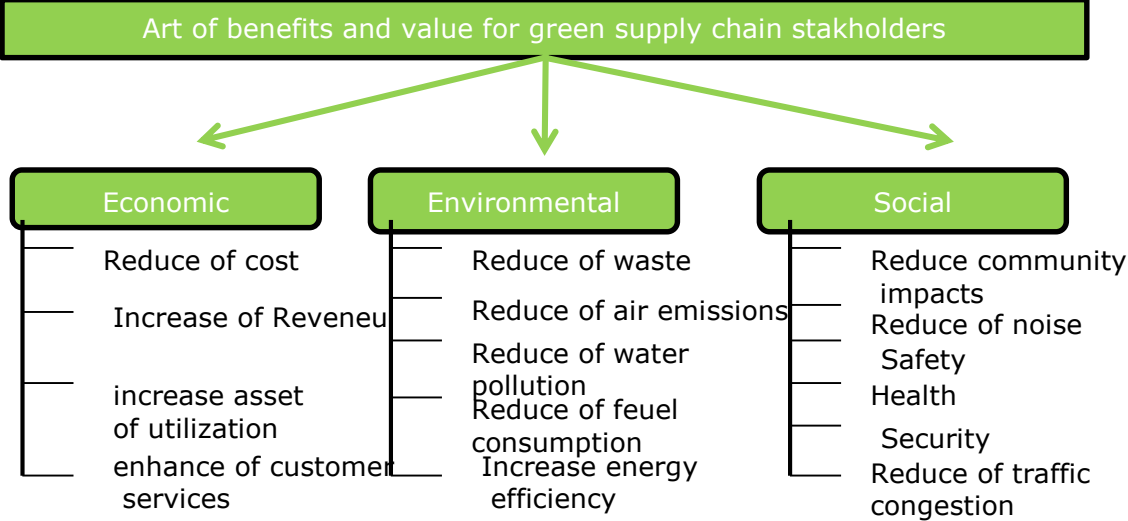


Figure 2. Value elements in green supply chain
Source: own elaboration.

It is known that the most important being green supply chain is "greening" its processes. This is a very general concept, but at the same time very capacious. In managing this type of chain must change approach to process management, and thinking about the supply chain. Firstly, it will not be finished with the delivery of product to the customer. That's why it needs to take into account the life cycle of the packaging and the product itself after the end of life cycle.

This approach is associated with the implementation of the recycling process, re-use or reduction. Then it will be essential logistics network design, including the optimization of transport routes, space allowances and the use of environmentally friendly vehicles. In addition, each stage of the chain must included green aspects.

An important aspect will be the saving of raw materials, including increasing the productivity of employees, and participating in the process. Important elements are associated with the storage of chain and production processes, which should be organized in such a way (this follows already from the stage and planning processes). To be the least waste, phrases and to many elements could be used again (promotion of modularity). The construction of the GSC should be based on a closed cycle. The traditional approach will involve input, transformation and output. All items respectively many of them should be neutral to the environment, or should keep the impact as low as possible. As indicated in Figure 3, at each stage of the process, you can apply the principle of 3 R, which in combination with the level of strategic and management support of the chain should lead to the creation of green supply chain, that will provide value for many participants.

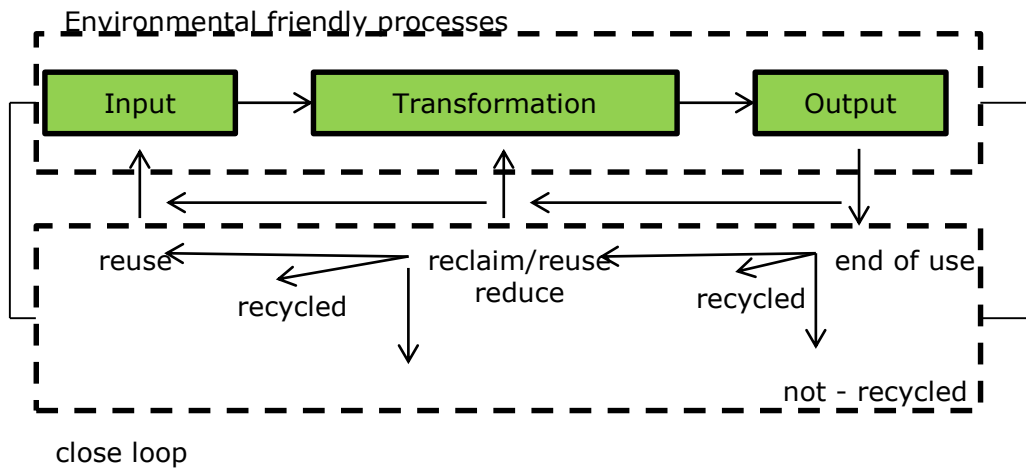


Figure 3. 3R in supply chain
Source: own elaboration.

4. The importance and identification of values for selected groups of stakeholders of green supply chain

Not in every situation, those who take decisions about the shape of the supply chain can understand the potential and benefits, they give for all of participant. The specific roles should assign a value added. The newly created chains, including the pre-defined and identified green supply chains must bring value to stakeholders. Stakeholders determine the activity and efficiency of the chain or organizations acting in it, as well as innovation. They can also be initiators of new solutions. Due to the scarcity of publications and authors of the initial phase of research focused on the exploration of the impact and added value of green supply chain for the following stakeholder groups: participants in the chain, Lenders (shareholders), external beneficiaries affected by chain activities that are not directly involved in the chain process or government. Referring to the approved thesis it must be noted that each group define value in a different way and other of its elements will play a greater or lesser role. Indicated what kind of values displayed by the green supply chain, which plays a role so that these elements have become the basis of this model. The planned next stage of the research will be verified by the thesis of empirical research. Linked and identified stakeholders are shown in figure No. 4.

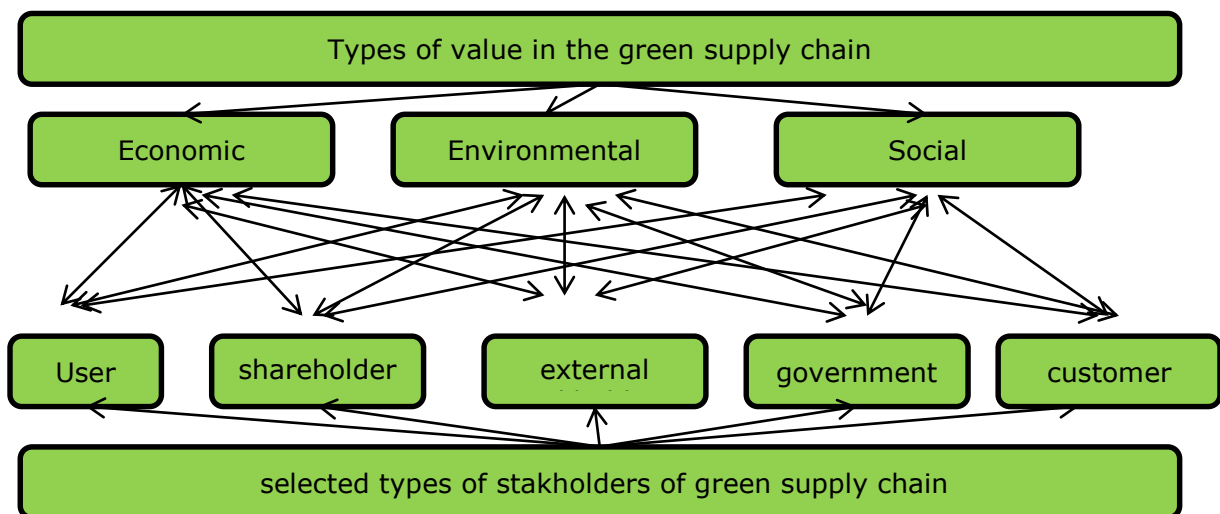


Figure 4. Demand between stakeholder groups and the factors adding value in the green supply chain
 Surce: own celaboration.

The individual elements of the model will form the basis of value creation for selected groups of stakeholders.

5. Basic model

The green supply chain especially apparent conflicts are discussed in stakeholder and shareholder theories. The expectations of stakeholders are manifold, but the most can distinguish the primary factor value creating for each stakeholder, which to a certain extent are subordinate to other factors. The base model of expected value flow for the stakeholders of green supply chains, based on literature research, is presented in Figure 4.

Creation of value flowing from the environment of green supply chain also depends on the relationship between the elements of this environment. Their identification is important to find specific connections trade-up, thanks to which we can better determine the degree of impact of decisions made in the supply chain. Types of relationships between environment entities of green supply chain is presented in Table 1.

Table 1. Types of value creation between the entities environment of green supply chain

from to	Competitors	Communités	Public administration	Owners
Competitors		Economical	Economical Social	Economical
Communities	Economical Enviromental Social		Economical Enviromental Social	
Public administration	Economical	Economical		Economical
Owners	Economical		Economical Social	

Source: own elaboration.

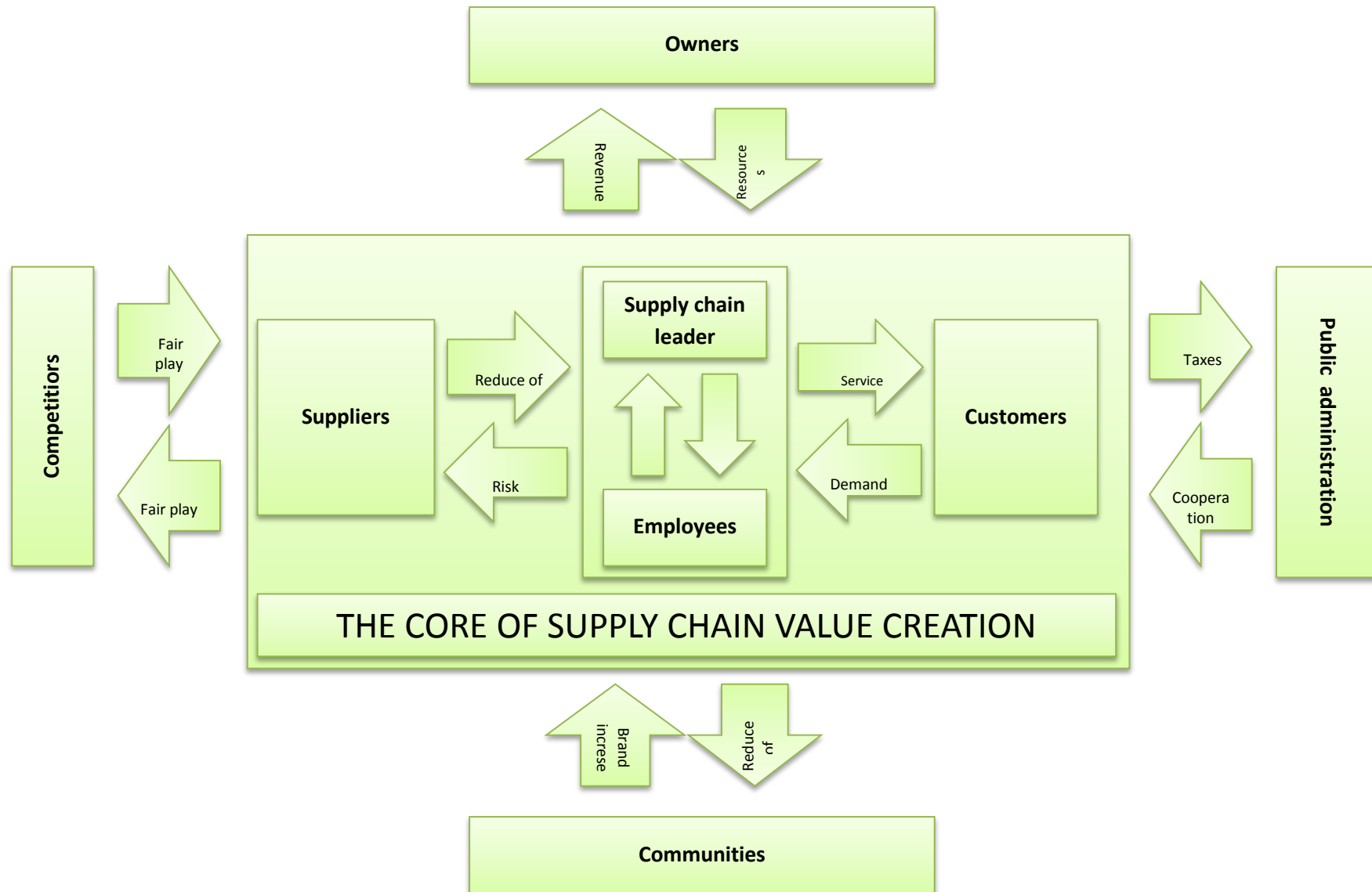


Figure 4. The basic model of the expected major value flow for green supply chain stakeholders
 Source: own elaboration.

The first step of the planned analyzes is juxtaposition presented model of creating value for the stakeholders of green supply chain with salience model for stakeholder classification (Figure 5) to hierarchies their validity for the chain. Model takes into account three main areas: power, legitimacy and urgency. Power is "a relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not otherwise have done". Legitimacy referring to socially accepted and expected structures or behaviors, often is coupled implicitly with that of power when people attempt to evaluate the nature of relationships in society. Urgency helps move the model from static to dynamic and exists only when two conditions are met: when a relationship or claim is of a time-sensitive nature and when that relationship or claim is important or critical to the stakeholders [R.K. Mitchell, B.R. Agle, D.J. Wood; 1997].

For key stakeholders according to this model should be considered those who are in the center of the model, and thus have all: the power, legitimacy and urgency. Stakeholders of this level should be constantly monitored by the entities. A little less attention can be given to stakeholders referred to as "Dominant", "Dangerous" and "Dependent". The least attention to the stakeholders located in only one of the presented model areas. The levels of prioritization of stakeholders in the model shown in Table 2.

In the case of green supply chain, selection matrix of stakeholder type is shown in Table 3. In accordance with the results obtained for the key stakeholders should naturally be considered customers and suppliers. Dangerous entities, due to the need for quick reactions associated with their actions, remain competitive supply chains (including not only the green chains). The strength and legitimacy of the actors show a government, workers and owners of capital.

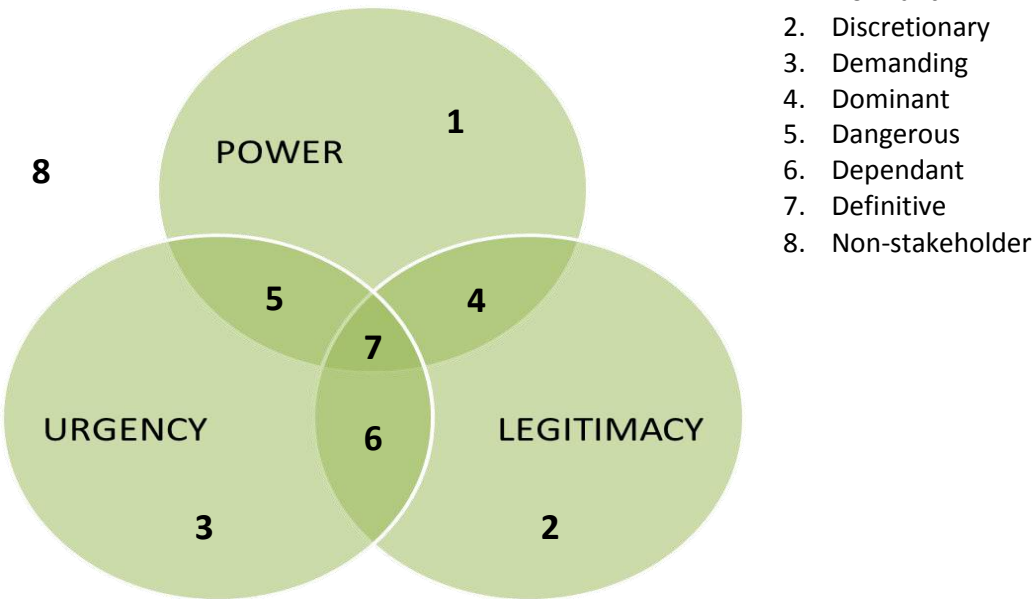


Figure 5. Sailability model/ Stakeholder typology

Source: Ronald K. Mitchell, Bradley R. Agle, Donna J. Wood: Toward a Theory of Stakeholder Identification and Salience: Defining the Principle of Who and What Really Counts. The Academy of Management Review, Vol. 22, No. 4 (Oct., 1997), pp. 853-886.

Level 3 (High Priority)	7 - Definitive Power, Legitimacy & Urgency		
Level 2 (Medium Priority)	4 – Dominant Power & Legitimacy	5 - Dangerous Power & Urgency	6 – Dependent Legitimacy & Urgency
Level 1 (Low Priority)	1 – Dormant Power	2 – Discretionary Legitimacy	3 – Demanding Urgency

Table 2. Assignment of stakeholders level by salience model

Source: <http://virk.wordpress.com/> [10.05.2014].

Stakeholder	Power	Legitimacy	Urgency
Suppliers	1	1	1
Employees	1	1	0
Customers	1	1	1
Public administration	1	1	0
Owner	1	1	0
Competitors	1	0	1
Communities	0	0	1

Table 3. Matrix of stakeholder relationship in green supply chain relative to its leader

Source: own elaboration.

The smallest role in this division play communities, where the real power is hidden. Interaction with the chain held by other stakeholders, with which is strongly bound. Presented assumptions are the first step to study of the strategic behavior of green supply chain. It is obvious that in the first place should be taken into account the need to "complete" the stakeholders, but this does not mean that the needs of others can be omitted. The authors believe that the identification of relationships between stakeholders and the types created by these values, as well as determining the impact of various decisions taken by the actors of green chain, will distinguish between the different substrategies of these chains.

6. Summary

Stakeholders of green supply chain do not differ from other supply chain stakeholders. This what sets them apart is the other types of value they have come to expect and create. Good identification of these values is extremely important in the case of open systems which are supply chains. The possibility of connections different value streams will allow for a better strategies selection such chains, will pay attention to factors so far marginalized and allow for a more accurate analysis of the efficiency of these chains.

The basic model, in subsequent steps of analysis will be verified by practical research. Affixed after research weight will be the basis for calculating the overall effect of green supply chain strategy for all of its stakeholders and not just a customer.

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DETERMINANT FACTORS INFLUENCING THE ADOPTION OF ENVIRONMENTAL MANAGEMENT PRACTICES FOR LOGISTICS COMPANIES.

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ABSTRACT.

This research focuses on determining the factors that influencing the adoption of environment management practices in Malaysia logistics industry. The determinant factors are comprised of technological, organizational, environmental, and environmental awareness and attitudes dimensions. A pilot study of questionnaire survey on the environment management practices adoption of Malaysia logistics companies was conducted, and result from several interviews with the key player in logistic industries were examined. Research results reveal that relative advantage, compatibility, complexity, organizational support, quality of human resources, company size, customer pressure, regulatory pressure, governmental support, environmental uncertainty, general awareness, cost benefit awareness and environmental attitudes have significantly positive influences on the adoption of environment management practices for Malaysia logistics companies. This research also suggests implications and opportunities for future research.

INTRODUCTION

This research focusing on determining the factors influencing the environment management practices adoption in Malaysia logistics industry. Researchers need to identify the determinant factors of environment management practices for practitioners to implement. Several researchers have suggest various explanations on the factors influencing the implementation of environment management practices (e.g., Alvarez-Gil et al., 2007; Aragon-Correa et al., 2004; Gadenne et al., 2009; Henriques and Sadorsky, 1999; Lopez-Gamero et al., 2008, Williamson et al., 2006).

Variables of technological factors, organizational factors, environmental factors, and environmental awareness and attitudes factors are frequently appeared in the environment management practices study (Gonzalez-Benito and Gonzalez-Benito, 2006a). Although these four factors have been taken into account in several studies on environment management

practices issues, these factors have not yet been considered in the studies of environmental management in the logistics industry (Lin, 2011).

1.1. Technological factors

Technological factors are the factors that commonly found in the literature of technology innovation. Environment management practices are one of the practices that considered as a technology innovation (Lin, 2011). However, the influences of technological factors towards environment management practices adoption are hardly analyzed (Lin, 2011). Three variables of technological factors are consistently been found to be influencing on technology innovation (Frambach and Schillewaert, 2002; Jeyaraj et al., 2006; Rogers, 2003). The three variables are: relative advantage, compatibility, and complexity (Rogers,2003; Sia et al., 2004).

1.1.1. Relative advantage

Relative advantage is the degree to which a new product is superior to an existing one. Companies are more likely to adopt a technology which is able to provide better performance and higher economic gains than the other technologies and relative advantage is positively related to the adoption of technology innovation (Rogers, 2003). Organization would benefits from the implementation of environment management practices include reduced energy and natural resource consumption, reduced waste and pollutant emission, improved environmental and financial performance, and greater responsiveness to social environmental expectation (Hart,1995). The economic and financial advantages are important technological characteristics that influence the adoption of technologies innovation. The benefits of environment management practices offers will serve as motivations for companies to adopt the technology innovation practices (Del Rio Gonzalez, 2005). Hence, this research expects that relative advantage will positively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypothesis:

H1: The environment management practices relative advantage has a positive influence on environment management practices adoption for Malaysia logistics companies.

1.1.2. Compatibility

The compatibility of a new technology such as environment management practices fits in with the company operations is an important factor that influences technical innovation (Chau and Tam, 1997; Tornatzky and Fleischer, 1990). Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, experiences, and needs

of the firms (Lin, 2011; Rogers, 2003). A company will be more likely to adopt the new technology that is more compatible with the company's current operational knowledge (Tornatzky and Klein, 1990). Compatibility is also relevant to environment management practices adoption. Environment management practices will be more easily distributed within a company when the practices are more compatible to the company's current technologies and processes. As a result, this research expects that compatibility will positively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypothesis:

H2: The environment management practices compatibility has a positive influence on environment management practices adoption for Malaysia logistics companies.

1.1.3. Complexity

A company is comfortable to pursue to any technology innovation when the knowledge is shared easily within the organization. Complexity is the degree to which an innovation is perceived to be difficult to understand and use. It will increase the difficulty in knowledge transfer and innovation diffusion (Rogers, 2003), and is usually hypothesized to be negatively related to innovation adoption (Tornatzky and Klein, 1990). The difficulty in learning technological knowledge makes it difficult to adopt the complex technology. Therefore, this research expects that complexity will negatively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypothesis:

H3: The environment management practices complexity has a negative influence on environment management practices adoption for Malaysia logistics companies.

1.2. Organizational factors

Organizational factors are commonly analyzed in research on technology innovation and environmental management. Variables such as quality of human resources, top management's leadership skills, organizational support, organizational culture, and organizational size have been discussed on their influences on technology innovation (Kimberly and Evanisko, 1981; Tornatzky and Fleischer, 1990) and environmental strategy (Gonzalez-Benito and Gonzalez-Benito, 2006a). This research focuses mainly on the organizational support, quality of human resources, and company size because they are organizational resource-related variables widely analyzed in research on technology innovation and environmental management.

1.2.1. Organizational support

Organization support is the extent to which a company supports employees using a particular technology or system that influence technology innovation. Organization will provide incentives for innovation adoption and ensuring the availability of financial and technical resources for successfulness in adoption of technical innovation (Jeyaraj et al., 2006; Lee et al., 2005). Organizational support is essential in the development of environmental management because the resources required for adopting environment management practices will be more easily available and the employees will be motivated to implement the environmental practices. Top management always plays an important role in organizational support. Environmental management practices require the collaboration and coordination of different departments and divisions during adoption process. Top management has to endorse and gives encouragement to ensure the successfulness of the environmental management practices (Gonzalez-Benito and Gonzalez-Benito, 2006a). Consequently, this research expects that organizational support will positively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypothesis:

H4: Organizational support has a positive influence on environment management practices adoption for Malaysia logistics companies.

1.2.2. Quality of human resources

Adopting technology innovations requires trained employees with competent learning and innovative capabilities to practice environment management (Tornatzky and Fleischer, 1990). Adopting environment management practices is a complicated process requiring cross-disciplinary coordination and significant changes in the existing operation process (Russo and Fouts, 1997). It will depend heavily in human resources department on the development and training of skills through the employees' involvement (Del Brio and Junquera, 2003; Hart, 1995). Employees with competent learning capabilities will be easily involved in training programs that can advance environment management practices adoption. Therefore, this research expect that the quality of human resources will positively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypothesis:

H5: The quality of human resources has a positive influence on environment management practice adoption for Malaysia logistics companies.

1.2.3. Company size

Company size has been commonly analyzed in the literature on technology innovation (Frambach and Schillewaert, 2002; Kimberly and Evanisko, 1981) and environmental activities (Del Brio and Junquera, 2003; Etzion, 2007; Gonzalez Benito and Gonzalez-Benito, 2006a). Large companies tend to adopt innovations and environmental management practices more easily than the smaller companies because they have sufficient resources and strong infrastructures. Small companies, in contrast, may suffer from the lack of financial resources and professionals, which results in difficulties in adopting environment management practices. In addition, large companies are often required to implement environment activities because they have greater environmental impact on the society and receive more pressure from the stakeholders (Gonzalez-Benito and Gonzalez-Benito, 2006a). Therefore, we expect that the company size will positively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypothesis:

H6: There is a positive association between the company size and environment management practices adoption for Malaysia logistics companies.

1.3. Environmental factors

The environmental factors in this study refer to the external environment in which a company conducts its business. Several environmental variables such as stakeholder pressure, environmental uncertainty, environmental munificence, governmental support, competition, and network relations have been discussed in the literature of technical innovation (Frambach and Schillewaert, 2002; Jeyaraj et al., 2006) and environmental management (Etzion, 2007; Gonzalez-Benito and Gonzalez Benito, 2006a). Stakeholder pressure, external resource availability, and environmental uncertainty are consistently regarded as primary environmental factors influencing technical innovation (Jeyaraj et al., 2006; Tornatzky and Fleischer, 1990) and environmental strategy (Aragon-Correa and Sharma, 2003; Etzion, 2007; Rothenberg and Zyglidopoulos, 2007). The government plays an important role in supporting resources for innovation adoption (Lee, 2008; Scupola, 2003). Therefore, this study focuses mainly on the influences of stakeholder pressure, governmental support, and environmental uncertainty.

1.3.1. Stakeholder pressure

Stakeholders are individuals or groups who affect and affected by a company's activities. The stakeholders play an important role in organizational environment in research on environmental issues (Etzion, 2007). Stakeholder pressure is considered as the most prominent factor influencing a company's environmental strategy (Buysse and Verbeke, 2003; Gonzalez Benito and Gonzalez-Benito, 2006a). According to the stakeholder theory, organizations carry out activities to satisfy their main stakeholders. Among various groups of stakeholders, customers and regulators are arguably viewed as companies' most important stakeholders (Christmann, 2004; Etzion, 2007). A body of research reveals the positive relationships between firms' environmental activities and customer and regulatory pressure (e.g., Christmann, 2004; Lee, 2008). Therefore, we expect that customer and regulatory pressure will positively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypotheses:

H7: The customer pressure has a positive influence on environment management practices adoption for Malaysia logistics companies.

H8: The regulatory pressure has a positive influence on environment management practice adoption for Malaysia logistics companies.

1.3.2. Governmental support

Several researchers have suggested that governmental support is a relevant environmental factor influencing technology innovation. The governments can advance technology innovation through encouraging policies such as providing financial incentive, technical resources, pilot projects, and training programs (Scupola, 2003; Tornatzky and Fleischer, 1990). Moreover, the availability of external resources will influence the adoption of environment management practices. Abundant of resources in the business environment increases the degree to which a company engages in environmental management (Aragon-Correa and Sharma, 2003; Rothenberg and Zyglidopoulos, 2007). The government can raise the resources by providing governmental subsidies or tax incentives for alternative energy technologies, bank financing at lower rates for environmentally friendly technologies, and lower insurance premiums for lower environmental risks (Aragon-Correa and Sharma, 2003). Therefore, this research expects that governmental support will positively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypothesis:

H9: The governmental support has a positive influence on environment management practice adoption for Malaysia logistics companies.

1.3.3. Environmental uncertainty

Environmental uncertainty is the most relevant environmental characteristic that affects a firm's decision making (Li and Atuahene-Gima, 2002). It refers to the frequent and unpredictable changes in customer preferences, technological development, and competitive behavior perceived by the managers. Managers facing uncertain business environments tend to be more proactive and use more innovative strategies. With environmental uncertainty, companies will attempt to gather and process information frequently and rapidly to address environmental changes (Gupta and Govindrajana, 1991), and also tend to pay more efforts on innovation and increase the rate of technical innovation to maintain a competitive advantage (Damanpour, 1991; Kimberly and Evanisko, 1981; Zhu and Weyant, 2003). As adopting environment management practices can be regarded as a technology innovation process that can improve a company's environmental performance, environment management practice adoption is expected to be positively associated with the environmental uncertainty. Some researchers (Aragon-Correa and Sharma, 2003; Rothenberg and Zyglidopoulos, 2007) also suggest that companies are more likely to adopt environmental innovations to generate the capacity to improve environmental performance in uncertain environments. Therefore, this research expect that environmental uncertainty will positively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypothesis:

H10: The environmental uncertainty has a positive influence on environment management practice adoption for Malaysia logistics companies.

1.4. Environmental awareness and attitudes

A company may choose to adopt environmental-friendly processes and procedures regardless of whether they are required to do so by law, or whether they believe that profits will increase (Gadenne, Kennedy & McKeiver 2009). Individual behavior is believed to be affected by the beliefs and attitudes of the individual (Ajzen and Fishbein, 1980), and for some, treatment of the environment is an ethical issue. It is expected that those who are aware of environment issues and are concerned about the impact of their business on the environment will be more likely to act to reduce the impact of their business activities. Those who regard environmental management as an ethical issue (or want to be perceived as such)

might also support environmental activist groups (Gadenne, Kennedy & McKeiver 2009). A potential and large number of businesses could be engaging in a combination of environmental activities, such as recycling, waste management or energy conservation without engaging in formal certification processes (Hillary, 1999) either because of moral concerns or because they see the economic benefits of such actions.

Numerous studies have reported that company's owner is concerned about their environmental impact (e.g. Groundwork, 1995; Roberts et al., 2006; Tilley, 1999). However, empirical studies which relate attitudes to environmental performance have produced mixed findings. Schaper (2002) found no relationship between positive personal environmental attitudes and positive environmental performance. Tilley (1999) also reported a gap between the attitudes of small business owners and their environmental behavior. In contrast, Naffziger et al. (2003) reported that managers with a high level of concern for the environment expend more time and resources on environmental initiatives than those with a low level of concern.

Environmental awareness was divided into two categories – general environmental awareness and cost-benefit environmental awareness. The former was measured through an aggregate response to Likert scale questions relating to their firm's environmental impact, environmental initiatives, environmental policy, "best practice" in environmental performance, and how legislation affects the business (Gadenne, Kennedy & McKeiver 2009). The latter was measured through an aggregate response to Likert scale questions relating to the effect of improved environmental performance on significant cost benefits and improved production efficiency (Gadenne, Kennedy & McKeiver 2009). Environmental attitudes were determined through compiling a series of responses to five point Likert scale questions that relate to personal environmental attitudes adapted from Schaper (2002). Schaper (2002) utilized Ray and Hall's (1995) Australian Environmental Attitude Scale; the only Australian scale designed to measure environmental attitudes. Therefore, we expect that environmental awareness and attitudes will positively affect the adoption of environment management practices for Malaysia logistics companies and propose the following hypotheses:

H11: The environmental awareness and attitudes has a positive influence on environment management practice adoption for Malaysia logistics companies.

2. Conceptual Framework

As adopting environment practices involves implementing new technology innovation, techniques, and systems to reduce pollution emissions and energy consumptions, the adoption behavior can be regarded as a technological process. In this research, the environment management practices will be analyzed in the dimension of technological factors, organizational factors, environmental factors and environmental awareness and attitudes factors simultaneously.

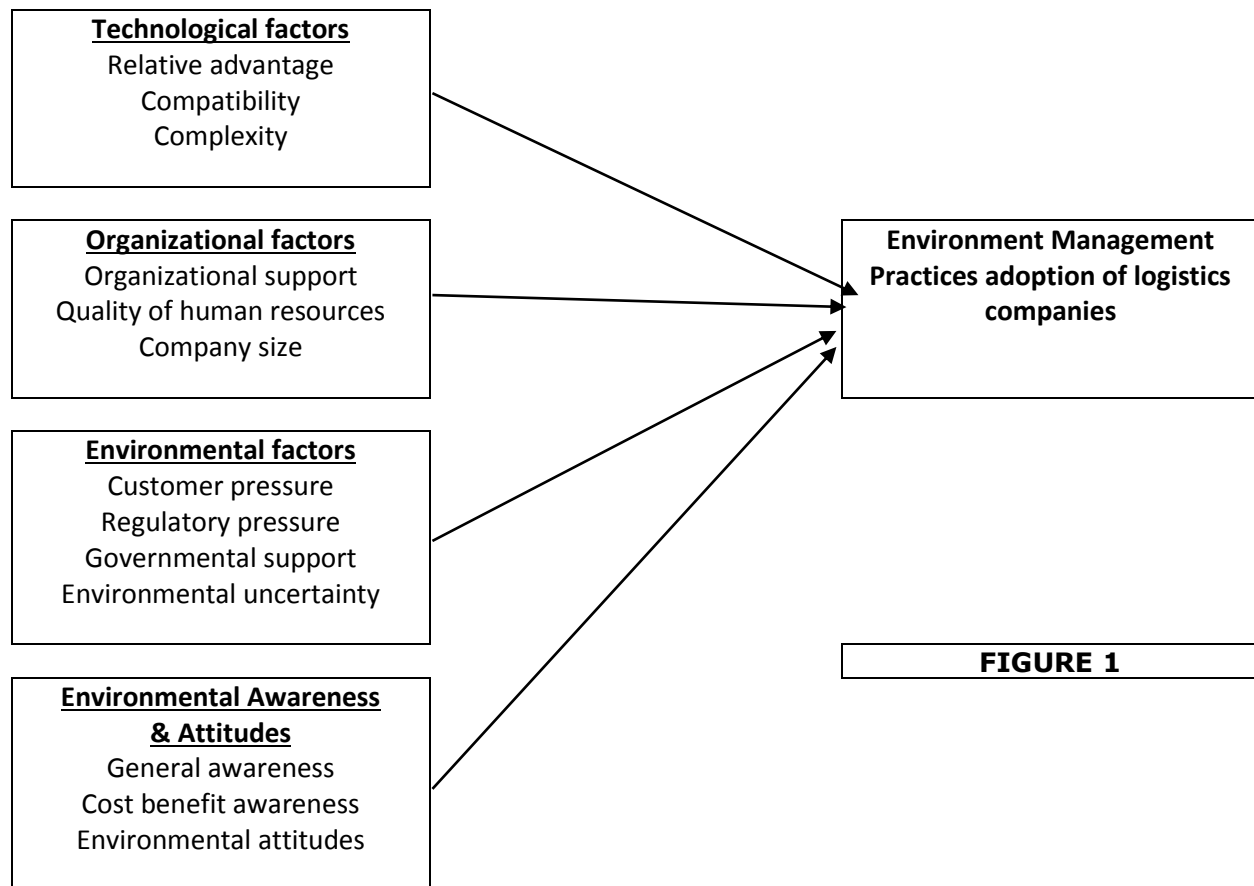
Figure 1 illustrates the research framework of the research. The technological factors include the relative advantage, compatibility, and complexity of environment management practices; the organizational factors include organizational support, quality of human resources, and company size; environmental factors include customer pressure, regulatory pressure, governmental support, and environmental support and lastly the environmental awareness and attitudes includes general awareness, cost benefit awareness and environmental attitudes.

2.1. Target Group

Sample randomly drawn from the list of Federation of Malaysian Freight Forwarders consists of 1,135 members.

2.2. Filling the Gap

In order to fill the research gap, this research aims to study the influences of technological, organizational, environmental and environmental awareness and attitudes factors on the adoption of environment management practices for the logistics companies in Malaysia.



3. DISCUSSION AND CONCLUSION

This research focuses on issues related to environmental issues in the logistics industry. Environment management practices is the important issues that has been highlighted. The research reported above includes a variety of several important findings. Some of these findings merely argued the importance of environmental issues for the logistics industry (Rodrigue et al., 2001; Rondinelli & Berry, 2000); some explored the environmental practices adopted by the logistics industry (Murphy & Poist, 2000, 2003; Wu & Dunn, 1995); and some introduced some possible factors that may influence the adoption of environmental practices for the logistics companies (Lin & Ho, 2011; Murphy et al., 1994; 1995; 1996; Szymankiewicz, 1993; Wong & Fryxell, 2004).

This research highlights the need for future researchers to endeavor to raise the quality of research in environmental issues in the logistics industry. Future logistics research would benefit from other methodologies such as field experiments to show causality, and relying on actual behavior rather than intended behavior.

Environmental management provides an important framework for a resercher to understand environmental change and is an important means of solving a country's ecological problems. Environmental management is a complex, dynamic and interactive process with many paradoxes, and is a multidisciplinary phenomenon and should be viewed from a

technical, managerial and social perspective. Lin & Ho (2011) analyzed the influences of technological, organizational and environmental factors on the adoption of environmental practices in Chinese logistics industry. However, there is an amount of explanations as to why manufacturing firms should engage in environmental activities, including stakeholder pressure, environmental regulation, industrial sector, company size, managers' characteristics, human resources, internationalization, organizational structure, corporate operation activity, environmental technology characteristics, position in the value chain, strategic attitude, and geographical location (Etzion, 2005; Gonzalez-Benito & Gonzalez-Benito, 2006; Pun, 2006). As all industrial sectors are not exposed to the same types of pressure or to the same extent, there is a clear research need to explore more potential factors that will influence the adoption of environmental management practices for the logistics industry.

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THE IMPACT OF NONLINEAR DYNAMICS ON THE RESILIENCE OF A GROCERY SUPPLY CHAIN

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ABSTRACT

Purpose of this paper

The resilience of supply chain replenishment systems is an important performance attribute and especially so in the retail sector where initiatives such as Efficient Consumer Response have led to lower inventory holding while attempting to maintain high levels of on-shelf availability. A common approach to testing for resilience of such systems would be through simulation modelling, especially where batching of orders occurs, for example. However, with developments in non-linear control theory, there is an opportunity to use more sophisticated analytical approaches to evaluate and improve resilience. The aim of this paper is to demonstrate the value of an analytical approach with empirical testing on a replenishment system used by a grocery retailer.

Design/methodology/approach

An Industrial Dynamics (ID) approach is used for framing and building a credible representation of the grocery retailer's replenishment system. Initially a nonlinear causal loop and block diagram representations of the actual system were developed based on empirical data collection. Mathematical analysis of the model, based on nonlinear control engineering techniques in combination with ID simulation, have been used to understand the behaviour of stock and shipment output responses in the distribution centre given step and periodic demand signals.

Findings

Mathematical analysis through nonlinear control theory techniques has led to insights into the dynamic behaviour of the replenishment control model. This allowed the identification of specific behavioural changes in the supply chain stock and shipment responses, which are key indicators for assessing supply chain resilience, without going through a time-consuming simulation process. Transfer function and describing function analyses served as guidelines for undertaking ID simulation.

Value

The integrated method we have used combines to best advantage the knowledge generated via the twin approaches of non-linear control systems engineering analysis plus ID simulation. This duality maximises insight into the resultant causal relationships output from these procedures and hence enables the engineering of the optimal design for a real-world supply chain. The consequence is the development of a robust system based approach which brings together two mutually supportive components, simulation and non-linear control theory, to enhance supply chain resilience. The approach is illustrated using data concomitantly with a comprehensive grocery supply chain case study.

Research limitations/implications

This research is limited to the dynamics of single-echelon supply chain system. Although the electronic point of sales data and the store replenishment system have been considered in the validation process, this study has focused on analysing the resilience performance of a replenishment system only. Future research will consider a multi-echelon supply chain.

Practical implications

The systems based method is readily transferable to other industrial settings and environments, thereby enabling insights into resilience. A number of lessons for the case study are identified and these may also be applicable in other practical contexts.

INTRODUCTION

In recent years, successful businesses have moved from a product-driven strategy to a more market-driven one. In the retail environment, strong competition creates constant pressure on retailers to continually improve performance. To achieve this, grocery retailers have modernised their supply chains (Hingley et al., 2011). The distribution centre has become increasingly important in decreasing lead-times and taking inventory out of the retail operations. Moreover, with the growth of internet ordering for groceries and the use of store-based picking strategies for e-fulfilment to home shoppers, DCs now have to deliver stock to meet demands of both store and home shoppers (Fernie and Grant, 2008). Hence, this resulting complex retail business created the necessity for DCs to have effective replenishment systems, not only to meet the requirements of the supply chain but to be resilient to disturbances.

The dynamic behaviour of these systems plays a significant role in supply chain resilience performance. These dynamics are normally driven by the application of different control system policies and can be considered as a source of supply chain disruption depending on the control system design (Mason-Jones and Towill, 1998). More often than not, such resilience may be evaluated through simulation, given the complexity of the system. However, developments in computing capabilities allow non-linear control theory to now be effectively used instead. In this paper, we aim to analyse the resilience performance of a DC replenishment system within one of the largest grocery retailers in the UK, using an approach that combines nonlinear control theory and simulation modelling.

SUPPLY CHAIN RESILIENCE AND SYSTEM DYNAMICS

In the supply chain literature, the idea of resilience has recently emerged (Christopher and Peck, 2004), and is defined as "the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at desired levels of connectedness and control over structure and function" (Ponomarev and Holcomb, 2009). This definition implies achieving three properties: readiness (being prepared or available for service), response (reaction to a specific stimulus) and recovery (a return to 'normal' stable or steady state conditions).

Despite the growing importance of the field of supply chain resilience, most existing studies are qualitative in nature. An exception is Wilson (2007), who analysed the impact caused by disruptions in transport processes on customer service levels, inventory levels and goods in transit and how a more collaborative supply chain can help to overcome this problem. Spiegler et al. (2012) investigated how different control policies and system dynamics in supply chains affect resilience, which is measured by calculating the integral of time absolute error (ITAE) of inventory and shipment responses. Both of these works are conceptual, exploratory and no empirical data were considered. However, in this study, we extend Spiegler et al.'s (2012) analytical framework for assessing supply chain resilience by enriching it with empirical research. In doing so, there is a need to consider how non-linearities have been incorporated into the analysis of dynamic systems.

It has been claimed that in order to improve supply chain performance, dynamics in production-inventory control systems should be reduced (Torres and Maltz, 2010). Hence, there is a plethora of literature researching the bullwhip effect and its impact on different supply chain performances, from both a quantitative modelling perspective (Fransoo and Wouters, 2000; Dejonckheere et al., 2004), either conceptually or based on empirical studies, and a descriptive perspective in the form of case studies (Lee et al., 1997; Kumar and Nigmatullin, 2011). However, so far, emphasis has been given to financial performance measures. For instance, most research focuses upon the impact of system dynamics on inventory, production and transport costs. Even when service levels and customer satisfaction are considered, these have been seen as service penalty costs.

be the store demand, store orders plus any backlog. The ROUNDING function regards to the Buying Quantity and Truckload Constraint already mentioned before.

Having developed the simulation model, the next stage was to verify and validate the findings, using Sterman (1984)'s validation process. The model was verified by talking to the system manager through the equations entered into a spreadsheet. Then, tests using extreme input and parameter values and eliminating assumptions were undertaken. Finally, actual data obtained for three different products has been used to test the model. Results show that our model represents well the response of the real system, especially for products with high volume and lower standard deviations.

RESILIENCE PERFORMANCE ANALYSIS

In this section, analysis of the DC replenishment system's resilience performance will be undertaken. Transfer functions, describing functions and system dynamics simulations will be used to estimate the performance of this nonlinear system. The ITAE (Towill, 1970) of the DC stock response and the system's natural frequency (ω_n) and damping ratio (ζ) will be used as indicators of resilience.

Transfer Functions in ideal operating conditions

Under ideal operating conditions, a backlog situation would not occur and therefore shipments to the store would be made in full every period. Moreover, if buying quantity and truckload constraints could be overcome, then nonlinearities in the model of Figure 1 could be eliminated. In doing so, the DC replenishment system is simplified to a linear dynamic model and simple block diagram algebra can be used to find the system transfer functions:

$$\frac{Supplier\ Order}{OS} = \frac{1 + s(K + Ta + Ti + Tp) + s^2(K + Ta + Ti)Tp}{(1 + s.Ta)[1 + s(Ti.Tp + Ti) + s^2Ti.Tp]} \quad (1)$$

$$\frac{DC\ Stock}{OS} = \frac{K - Ti.Tp + s(-Ta.Ti.Tp - Ta.Ti - Ti.Tp) - s^2.Ta.Ti.Tp}{(1 + s.Ta)[1 + s(Ti.Tp + Ti) + s^2Ti.Tp]} \quad (2)$$

$$\frac{GIT}{OS} = \frac{(1 + s(K + Ta + Ti))Tp}{(1 + s.Ta)[1 + s(Ti.Tp + Ti) + s^2Ti.Tp]} \quad (3)$$

In order to find out how the outputs will respond to a step change in the input, initial and final value theorems can be used. Table 1 presents the results for the final values of supplier order, DC stock and GIT when store orders undergo a unit step change (from 0 to 1 unit). The initial values of all responses are zero, including their targets.

Response	Final value	Target
Supplier Order	1	1
DC stock	$K - Ti.Tp$	K
GIT	Tp	0

Table 1. Results from the Final Value Theorem

The results in Table 1 demonstrate that there is a permanent offset occurring in both DC stock and GIT responses since none of them will ever reach target values. The stock drift has a significant impact on the resilience performance since that the system has been designed in such way that stock levels will never recover from changes in the orders received from the store. The company had not recognised this problem since the replenishment system is continuously fed with erratic orders from the store. Hence, a proposed solution for the target GIT is to make it a variable with function of demand and the lead-time, assuming that lead-time is always known. In the case application, suppliers have consistent delivery lead-times, making this is a reasonable assumption.

In order to calculate ITAE of the DC stock response, the final value (Table 1) of DC Stock can be used so as to estimate which parameter values would increase the system's response and recovery. From Eqn (2), partial fraction expansion method can be used to determine the time function for the DC Stock. In this way, ITAE can be estimated as:

$$\begin{aligned}
ITAE &= \int_0^{\infty} t. |e(t)| dt = \int_0^{\infty} t. |K - Ti.Tp - DC Stock(t)| dt = \\
&= K Ta^2 - Ti^3 Tp (1 + Tp)^2 + Ti (Ta^2 - K Tp + K Ta (1 + Tp)) + Ti^2 (Tp + 2 Tp^2 + Ta (1 \\
&\quad + Tp) + K (1 + Tp)^2)
\end{aligned} \tag{4}$$

Note that Eqn (4) is only valid for $Ta > 0$ and $K > Ti.Tp$. It is also assumed that after the step change, the stock level drops and recovers without overshooting again. Hence it should be used only for exploratory analysis. Eqn (4) shows that ITAE can be minimised, hence resilience can be maximised, by decreasing Ti , Ta and Tp .

Effect of nonlinearities

In order to investigate the impact of nonlinearities in feedback systems, we can use the describing function method, which is a quasi-linear representation for a nonlinear element subjected to a sinusoidal input. A sinusoidal input raw order quantity (ROQ) with an angular frequency ω , amplitude A and mean B , to the ROUNDING nonlinearity will produce an output (*Supplier Order*) of same frequency and phase but different amplitude and mean. Although the function is nonlinear, it can be represented by multiple piecewise linear equations. In order to simplify calculations, the lookup table equation can be linearised beforehand and then we obtain the two piecewise linear equations:

$$Supplier Order(t) = \begin{cases} ROQ(t), & \text{if } ROQ > 0 \ (-\gamma < \omega t < \gamma) \\ 0, & \text{if } ROQ < 0 \ (-\pi < \omega t < -\gamma \text{ and } \gamma < \omega t < \pi) \end{cases} \tag{5}$$

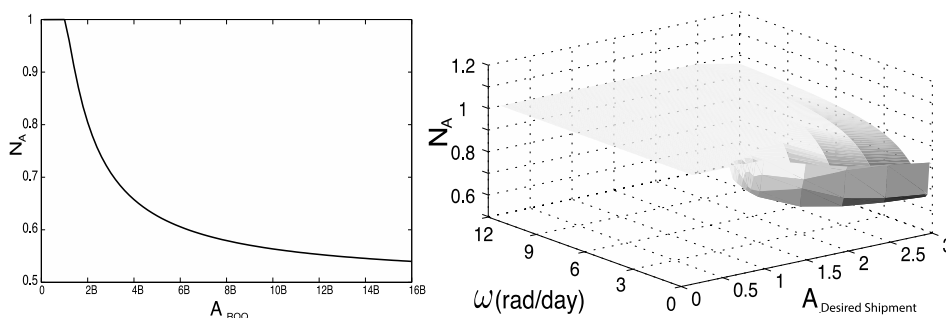
The basic idea of the describing function is to represent a nonlinear element by a type of transfer function, or gain, derived from its effects on a sinusoidal input signal. Given ROQ as a sinusoidal input, the output *Supplier Order* can be approximated to:

$$Supplier Order(t) \approx N_A. A \cos(\omega t + \phi) + N_B. B, \tag{6}$$

where ϕ is the phase angle. In order to determine the gain of the describing function (N_A) we need to expand the series and determine its first harmonic coefficients. Fourier series expansion method is used to represent the output *Supplier Order* as a series. For the describing function, only the first, or fundamental harmonic is usually used to approximate the periodic series. If we approximate the piecewise linear output *Supplier Order* to the first harmonic, we have that:

$$N_A = \frac{\gamma - \cos(\gamma)\sin(\gamma)}{\pi}, \text{ where } \gamma = \cos^{-1}\left(\frac{-B}{A}\right). \tag{7}$$

Figure 2a illustrates how the describing function gain varies as the amplitude of the ROQ increases. For amplitudes lower than the mean B , the system behaves linearly and *Supplier Order* will be equal to the input ROQ corresponding to a describing function gain (N_A) equal to 1. However, when the amplitude of ROQ increases only a fraction of this rate will actually be ordered. So, the gain of the describing function varies from 0.5 to 1.



a) N_A for ROUNDING function

b) N_A for CLIP function

Figure 2. Describing function gains

The second nonlinearity in the model is the CLIP function in the shipment system, which is used to avoid any shipments being made to the store if no stock is available. While in the ROUNDING function all constraints (buying quantity, truckload and non-negative orders) were fixed, in the CLIP function the constraint is given by current responses of

DC stock and delivery, which are variable values. Because of that, the nonlinearity caused by the CLIP function is not only amplitude-dependent but also frequency-dependent. Hence, there will be one describing function for each frequency. Matlab™ combined with Simulink™ has been used to automate calculations and find the describing function gains for a set of amplitudes and frequency resulting in Figure 2b. The figure demonstrates that the nonlinearity in the shipment process only occurs for very low frequencies and high amplitudes.

Although each nonlinearity in the DC replenishment system has different features, they both decrease their respective output gain, whose value is always between 0.5 and 1. Now, root locus techniques can be used to predict how these nonlinearities affect the system responses and the resilience performance. By replacing the ROUNDING and CLIP functions with the gains $N_{A(ROQ)}$ and $N_{A(Ship.)}$ respectively and using block diagram algebra again we find that the new system characteristic equation is equal to:

$$(1 + s.Ta)[N_{A(ROQ)} + s(N_{A(ROQ)}.Ti.Tp + Ti) + s^2Ti.Tp], \quad (8)$$

In this way the effect of the change in gains on the system natural frequency (ω_n) and damping ratio (ζ) can be calculated as:

$$\omega_n = \sqrt{\frac{N_{A(ROQ)}}{Ti.Tp}} \quad (9)$$

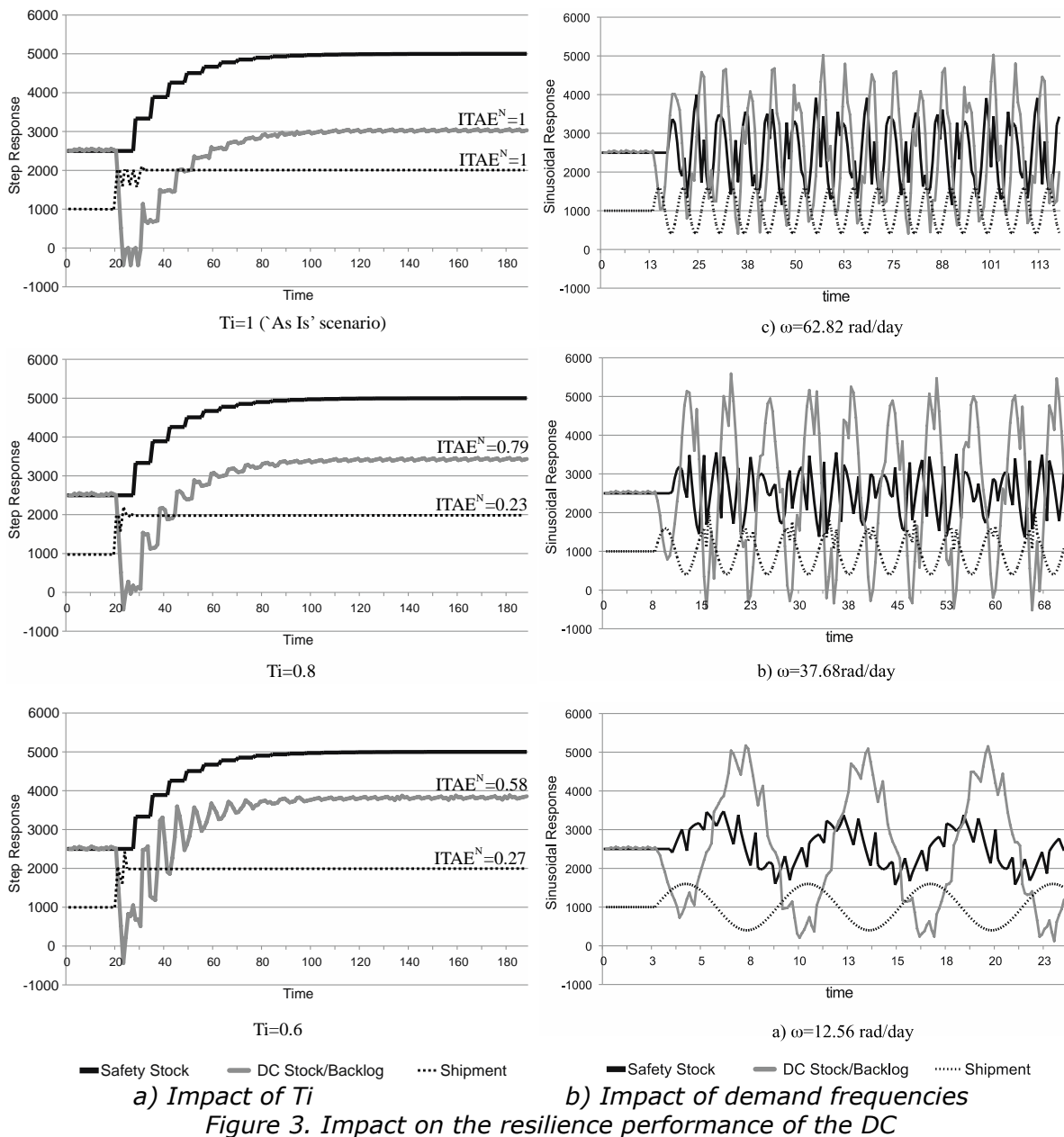
$$\zeta = \frac{(1 + N_{A(ROQ)}.Tp)Ti}{2N_{A(ROQ)}} \sqrt{\frac{N_{A(ROQ)}}{Ti.Tp}} \quad (10)$$

Analysing Eqns 8 and 10, the nonlinearity will always decrease significantly the value of the ω_n . This causes a negative impact on supply chain resilience since ω_n determines how fast the system oscillates during the transient response. On the other hand, the damping ratio, which describes how oscillations in the system decay with time, depends on the combining values of other parameters. When replacing the parameter values used by the DC replenishment system, the natural frequency decreases from 0.71 to 0.5 rad/day as the nonlinearity becomes active. The damping ratio decreases from 1.06 to 1, which means that the resilience performance is improved since the responses would switch from overdamped (slow decay of oscillations) to critically damped. Ti can also be adjusted in order to achieve responses which ideally has a $\zeta=0.7$. The ROUNDING nonlinearity provokes complex behaviour such that the resilience performance depends upon the parameters values, buying quantities and truckload constraints.

Note that the CLIP function $N_{A(Ship.)}$ has no effect on the ω_n and ζ . Hence, it does not influence the DC stock and supplier orders responses. The only impact that this nonlinearity has is in the shipment response. When the CLIP nonlinearity takes effect it means that DC Backlog is no longer zero and shipments to customers will be cut (ITAE in shipments will increase) and the supply chain will be less resilient.

Simulation Results

In order to understand the impact of both nonlinearities, we introduced a step input of 100% (from 1,000 to 2,000 cases/day). Figure 3a illustrates the 'As Is' scenario. When stock levels are negative (backlog situation), shipments to the stores are no longer made in full, which in consequence may lead to on-shelf stockouts. Hence, the replenishment system becomes less resilient to greater changes in demand and the stock offset is also intensified. By decreasing the values of the control parameter Ti we observed an improvement in the resilience performance because: i) the stock offset decreases because the final value of stock oppositely depends on this parameter, as demonstrated in Table 1; and ii) inventory response and recovery times are reduced, therefore the system recovers from backlog situation quicker.



In order to quantify the results, ITAE values of the DC stock and shipment responses for a period of 180 days have been calculated and normalised by dividing all the ITAE performance by the 'As Is' index value. As Figure 3 shows, the integral time absolute value error decreases as T_i is adjusted to lower values. However, if T_i is too small (lower than 0.5), the DC stock response will start to oscillate and potentially becomes unstable. Similar results are obtained for the forecasting constant T_a and T_p . As T_a and T_p decrease, ITAE values of both stock and shipment are improved.

A set of simulations has been undertaken to investigate in depth the ROUNDING function. This nonlinearity is very complex for the system manager to handle, not only depending on the parameter values, buying quantity and truckload constraint but also the demand pattern and steps. Depending on the step sizes, certain rounding values will improve resilience by making inventory recovery faster. But a single unit change in the rounding value may change completely the inventory response.

Another curious phenomenon discovered by employing the describing function technique was that the CLIP nonlinearity in the shipment process only occurs for low frequencies (but not too low) and high amplitudes. The effect of high amplitude demands has been

demonstrated by increasing the step sizes in the 'shock' analysis previously. To confirm the effect of demand frequencies, simulations using sinusoidal inputs of same amplitude but different frequencies have been undertaken. Figure 3b demonstrates that as input frequency decreases from 62.82 (or higher) to 37.68 rad/day, backlogs start to occur. But as the input frequency decreases further, the shipment process behaves linearly.

IMPLICATIONS AND CONCLUSIONS

This research has analysed the resilience performance of a DC replenishment system within a large grocery retailer. Potential risks from a lack of resilience include a mismatch between supply and demand, and serving stores inefficiently. The findings identify several potential improvements to the DC replenishment system that can be made in order to become more resilient. These include:

- making the target GIT a variable related to demand and a function of the lead-time, to address the permanent offset in the DC stock response. Inventory drift is a problem for the supply chain to maintain its resilience performance, especially under multi-event disruptions and uncertain demand.
- automatically adjusting the control parameters to the resilience 'mode' in times of uncertain demand patterns and abrupt, sharp changes in stock levels.
- grouping products with the same demand pattern to determine the order quantity that maximises resilience without negatively impacting on warehousing and transportation costs. This is because the demand amplitude and frequency affects potential backlog situations.

Preliminary mathematical analysis through nonlinear control theory techniques has been undertaken in order to gain initial insights in the understanding of the replenishment control model. Table 2 summarises the insights gained by combining these methods.

This research is limited to the dynamics of single-echelon supply chain systems. Although the EPOS sales data and the store replenishment system have been considered in the validation process, this study has focused on analysing the resilience performance of the DC replenishment system only. Considering the multi-echelon supply chain is intended for further research activities.

	Analytical Insights	Resulting simulation experiments	If not carried out
Transfer function analysis	Possibility to find system's transfer functions and ITAE estimated equations	Simulation process focused on important parameters for achieving supply chain resilience	A better understanding of each control parameter's influence on resilience was achieved by using both analytical and simulation techniques.
	Example 1: The parameters T_i was found to be important control parameters for resilience. It provokes opposite impacts on ITAE values. Hence it has been investigated more in-depth in the simulation process since its value may impact on system stability.		
	Example 2: Small values of T_a will always benefit resilience. Simulations confirmed that a demand chase strategy ($T_a=0$ or $\alpha=1$) is preferable and T_a causes no problem to stability.		
	Example 3: Delivery lead-time T_p is also important for resilience and should be minimised.		
	Possibility to find an inventory drift problem in the DC replenishment system	Simulations were undertaken to visualise the problem and to test solutions	Possibly gone unnoticed. Although step input simulation revealed the same result, this drift effect is only perceived if plotting both safety and current stocks together.
	Example 1: Initial and final value theorems revealed how parameters T_i and T_p influence in the inventory offset. This would have been impractical with numerical/simulation technique only.		
Example 2: Simulations confirm that T_a does not change the stock's final value.			
Describing Function	Understanding the impact of the different nonlinearities (CLIP & ROUNDING functions) and input amplitudes on system's damping ratio and natural frequency.	Simulations were undertaken to check whether the analysis gave correct insights and more effort has been given to check unexpected results.	The understanding of nonlinearities would be very difficult and some results would have been missed when using only simulation techniques.
	Example 1: Analysis showed that the ROUNDING function may cause a positive or negative impact on resilience depending on control parameters. In this way, simulation efforts were given to find such situations. Although simulations confirm this result and reveal an even more complex behaviour caused by this nonlinearity, the positive impact on resilience might have never been discovered when using only simulation.		
	Example 2: The CLIP function does not cause any impact on other system's responses. This effect was easily pointed out by describing function techniques and is confirmed via simulations.		
	Understanding the impact of different input frequencies on system's behaviour	Simulations were undertaken only to confirm analytical insights.	Several simulation experiments would have been necessary to gain the same insights.

Table 2. Insights gained from undertaking preliminary analysis of system dynamics models

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Section 10: Transport and Distribution

AN INVESTIGATION INTO CRITICAL SERVICE DETERMINANTS OF PRODUCT RETURNS IN RETAIL FIRMS

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ABSTRACT

Product returns are service activities and it is critical for organisations to consider returns strategically and develop customer oriented returns management systems. With the aim of extending the returns management literature, our research objective is to identify and prioritize critical determinants for product returns services in the Australian retail industry. We conducted 11 face-to-face interviews of senior executives of retail organisations and identified the critical determinants of product returns service through multi-criteria decision-making approach. Results indicate that the most important service dimensions are associated with the outcome of service recovery, and the manner in which service failures are handled. The top four critical product returns service determinants are (i) communication support service for customer, (ii) money-back for any type of return, (iii) customer support access and (iv) user-friendly interaction. The findings of the study can act as a reference guide to senior executives developing strategies for competitive advantage through product returns viz. customer retention.

Keywords: Product returns, returns service, AHP, Retail industry.

1.0 Introduction

Products returns are a reverse flow in the traditional supply chain (Rogers et al., 2002) and are categorised as activity of returning goods back through the supply chain with a focus on retailers (Bernon et al., 2011). Despite increased organizational attention to sophisticated philosophies and methods for achieving higher product quality (e.g., TQM, six sigma, and lean operations), the volume of returns is high and product returns are quickly becoming one of the biggest challenges for retail businesses today (Petersen and Kumar, 2009).

The management of returns is a service operation involving the process of handling returned goods from customers to satisfy their needs. If the returns process is complex, slow, or inconvenient, customer dissatisfaction will only escalate, which will put future business at risk (Griffis et al., 2012). Conversely, an efficient and customer focused returns operation can be a strategic asset of an organization and a source of competitive differentiation and customer-retention advantage (Petersen and Kumar, 2009). Returns become increasingly important as retailers see to maximize the value it can create for themselves and for customers (Mollenkopf et al., 2011). It is critical for organisations to consider returns strategically and develop efficient and customer oriented returns management systems that will benefit customers and as well as retailers. Some leading edge companies with more sales and returns have realized the strategic value of returns services and emphasized on the full-time administration of the product returns process (Stock et al., 2006). Furthermore, as the firm grows, it tends to handle increased number of products, and at the same time the number of product returns also increases (Ahsan and Rahman, 2013). As a result, demand relating to product returns services increases.

In spite of its strategic importance, research in the area of customer services elements of product returns is relatively limited (Mollenkopf et al., 2011; Bonifield et al., 2010). A review of recent returns management research implies that less attention has been given to link customers with the returns policy and process (Rogers et al., 2002, Dubbs, 2001). With the aim of extending the returns management literature, our research objective is to identify and prioritize critical determinants for product returns services in the Australian retail industry. We consider fairness theory (Adams, 1965) as a theoretical foundation of returns service, and develop a multi-criteria critical returns services determinants model. Through face-to-face interviews with senior executives of the top Australian retailers we

identify critical determinants of product returns services for retail industry.

2.0 Literature Review

2.1 Returns Management

Rogers et al. (2002) argue that returns management is an important supply chain process. Activities related to returns management start from customer request or complaints regarding a product or service; followed by gatekeeping; avoidance (Rogers et al., 2002); returns authorisation decision (Mollenkopf et al., 2011); product disposition (Guide & Wassenhove 2001); recovery; and crediting. In broad-spectrum, returns can be classified as customer returns and business returns. Customer returns are from end customers to retailers, and business returns are from business to business organisations such as manufacturer, dealer, and retailer. Customer returns are products that have been returned mainly due to buyer regret or product defect, and are normally the largest type of returns (Rogers et al., 2002). Therefore, customer product returns have become an important part of today's business and our research addresses customer product returns.

2.2 Customer Service in Returns

A customer's relationship with the firm is significantly influenced by the activities that occur after purchase and during the entire period of product ownership (Amini et al., 2005). During the product ownership period, customers return products for variety of reasons. It may be because products do not meet customer's needs due to defective product, customers do not understand how to properly use the product, or the product not matching the description or sample, or behavioural issues such as change of mind and family member influence (Cassill, 1998). In addition, more often customers return products because companies are motivated to loosen return policies due to competition. Considering the causes of returns, product returns handling can be considered as service recovery opportunity (Griffis et al., 2012; Mollenkopf et al., 2011). In retail, most important customer service experience occurs on sales floor and at the return counter (Cassill, 1998). Returns service comprises store returns policy, service providers interactions and actions (refunds, price discounts, upgraded services, free products or services, apologies, and acknowledgment) that the service providers offer to rectify, change, and restore the loss experienced by customers (Mollenkopf et al., 2011; Rogers et al., 2002). When returning the products, customers may have contrasting experiences that lead to different level of satisfaction and dissatisfaction (Cassill, 1998). Customer satisfaction level and their future loyalty depend upon whether the customers felt that they were treated fairly (McColl-Kennedy & Sparks, 2003). Positive customer experiences significantly increase repeat business, and to generate new customers through word of mouth recommendation (Mukhopadhyay & Setaputra, 2011). Therefore, retailers need to resolve customer dissatisfaction issues through effective service within timeliness and accuracy of processing the returned products (Mollenkopf et al., 2011).

Justice theory was introduced in the mid-1960s (Adams, 1965), has received considerable attention by service researcher as a theoretical framework of service recovery procedure (McColl-Kennedy & Sparks, 2003). Justice theory in service refers to consumers assessments of whether a retailer policy, price or service is fair or justifiable (Adams, 1965); service fairness predicts overall customer satisfaction and customer revisit intentions (Pei et al., 2014). Following the justice principal theory (Adams, 1965) as theoretical framework for returns service determinants, we consider product returns services with three important service dimensions of justice such as (i) interactive fairness, (ii) procedural fairness, and (iii) outcome fairness (Adams, 1965). Details of these major categories of service determinants and sub-categories are explained below and summarised on Figure 1.

2.2.1 Interactive fairness

Interactive fairness concerns the manner in which the service problem is dealt with by service providers and the specific interactions between the service provider and the customer (McColl-Kennedy and Sparks, 2003). The customer assesses whether the service provider could and should have done something more to remedy the problem (McColl-Kennedy and Sparks, 2003). Interactive fairness in product returns context refers to accessible facility or information for customer to locate and interact with retailers for

available service support (Collier, 2006). We categorize interactive fairness of returns services into sub-factors such as support access, user-friendly interaction, and communication support service (Figure 1). Support access means, customer should be able to easily locate the returns place and use contact details, including e-mail and phone number (Collier, 2006). User-friendly interaction means easy to lodge returns claim and the interaction process provides real-time feedback to the customer, on where and how to lodge a return, as well as feedback on returns claim authorisation (Collier, 2006). Interaction could be through information sharing relating to the returns flow and timing and status of return claims (Mollenkopf et al., 2011). Communication support service means timely communication is provided to the customer from acknowledgement of returned product received with valid proof of purchase, decision outcome, feedback, and claims tracking (Griffis et al., 2012). The maintenance of interaction and communication channel throughout the whole returns process is considered a critical aspect of effective return management (Stock et al., 2006).

2.2.2 Procedural fairness

Procedural fairness refers to the policies, procedures, and responsiveness in the service recovery process (Collier, 2006). The operational steps of returns include: returns request or claim, verification and inspection merchandise to confirm the legitimacy of returns (checking gate keeping rules), returns outcome decisions (Ahsan & Rahman, 2013). The speed of returns handling depends on returns process steps and gate keeping rules of returns policy, and it is a key component of overall returns experience (Griffis et al., 2012). For product returns, procedural fairness refers to convenience for customer to return the product, quick resolution of returns claims, and consistency and flexibility in returns policy (Mollenkopf et al., 2011).

Convenience

Convenience means customers require less effort and hassle to claim for the returns (Janakiraman and Ordóñez, 2011). Convenience could be considered as returns to any store, customer does not require to contact any third-party, and retailer absorbs any returns logistics costs. Return to any store includes being able to return the product either by visiting a nearest store or any chain store or collection center or return through online system. To sort out and to process the returns claim, retailer contacts the required third-party, including manufacturer, and logistics providers, on behalf of the customer, thereby reducing the effort required of the customer. Retailer covers all of the logistics costs involved and doesn't charge a return fee.

Returns policy

A returns policy ensures post-purchase customer satisfaction and is an element of a bundle of services that may be provided by retailers (Davis et al., 1998). A good returns policy should be clear and consistent in terms of explaining the returns process and relevant restrictions or gate keeping rules (Wood, 2001). Depth of returns policy may signal retailer/e-tailers quality and reliability (Bonifield et al., 2010). Some retailers offer generous return policies, while others impose more restrictions on returns (Griffis et al., 2012). Depending on the level of restriction we classify three different types of returns policies: strict, moderate and lenient policy.

A strict returns policy means many gate keeping rules or restrictions. Restrictions include very strict time limits for returns; must return in original packaging materials; must show original proof of purchase (purchase receipt, no credit card statement), no change of mind returns, and acceptance of only those products with no visible signs of use. Because of customer abuse and due to high costs of product returns handling, retailers have begun to scale back return policies in favour of more restrictive ones (Janakiraman and Ordóñez, 2012). Moderate or partial returns policy is best choice by retailers and is characterised by some restrictions or a few gate keeping rules for valid returns (Yan, 2009). For example retailers may accept change of mind returns; however only with a valid proof of purchase, and within the set time restrictions. The returns outcome will be no money-back, and only store credit available. A lenient or generous returns policy is characterised by almost no gate keeping rule; such as allowing change of mind returns, with lenient deadlines, with any proof of purchase, no restrictions of original packaging,

and a high coverage of money-back, availability of refunds, exchanges, and merchandise (Bonifield et al., 2010, Janakiraman and Ordóñez, 2012). The lenient returns policy gives consumers signal that they can get full money back without risk and increases consumers purchase intention (Pei et al., 2014).

Prompt resolution

Quick resolution means responsiveness to service recovery. It depends on the amount of time customers must wait to sort out a claim. Items of quick resolution of service processing time depend on factors such as less gate keeping rule for genuine retruns, skilled and trained personnel to handle return (Guide and Wassenhove, 2001), dedicated returns service department (Stock et al., 2006, Mollenkopf et al., 2011), software support to handle returns (Bonifield et al., 2010).

2.2.3 Outcome fairness

Outcome fairness means what the customer receives as an outcome of the recovery process (McCull-Kennedy and Sparks, 2003). A returns is considered complete once the retailer has received the returned merchandise and authorised or process a refund to the customer(Griffis et al., 2012). Outcome fairness includes monetary compensation, future free services, or an apology (Collier and Bienstock, 2006). Outcome fairness for returns could be the extent of service coverage (Janakiraman and Ordóñez, 2011, Posselt et al., 2008, Mollenkopf et al., 2011) about claiming the returns, and resending a defective product or a product that doesn't meet the conditions of sales. This coverage includes how retailers usually sort out returns claims through exchanges such as: full money-back, product replacement, and gift voucher or store credit. Many faulty product returns claims are sorted out by replacing the returned item with a similar product or repair guarantee without cost for faulty product. Stores sometimes do not accept returns with full money back for no fault or change of mind returns or returns without original receipt. For those causes of returns, stores provide only store gift vouchers or store credit.

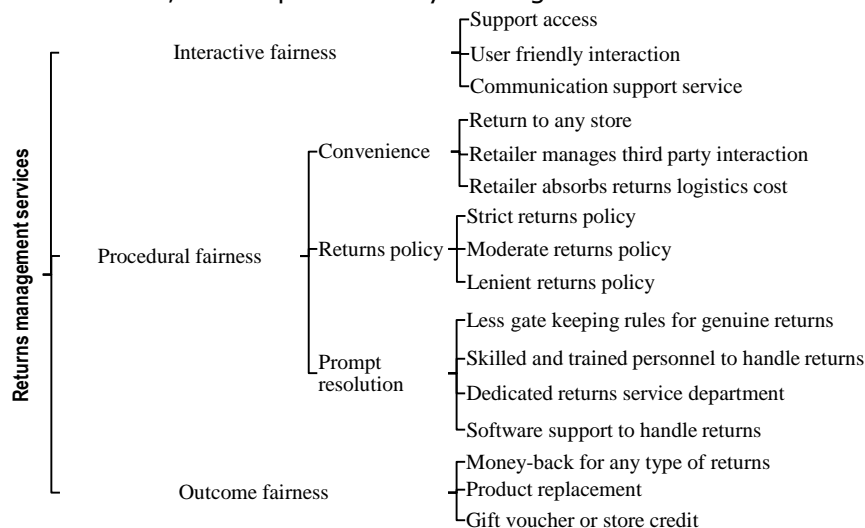


Figure 1: Returns management service determinants

3.0 RESEARCH METHODOLOGY

We adopt the case study interview approach and employ analytic hierarchy process (AHP) methodology to identify the critical determinants of returns service.

3.1 ANALYTIC HIERARCHY PROCESS (AHP) - A RESEARCH TOOL

Saaty developed the analytic hierarchy process (AHP) multi-criteria decision-making technique that was used in the military for allocating resources and planning needs in the 1970s (Cheng and Li, 2001). AHP helps in breaking down a complex, unstructured problem into its components part in hierarchical structure. It integrates simultaneously qualitative and quantitative information for prioritizing alternatives. AHP has been widely used in decision problems in areas such as logistics and supply chain decisions area, followed by outsourcing decision with minimum applications in managing the stock (Subramanian and Ramanathan, 2012). AHP is a subjective method that focuses on

specific issue, and seeking a large number of participants is not a necessity in AHP (Wang et al., 2009). The modelling process of critical service element determination involves following four AHP steps: (i) assessment of the critical elements of product returns service, (ii) structuring the problem as a hierarchy using criteria and factors and building the AHP model, (iii) collection and compilation of decision-makers' opinions and application of the prioritisation procedure, and (iv) determination of critical challenges through the synthesis of normalized priority weights and checking the consistency of opinions of decision makers.

3.2 SAMPLE AND DATA COLLECTION

We consider 25 top ranked Australian retailers to identify critical returns service determinants. We chose these top retailers based on 2012 sales volume (*Inside Retail, April/May 2012*) and with the assumption that retailers with more sales, experience more return. These retailers have major market share in each retail category for example top departmental stores (Big W, Target, Kmart, Myers, David Jones, Retail Adventures) have a market share of around 90%, and top food and liquor stores (such as Woolworths, Coles and IGA) have around 70% market share. For collection and compilation of expert's opinions and application of the AHP prioritisation procedure we used face-to-face interview. Initially, we approached 25 retailer operations managers who have extensive experience and expertise in returns management field. We received confirmation of participation from 11 managers, later e-mailed the questionnaires and organised face-to-face semi-structured interviews. Each interview lasts approximately 60 minutes and the interview session was audio recorded and then crosschecked with the paper format of AHP questions.

We develop a two-part questionnaire for data collection. Part-1 is related to respondent's opinion on relative importance of weights amongst different service determinants and part 2 consists of open-ended questions about the returns service issues and respondent's background information. Based on returns service determinants framework of Figure 1, we develop part 1 questionnaires (in AHP format) to capture respondent's opinions on the relative importance of weights amongst different service determinants and their sub-factors. As the respondents were not familiar with AHP data collection procedure, the following steps were considered: (i) the meanings of the integer priority scores of the 1-9 scale used was explained; (ii) how the scores need to be considered while making the pairwise comparisons between any two criteria of factors was explained. These two steps were critical to ensure the accuracy of data and consistency of judgements discussed earlier.

4.0 RESULTS AND ANALYSIS

Interview results for expert's judgement matrices were translated into the largest eigenvalue problems, and then calculated the normalised and unique priority vectors of weights by using the AHP Expert Choice® software. AHP analysis determines overall and relative priority weight of each service determinant and their sub-factors and relevant consistency of opinions of decision makers. We use industry group and subgroup outlines by Australian Bureau of Statistics ANZSIC 2006 classes and further compare the returns service preferences according the retailers groups: departmental, electrical, sports and toys, and all groups (for 11 studied retailers). Relative weights of returns service determinants and their sub-factors are summarised in Table 1.

Major returns service categories

Synthesising the relative priority of all 11 retailers (last column of Table 1), we found major service determinants as interactive fairness (0.381), followed by outcome fairness (0.365) and lastly procedural fairness (0.255), with an overall inconsistency index 0.0005. We also identify returns service priorities of different retail groups to see whether there are any particular attentions given on any key service determinants. From Table 1, we can reveal that in case of departmental stores more service emphasis is given on returns outcome fairness (0.495) and less on interactive fairness issues (weight 0.183). On the other hand, electrical stores give more priority on interactive service determinants (0.542) and less importance on procedural aspect (0.136) of services. For sports store, most prioritised returns service determinant is interactive fairness (0.668).

Table 1: Relative weights of returns service determinants for different retail groups

Major returns service category	Service determinants	Relative weight (Dept. store)	Relative weight (Electro. store)	Relative weight (Sports store)	Relative weight (for 11 retailer)
Interactive fairness		0.183	0.542	0.668	0.381
	Support access	0.299	0.271	0.452	0.332
	User friendly interaction	0.272	0.186	0.095	0.249
	Communication support service	0.430	0.561	0.452	0.419
Procedural fairness		0.322	0.136	0.200	0.255
Convenience		0.417	0.076	0.241	0.356
	Return to any store	0.544	0.327	0.169	0.436
	Retailer manages third party interaction	0.133	0.418	0.180	0.215
	Retailer absorbs returns logistics cost	0.323	0.255	0.650	0.349
Returns policy		0.197	0.507	0.170	0.156
	Strict returns policy	0.106	0.132	0.073	0.153
	Moderate returns policy	0.545	0.638	0.393	0.503
	Lenient returns policy	0.349	0.230	0.533	0.344
Prompt resolution		0.386	0.418	0.589	0.489
	Less gate keeping rule for genuine returns	0.201	0.057	0.113	0.129
	Skilled and trained personnel	0.349	0.391	0.086	0.565
	Dedicated returns service department	0.233	0.398	0.128	0.175
	Software support to handle returns	0.216	0.154	0.183	0.131
Outcome fairness		0.495	0.322	0.132	0.365
	Money-back for any type of returns	0.616	0.073	0.594	0.571
	Product replacement	0.173	0.735	0.249	0.243
	Gift voucher/store credit	0.211	0.192	0.157	0.186

Service Determinants

There are 16 operational level returns service determinants in the proposed returns service model (Figure 1). We investigate overall importance of these service determinants for different groups of retail stores individually and combined. Top four critical service determinants are shown in Table 2. We found overall rank orders of service determinants are different for different retailer group. For example, departmental store gives more importance to money-back for any type of returns; electronic stores give high priority to communication support service of returns; and sports stores are giving more emphasis on support access of returns service. Among the top four critical service determinants, communication service is common for all the three different groups of retailers.

Table 2: Critical service determinants for different retail groups

Rank	Departmental store	Electrical store	Sports store	All retail groups
1	Money-back for any type of returns	Communication support service	Support access	Communication support service
2	Communication support service	Product replacement	Communication support service	Money-back for any type of returns
3	Gift voucher/store credit	Support access	User friendly interaction	Support access
4	Product replacement	User friendly interaction	Money-back for any type of returns	User friendly interaction

Overall for all different groups of retailers, the four critical service determinants (at operational level) are respectively communication support service (18.5%), money back

for any type of returns (17.7%), support access (14.7%), and user-friendly interaction (11%). Whereas, least priority services factors are respectively strict returns policy (0.6%), lenient returns policy (1.3%), software support to handle returns (1.4%) and less gate-keeping rule for prompt returns (1.4%). Results of AHP analysis also show that the respondent's opinions are consistent to determine the critical returns service factors (inconsistency ratio=0.02<max allowable 0.1). Further detailed rank order of the returns service factors can be seen from Figure 2.

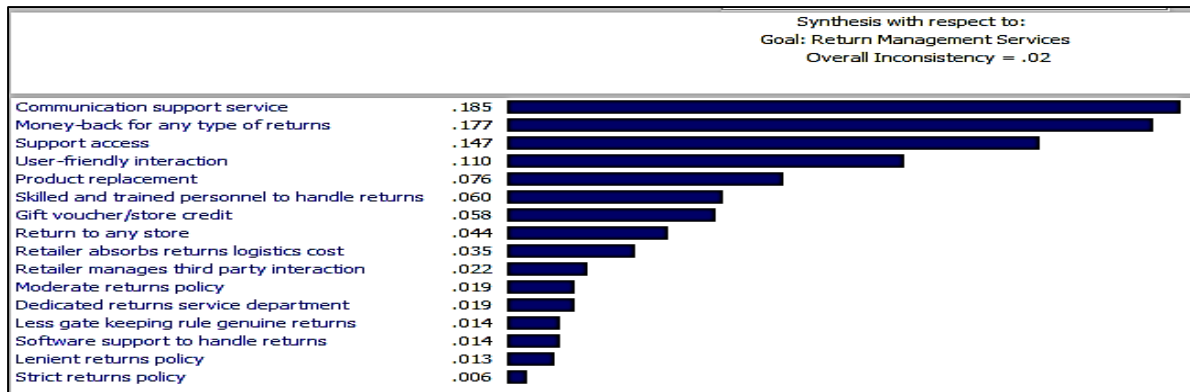


Figure 2: Overall priority weights of returns service factors/determinants

Sensitivity analysis

The sensitivity analysis is performed to investigate whether small variations in the model parameters would change the ranking of the enabling factors considered in this study. In AHP, the final rank of the sub-factors depends on the weights associated with the major service determinants. Therefore, minimal change of priority in major determinants could potentially change the ranking initially determined. We change the weight of 'interactive fairness' and observe subsequent changes of priority ranks of 16 sub-factors of service determinants. When priority of 'interactive fairness' is increased from 0.0381 to 0.0399, service factor 'communication support service' becomes the third most important factor instead of 'return to any store' (moves to rank 4). However, 'money back for any type of returns' and 'skilled and trained personnel to handle returns' remains same in the top two ranks. Likewise, with a slight decrease in original weight of 'interactive fairness' from 0.0381 to 0.0374, 'communication support service' moves down one position to rank 5, 'product replacement' moves up to rank 4. Further decrease of the weight to 0.037 will result in lowering the rank order or priority of 'communication support service' to rank 6.

Similarly, we change 'procedural fairness' weight from 0.0255 to 0.0265 and observe changes of priorities only between determinant 'retailers absorbs returns logistics cost' (new rank 5, previous rank 6) and 'product replacement' (new rank 6, previous rank 5). Likewise, with the decrease of original weight of 'procedural fairness' from 0.0255 to 0.0185, changes the priority position of 'returns to any store' (new rank 3, previous rank 4) and 'communication' (new rank 4, previous rank 3). Lastly, we investigate the impact of slight change of weights of 'outcome fairness' from 0.0365 to 0.0371, and found change of position of sub-factors 'product replacement' (new rank 4, previous rank 5) and communication (new rank 5, previous rank 3).

Discussion and Conclusions

We identify and prioritize critical determinants for product returns services in Australian retail industry. We interviewed senior executives of 11 top retail organisations who have major market share in their each retail category. Identification of the critical product returns service determinants is a multi-criteria decision making problem and we use AHP approach. Result shows that the most important returns service determinants are the interaction with customer and the manner in which outcome of product returns claims are handled. The sensitivity analysis shows that slight changes of interactive fairness and outcome fairness weights have impact on change of weights of other service factors. Among the 16 operational level returns service determinants, the top six critical management of product returns are (i) communication support service for customer, (ii) money-back for any type of return, (iii) customer support access, (iv) user-friendly

interaction, (v) product replacement, and (vi) skilled and trained personnel to handle returns. Out of the top six critical service determinants, three are interactive, two are outcome based, and only one is returns process oriented.

All retailer groups individually and jointly considers communication as an important factor of interactive fairness of service determinants. At the first stage of the returns process, retailers interact with customer where customers explain the causes of service failure and claim product replacement, repair or money back. Since the process is a service recovery operation; retailers should provide proper customer support and ensure positive experience. Positive customer experiences significantly increase repeat business, and generate new customer through word of mouth recommendation (Mollenkopf et al., 2011). Customers should be provided easy access and user-friendly service to find the returns service desk, telephone number, e-mail address of customer service or dedicated returns management department. Furthermore, real time communication support service is necessary to provide acknowledgement of returns claim, decision outcome and claim tracking. Through proper interaction with customer retail can come to understand the root cause of returns and then other related returns issues can be solved faster and efficiently. One retail manager expressed, "I think good interactive fairness is important, because I think a lot of the reasons why people return is that they don't understand how to use the product or set it up. They will quite often return something that may take 30 seconds to explain how to use. Therefore, we explain how to use it and then they keep the product".

Retailers are focusing more on service outcome compared to the process. One of the retail manager said, "the customer wants the outcome and they don't really interested to know how it happens" and that is why they focus more on outcome. Customers return products mainly because of change of mind and product quality issues (Autry 2005) and in both the cases they expect the outcome as money back. Individually, departmental retailers and sports stores provide more importance to money back for any type or returns, and the electronic store provide more preference to product replacement. Within the procedural fairness factors, prompt resolution is considered to be the most important factors, and 'skilled and trained personnel to handle returns' is the most important sub-factor. Companies those employ skilled personal or full time managers for returns processing perform the best job of processing returns (Stock et al., 2006; Guide and Wassenhove, 2001).

Overall, this study is a pioneering study identifying critical determinants of product returns management in retail firms. The findings of the study can act as a reference guide to senior executives of retailers developing strategies for competitive advantage through customer focused product returns management viz. customer retention and asset management. Although the use of 11 large firms is adequate given the methodology employed, it is recommended to conduct empirical study using a large sample data set in the future.

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VALUING INTEGRITY IN CREDECE QUALITY FOOD SUPPLY CHAIN

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ABSTRACT

The 2013 'Horsemeat Scandal' and rapid progression of equivalent incidents have exposed the real potential for dishonesty in food products. In this context, the food integrity paradigm has increased significantly and become more important to food industries. However, very little is known about 'food integrity' in the existing literature. Thus, this paper aims to abridge the integrity risk and variables into a framework capturing the 'Farm to Fork' (f2f) concept. The framework was developed through the Q-sort analysis introduced by Stephenson (1965), which is largely used by psychologists, and in-depth interviews with the representatives of halal food supply chains in Malaysia. The f2f concept was adhered to in capturing the absolute guarantee of food integrity within the supply chain. In this paper, we developed a measurement scale for a framework called 'food supply chain integrity' in the attempt to safeguard the integrity of credence quality food.

Keywords: food integrity, food supply chain, Q-sort, halal

INTRODUCTION

Food integrity is relatively a new concept and very little literatures are known has addressed this particular issue. The concept can be interpreted and discussed in many perspectives. Thus, the important elements of the concept may differ predominantly in different views. Especially for complex supply chain issues as an example, perspectives from other fields of study are sought to explain the phenomenon (Chen et al. 2009). As well as the disadvantages arising from the scarcity of knowledge or literature, such a combination may also clutter the actual definitions of the items. Furthermore, the improvement can only be made to measureable concepts; it is therefore crucial that certain of these concepts are measured to indicate their status/level. In this light, the non-measureable concept remains vague in its definition and context. Therefore, we are inspired to value the integrity of the halal supply chain. Food integrity is a relatively new concept, which can be looked at from many different angles, i.e. performance, quality, etc. Within this limits, we have framed the study in the supply chain context. This study is an extension of one conducted earlier (Ali, Tan, Makhbul, & Pawar, 2014), which discussed the halal integrity dimension framework. In this study, we value the dimensions suggested using the Q-sort method (Stephenson, 1965). We then highlight the items that define the halal supply chain integrity construct. Furthermore, we offer the factors that are important for consideration in the Q-sort processes.

We start this paper with a literature review that contextualizes the halal supply chain integrity and scale development. Secondly, we discuss the Q-sort processes in the methodology section and then follow this with the results and discussion. We end this paper with a conclusion and future research proposals.

CONTEXTUALIZING HALAL FOOD SUPPLY CHAIN INTEGRITY

Halal is a credence quality product, where the quality is impossible to ascertain even after consumption (Bonne & Verbeke, 2008). Characteristics of halal products are determined by the Quran, the divine book. In upholding halal characteristic, all stages in supply chain need to be solidified accordance to the requirements which is extracted as the following conditions (Amat, 2006):

- The food or the ingredients must not contain any parts or products of animals that are non-halal to Muslims by Islamic law; or products of animals which are not slaughtered in accordance with the Islamic law.
- The food must not contain any ingredients that are *Najis* (ritually unclean) as per Islamic law.
- The food must be safe and not harmful; and clean.
- The food must not be prepared, processed or manufactured using equipment that is contaminated with things that are *Najis* as per Islamic law.
- The food or its ingredients must not contain any human parts, or derivatives of human parts, that are not permitted by Islamic law.
- During preparation, processing, packaging, storage or transportation, the food must physically separated from any other foods that do not meet the definitions stated in the items above; or from any other things decreed as *Najis* by Islamic law.

Thus, as the product moves from one stage to another, similar halal specific requirements must be adhered to. However, the criticality of the issues is dependent upon the core process of each stage of the supply chain. With halal food products, it is almost impossible to detect any glitches, and the possibility of the actors to take the requirements for granted is high through cutting corners in order to fatten their profits (Roth et al., 2008). Take the example of the horsemeat scandal in 2013, which has an almost similar background concerning beliefs surrounding consumption of a 'sacred' animal (horse for the Irish); this created a chaotic impact upon the food industry. Likewise, the determinant of halal food for Muslims was also swayed. Seen from these two parameters, supply chain integrity is important to halal food production. However, there is lack of evidence in literature for measuring the supply chain integrity of identical food products; thus in this paper, we have set the context of the supply chain within the perspective of the focal company (brand owner). There are compelling reasons for why the focal company is selected: firstly, the focal company has total control of its supply chain; secondly, it covers every stage of the supply chain; thirdly, it is the biggest stakeholder of the product; and finally, it is the consumers' reference point for the product. In this essence and for the purpose of this study, we have adapted the f2f concept by Tunçer (2001), starting from the suppliers to the consumers, from the perspective of the focal companies.

HALAL SUPPLY CHAIN INTEGRITY MEASUREMENT SCALE DEVELOPMENT

Developed scales and scale testing are not often well detailed in existing studies (Hensley, 1999). Halal food supply chain integrity constructs suffer from inconsistency, lack of clarification (the discussions were either too vague or too technical), and the scales do not accurately measure the constructs. These weaknesses are mainly due to the novelty of the halal food integrity concept, complexity of the supply chain, and different business and social contexts depending on the nature of food production. Furthermore, operation management concepts are often multidimensional, thus daunting the translation of practice into theory and vice versa (Forza, 2002). The Q-sort technique was developed by William Stephenson and is rooted in Q-methodology (ten Klooster et al., 2008). The technique comprises of iterative processes which assess the validity and reliability of the constructs. Halal food supply chain integrity requires careful interpretation as the issues are subjective in any situation (i.e. at each stage of the supply chain). In the light of construct subjectivity, it is appropriate to use the Q-sort technique (Cross, 2005; McKeown, 1984), as it combines the strength of qualitative and quantitative research for complex issues (Brown, 1996; Valenta & Wigger, 1997). In

operation management research, the Q-sort technique as published in the Journal of Operation Management was employed by many researchers, such as Menor & Roth (2007), Wong & Boon-itt (2011), Kristal et al. (2010), Li et al. (2005) and Cao & Zhang (2011). Therefore, the Q-sort technique is appropriate for the present research due to the following: (i) the newness of the concept (Tractinsky, 1995); (ii) subjectivity of issues in different natures of production (Cross, 2005; McKeown, 1984); (iii) it upholds the richness of the subjectivity of respondents (McKeown, 1984); (iv) it is used as a method to assess initial levels of construct reliability and content validity (Moore & Benbasat, 1991); and (v) for pre-testing the scales for content, discriminants and convergent validity enhancement (Li et al., 2005; Swafford, Ghosh, & Murthy, 2006). Therefore, this research employs the Q-sort technique in three stages: item creation, scale development and scale testing.

METHODOLOGY

In this section, we highlight the steps deployed in approaching the Q-sort analysis for halal food supply chain integrity.

Item generation

The aim of item generations is to build valid constructs which are able to explain the specific domain of interest (Churchill, 1979; Hensley, 1999). This research generates the items through extensive literature review and a series of previously conducted case studies of four halal food supply chains (i.e. fast-food, casual dining, *kopitiam* and processed meat products – refer to Ali et al., 2014). The extensive literature reviews (searching for existing scales) enable the present studies to substantiate the theoretical grounds of conceptual domains and demonstrate the content validity of the constructs (Rosenzweig & Roth, 2007). On the same note, the combination of both academic and practical perspectives provides good preliminary scales to keep item revision to a minimum (Forza, 2002; Hensley, 1999). In summary, the purpose of this stage is to ensure the content validity by having at least two statements that acceptably describe the constructs (Moore & Benbasat, 1991).

Interview structure and sorting procedures

In this step, academicians and practitioners evaluated the measurement items. A total of 20 participants – seven academicians and 13 practitioners (two general managers, three production managers, three sales managers, three senior halal executives and two halal enablers) – were involved in providing inputs. Participants were drawn from enterprises of varied status: Malaysian-owned, joint venture and according to the nature of production of the companies. The participants were put in a structured workshop and interviewed to check the relevance and clarity of the definition of each construct.

Then, six participants were selected to further sort the cards, which made three rounds pairwise (practitioners and academicians) of judges. The judges were informed in more detail about the research topic, objective, scope and model and given a sheet of the definitions of each construct. The judges were informed about the sorting procedure and allowed to ask questions in order to make sure they understood the procedures. The items were printed on A3 sized paper in shuffled conditions. The constructs (supplier, production/manufacturing, restaurants/retailer and consumer/customer stages) were predetermined on the paper; the judges were asked to place the items with the most appropriate construct and they were allowed to write new item pools. For the items that were not applicable, the judges are permitted to note 'not applicable' beside those items.

Q-sort analysis techniques and inter-rater reliabilities

The Q-sort techniques were analyzed by two indices used for measuring the level of inter-judge agreement: Cohen's Kappa and 'Hit Ratio'. The Kappa coefficient is intended to generalize the findings of a reliability study in a population of raters; the coefficient is frequently assessed for statistical significance through a hypothesis test (Sim & Wright,

2005). The Cohen's Kappa results were interpreted using the guidelines proposed by Landis & Koch (1977). Similarly, Li et al. (2005) argued that a Kappa score greater than 0.65 is acceptable. Meanwhile, the 'Hit Ratio' was calculated by counting all the items that were correctly sorted into the target category by each of the judges and dividing them by twice the number of the total items. The aim is to obtain results from the level of agreement between the judges derived from each of the indices; (i) Cohen's Kappa value is to assess the reliability and (ii) Hit Ratio is for the validity of the items (Moore & Benbasat, 1991).

RESULTS

In this section, we present the results obtained from the Q-sort analysis and discuss the result for each round conducted. Each round involves different respondents altogether, in order to reduce the bias of the learning circle and increase reliability and validity. The following table summarizes the results of the first, second and third rounds of sorting.

Inter-Judge Agreement			
Agreement Measures	Round 1	Round 2	Round 3
Raw Agreement	0.60	0.82	0.95
Cohen's Kappa	0.66	0.82	0.95
Hit Ratio	0.58	0.82	0.91
Placement Summary			
Raw Materials Integrity	0.56	0.80	1.00
Production Integrity	0.64	0.72	1.00
Service Integrity	0.59	0.85	0.93
Information Integrity	0.82	1.00	1.00

Table 1: Summary of Q-sort result

The results of Q-sort round 1

In the first round, there was a total of 30 items for the Q-sort input. The 30 items were placed and completed by two judges. The inter-judge raw score agreement was 60%, Cohen's Kappa was 66% and the placement ratio was 58%. The Cohen's Kappa value was fair due to some items being located in the off-diagonal cells and in the N/A category, which indicates that the item requires rewording or removal from the list. For construct 1, raw materials integrity, two items were located in the diagonal cell and two items located in N/A. The items were discussed with the judges and two items were combined and reworded, and one item removed. One item was introduced by the judges and set for the next round of sorting. For construct 2, production integrity, three items were located in the diagonal cell. The items were discussed with the judges and both items were reworded. Meanwhile, for construct 3 (service integrity), three items were located in the diagonal cell and one item located in N/A. The judges suggested removing the items in the N/A cell and rewording the three other items. Judge 2 suggested it was important to include one item for the next round of sorting. Finally, for round one, construct 4 (information integrity), one item was removed and one more item required rewording.

The results of Q-sort round 2

For the second round of sorting, a total of 28 items were administered to the judges. The result of the second round was: inter-judge score, 82%; Cohen's Kappa, 82%; and the placement ratio, 82%. All indicators were improved; however, the round quality was not efficient, as some items were still placed in diagonal groups. For construct 1, raw materials integrity, one item required rewording while one was removed. For construct 2 (production integrity), one item was located in the diagonal cell, and was suggested to be reworded by the judges. Meanwhile, for construct 3, service integrity, two items were not agreed upon and one was regarded as N/A. The two items seemed to carry same

discussion and the judges suggested that they be combined. For construct 4 (information integrity), all items were agreed upon as per theoretical categories. In summary, up to the second round of sorting, four items were removed, two new items were added and two sets of two items were combined. This leads to a total of 26 items for input in the third Q-sort round. Based on the Hit Ratio of Moore and Benbasat (1991) of the second round, the raw materials integrity, production integrity, and service integrity constructs require another round of Q-sorting to increase validity and reliability.

The results of Q-sort round 3

The scores from the third round indicate that each construct item does not correlate contextually with one another. The sorting scores of a total of 26 items were: inter-judge score, 95%; Cohen's Kappa, 95%; and the placement ratio was 91%. All indicators have been much improved, indicating reliability and validity of the constructs. Constructs 1, 2, and 4 had a placement score of 100%, indicating high validity and reliability. Construct 3 had a placement score of 93%, also indicating an excellent result as well. Finally, a total of 26 items remained for questionnaire input.

DISCUSSION

From the sorting procedure activities, we found that valuing the halal food supply chain is a daunting process. Through iterative sorting processes in order to obtain the intended agreements between the judges, we provide suggestions that are worth taking into consideration in valuing integrity when evaluating the qualitative data. We then offer concise halal supply chain integrity dimensional elements in measuring each construct.

Valuing the multidimensional matters

As Q-sort methodology is intended for: (i) reducing the weaknesses of the qualitative and quantitative data; (ii) transforming the qualitative data into measureable items; and (iii) creating a means of quantification, we found that the item generation and regeneration stages are the most crucial in the process. The quality of the earliest item generation stage has a significant impact towards the subsequent regeneration activities, made after the inputs obtained from the judges. Thus, we suggest that during the item generation stages, a researcher should predetermine the research context to ensure the consistency of the discussion of the items. The context is important due to the supply chain complexity; where a firm can be either a supplier or customer depending on the settings. Secondly, the researcher should be selective within the limitations of the study; terms like 'supply chain', 'integrity', 'food safety', etc. can easily be misinterpreted in different contingencies. Thus, we found that items' descriptive meanings are a handy tool for the researcher during sorting processes to maintain control of the paradigm required.

Halal supply chain integrity items

We adopted the f2f concept to gain an absolute meaning of halal food supply chain integrity. From the concept, we predetermined the categories of halal supply chain integrity as: raw materials integrity, production integrity, service integrity and information integrity. However, we find it is difficult to explain the categories due to the novelty of the integrity notion and when defining it to the practitioners. Thus, we renamed the categories as per the main activities in the focal company as procurement, production and sales.

From the sorting process, we discover that the pattern when valuing raw materials integrity is highly associated with the supplier's context. As argued by Tse & Tan (2011), regarding quality, halal integrity is highly dependent on the supplier's integrity. In this context, raw materials integrity was valued from the supplier's credibility, hygiene, information sharing, quality and source of supply. Valuing integrity outside the factory wall is a rebuttal when there are many possibilities that can be associated with halal

integrity. However, the supply chain integrity offers additional measures to the conventional way of valuation, which is represented by the halal certification.

On the other hand, we found that there is a thin line separating production and service in the food industries. Thus, it has been difficult to adopt a stance between these two stages. We epitomized the production integrity by the operations that involve food manufacturing, automation and have no direct contact with the end consumers. The production integrity was then valued by the judges as the organizational efforts and capabilities (in managing production flexibility, standardization, critical point, cost, tracking and testability), which are highly associated with halal integrity during the production stage. Meanwhile, we typified the service by operations that have direct contact with consumers, in which delivery and quality are closely related to labour time expended (Jones, 1990). Seen in this context, halal service integrity is highly related to the human interface (i.e. competency, training, handling, distribution and staffing regulations). The judges also highlighted that the production and service components can be combined for the smaller sized company sample (e.g. Small and Medium Enterprises). Moreover, the combinations can also apply to the halal food companies that are driven by make to order, have a non-standardized menu and are non-chain types of restaurant.

Finally, information integrity is valued from the facts shared by the company with the consumers. There are many ways of information sharing as discussed during the sorting processes and it is not feasible to list each as the items of the component. Thus, there are two ways of sharing as highlighted by the judges: top-down (producer to consumers) and bottom-up (consumers to producer). Top-down sharing is executed from labelling and logo displays, while bottom-up is the feedback and the involvement of the consumer representatives in ensuring that information is fairly shared in accordance to the consumer's right. Figure 1 below shows the summary of items that are important in valuing the halal supply chain integrity.

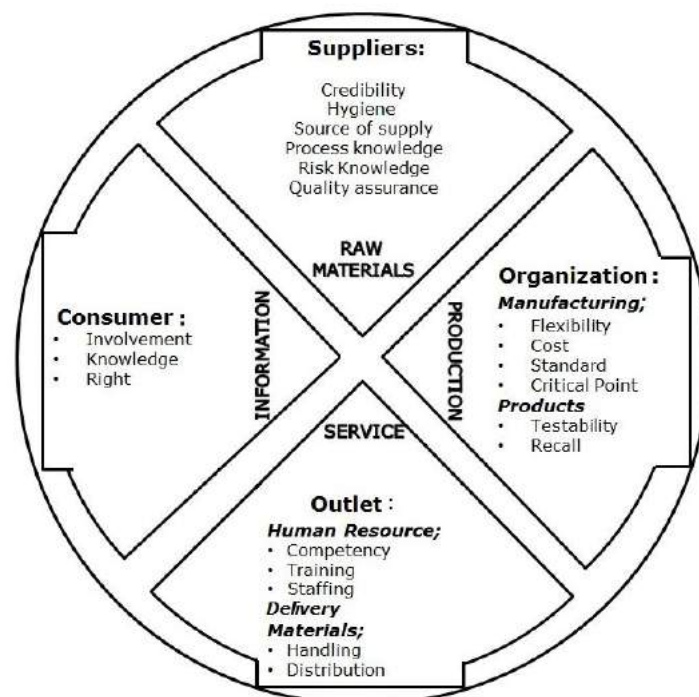


Figure 1: Halal supply chain integrity items

CONCLUSION

Phenomena like food integrity and food supply chain are multidimensional in nature. Interpretation and evaluation of these types of context can be different in many ways. Combining both phenomena under a paradigm can be confusing and exhausting. Thus, we offer the halal supply chain integrity items as our contribution to knowledge. Furthermore, halal food – as a credence quality product – embraces more stringent requirements in the supply chain, which can shed light on other food supply chains. The applicability can be used in, for example, vegetarian and kosher food chains. Similarly, it is important to highlight for governments, authorities and business organizations the additional benchmarks in safeguarding food integrity. Our purpose is to propose a new integrity framework which is little known in the relevant literature. Thus, it is yet to be tested within the larger scale industries. We therefore recommend that future research on the modelling of the framework concentrates on quantifying the importance of the variables in the framework.

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ONLINE RETAIL STORE'S PRODUCT DELIVERY METHOD THAT TAKES ACCOUNT OF AN INCREASE IN SALES

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ABSTRACT

Online supermarkets, which receive orders via the Internet and deliver ordered foodstuff and daily necessities, have been growing steadily [1]. To ensure profitability in this business, they need to study both marketing strategies to increase sales and logistic strategies to improve delivery efficiency. Logistic strategies address operations at shipping sites and product delivery methods.

This paper focuses on the method of product delivery, and proposes a "site handover method," in which products are handed over to customers at specified handover sites. This method can cope effectively with an increase in the number of online customers. The paper compares this method with the existing "house-to-house delivery method" in terms of the travel distance and travel time of delivery trucks, and shows that the proposed method becomes more effective as the number of customers increases. It also presents issues that need to be addressed in actually introducing the proposed delivery method.

1. INTRODUCTION

1.1 Background

Backed by the recent high penetration of smartphones, online supermarkets are endeavoring to expand sales by targeting not only double-income families and elderly people but also general consumers. In parallel with this, they are working to increase the numbers of stores involved and of types of products sold, and also strengthening their capabilities to handle orders and to deliver products. However, an increase in the number of customers means a greater number of houses to which products need to be delivered. Therefore, to ensure profitability, it is important to increase efficiency in product delivery.

1.2 Objectives

This paper focuses on how to improve online supermarkets' product delivery to cope with an increase in the number of customers (i.e., the number of houses to which products need to be delivered). Specifically, it proposes a "site handover method," in which products are handed over to customers at specified product handover sites. Using a simple service model, the paper evaluates basic characteristics relating to delivery costs, such as the travel distance and travel time of delivery trucks. It shows that the proposed method is more effective than the existing house-to-house delivery method, and presents issues to be addressed in actually introducing the method.

1.3 Major examples of existing studies on product delivery

Many studies on the delivery of products ordered online focus on how to hand over products that could not be delivered because the customer concerned was absent. Some contemplate the use of reception boxes, which are placed in customers' yards or garages [2][3], or the use of collection and delivery points (CDPs), which temporarily store products that have been brought back because there was no one in the customer's house [4]-[6]. In recent years, there has been a growth in the so-called "click and collect" service, in which products ordered online are delivered to certain predetermined sites and customers pick them up there at a time convenient for them [7][8]. One paper has studied how the efficiency in delivering goods to individual customers is affected by two factors: customer density and delivery window length [9].

2. ACTIVITIES OF ONLINE SUPERMARKETS TO EXPAND DEMAND

2.1 Overview of online supermarkets

A typical online supermarket freezes its reception of orders from customers at certain fixed times in a day, issues order slips, spends some time to pack and load products, and dispatches trucks also at certain specific times in a day (**Figure 1**). For example, Ito-Yokado (a supermarket in Japan) freezes its receipt

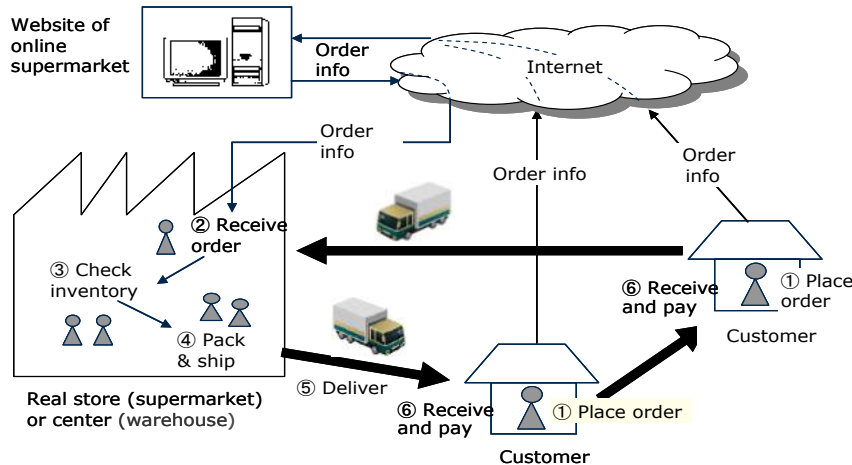


Figure 1: Typical operations of an online supermarket

of new orders at 9:00, 11:00, 13:00, 15:00 and 16:00. The period between the time when a new batch of orders is started and the time when it is closed is referred to as an "order reception period." The online supermarket prepares for shipment, and then starts delivery of products 3 hours after the close of each order reception period, i.e., at 12:00, 14:00, 16:00, 18:00 and 19:00. The delivery window, that is the period during which the items will be delivered, is 2 hours. The period between the time when delivery of products for a certain order reception period is started and the time when it is ended is referred to as a "delivery period." SUMMIT Netsuper, another supermarket, uses a more flexible delivery schedule (**Table 1**).

<i>Ito-Yokado</i>		<i>SUMMIT</i>		
<i>Delivery period No.</i>	<i>Order reception closed at</i>	<i>Delivery period</i>	<i>Delivery period name</i>	<i>Delivery period</i>
1	9:00	12:00 - 14:00	Morning	8:00 - 12:00
2	11:00	14:00 - 16:00	1	10:00 - 14:00
3	13:00	16:00 - 18:00	2	12:00 - 16:00
4	15:00	18:00 - 20:00	3	16:00 - 18:00
5	16:00	19:00 - 21:00	Night	20:00 - 22:00
-	-	-	Budget	9:00 - 17:00

Table 1: Examples of delivery services

Online supermarkets in Japan distinguish themselves from the more widespread online shopping in the following aspects:

- Online supermarkets serve customers in areas near real stores (typically up to 5 km from a real store) while online shopping usually covers the whole country.
- Online supermarkets handle 1,000 to 30,000 types of products, which are mainly perishable foodstuff or daily necessities, such as clothing.
- They deliver products on the day when an order is placed (2 hours after order placement in the quickest case) or the next day, while online shopping services often deliver goods several days after order placement. Online supermarkets have 3 to 5 delivery periods per day. The delivery charge is 100 to 500 yen per household, but delivery is usually free with a purchase of 5,000 yen or more.

– The main targets are two-income families (in their 20s to 40s) and elderly people, both of whom are often dubbed “restricted shoppers” in Japan.

2.2 Activities to increase demand

The recent online supermarkets’ marketing strategy to arouse and boost demand is to target general consumers. Their activities include renewing their websites, introducing new websites designed for smartphones, and inviting customers in real stores to visit their websites. In parallel, they are increasing the number of real stores involved and the variety of products sold, expanding distribution networks, shifting shipping sites from real stores to warehouses, and performing handling operations during late night hours.

3. OVERVIEW OF HANDING PRODUCTS OVER TO CUSTOMERS AT HANDOVER SITES

When the number of customers in a service area increases, the number of customer houses to be visited in each delivery period also increases. To keep the number of delivery periods per day unchanged and ensure that delivery is completed within the defined delivery window, it will be necessary to increase the numbers of trucks and drivers.

An effective way of coping with this problem can be setting up product handover sites near customers’ locations. This delivery method is referred to as the “site handover method” (Figure 2). The specific procedure for product delivery in this

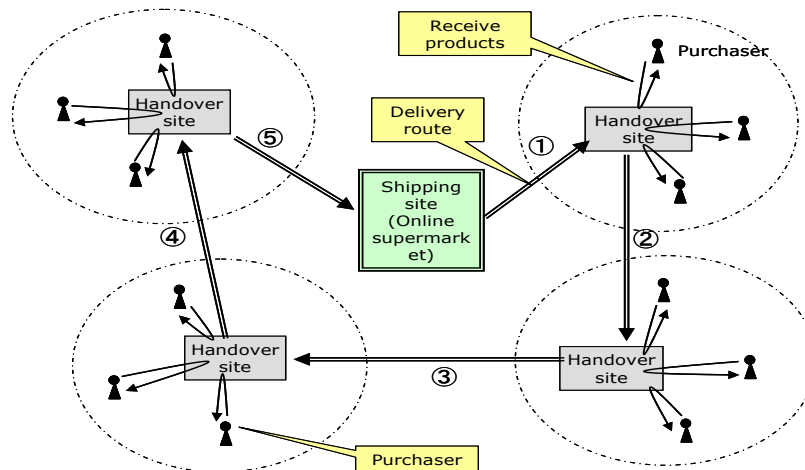


Figure 2: Illustration of the site handover method

method is as follows:

(1) The online supermarket sets up product handover sites near customers’ locations.

– A handover site is accessed by a number of customers residing near the site.
 – At a handover site, there are containers, such as those similar to baggage lockers found at train stations. Each is dedicated to an individual customer.

(2) Customers collect products at handover sites. Therefore, the online supermarket and the customers can act independently of each other.

– The online supermarket only delivers products to handover sites.
 – It notifies each purchaser of the relevant handover site by email or phone in advance.

– Containers at handover sites are designed in such a way that only the correct customer can collect the relevant products.

– Customers who have been notified of the arrival of their products at a handover site can collect the products at a time convenient for them.

Seven & i Holdings, the parent company of Ito-Yokado, announced its plan to make 3 million varieties of products sold by its group stores available for purchase at its online supermarket by fiscal 2018, and to enable customers to receive products not only at their homes but also at its group stores, such as its convenience stores [10]. Such stores can be considered handover sites as defined in this paper.

4. EXAMINATION OF THE BASIC CHARACTERISTICS OF THE PROPOSED METHOD

This section compares the proposed site handover method with the house-to-house delivery method in terms of travel distance and travel time of delivery trucks.

4.1 Evaluation model

The following model is used to reflect the conditions of a typical online supermarket in Japan.

(1) Service area (Figure 3)

The service area is a circular area with a radius of 3 km from the shipping site. The locations of handover sites are selected on the assumption that customers do not mind walking up to 1 km to receive their products. This model has 6 handover sites, each located 2 km away from the shipping site. Their locations are arranged in a circle with an angle of 60 degrees from the shipping site between two adjacent handover sites.

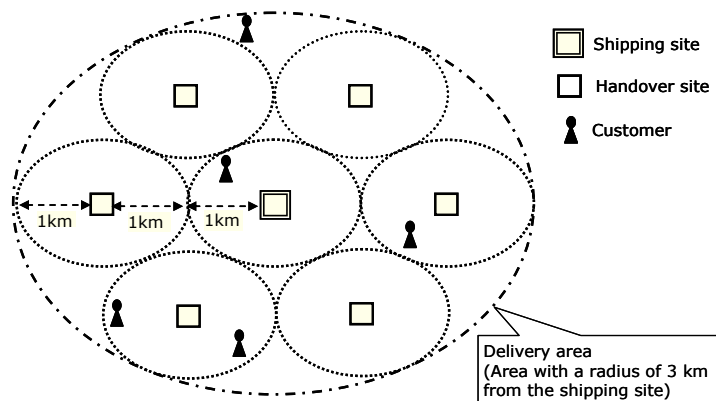


Figure 3: Service model of an online supermarket

(2) Distribution of customers

Customers are distributed with a uniform density within the service area. In other words, the number of customers per a unit area is uniform.

(3) Generation of orders from customers

It is assumed that the intervals at which orders arise follow an exponential distribution, which is often used for representing intervals for the generation of telephone calls. To be able to take account of an increase in the number of customers, three values for the average interval at which orders are received by the supermarket are considered: 5, 10 and 20 minutes.

For the calculation of the travel distance of delivery trucks, it is assumed that there is a sufficiently large number of customers per store. Uniformly random coordinate points are generated in a 6 km × 6 km square area. For each coordinate point (x, y), 0 < x < 6 and 0 < y < 6. All coordinate points that fall in the circular area of a radius of 3 km are considered to be customers' locations. However, any points that are outside the 7 circles, but within the 3 km circle are

also included in the examination. Customers at these points collect their products from their nearest handover site.

(4) Delivery route

–House-to-house delivery method: For the sake of simplicity, the delivery truck travels in a counterclockwise direction to visit each customer. In the example of **Figure 4**, the truck travels from the shipping site to a, b, c, d and e, in this sequence, and returns to the shipping site. The sequence of a, b, c, d and e is determined based on the positions in the counterclockwise direction, and thus is in no way related to the sequence in which purchase orders were received.

–Site handover method: The truck travels counterclockwise to visit handover sites. In the example shown in **Figure 5**, the truck travels from the shipping site to ①, ③ and ⑤, in this sequence, and returns to the shipping site. It does not go to ②, ④ or ⑥ because no one in the areas covered by these handover sites placed orders.

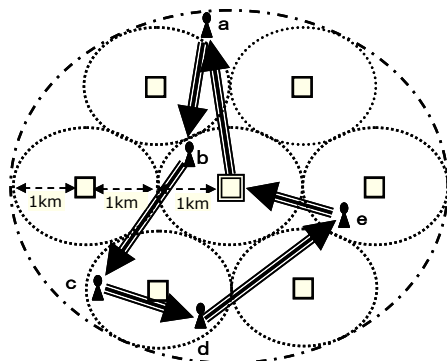


Figure 4: Travel of the truck in the house-to-house delivery method

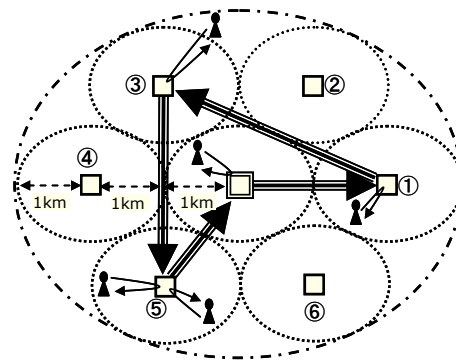


Figure 5: Travel of the truck in the site handover method

(5) Travel distance and travel time

The order reception period is 3 hours. Products ordered in each order reception period are then delivered. It is assumed that customers do not specify the delivery time.

Travel distance is the distance covered by the delivery truck as it starts from the shipping point, visits either customers or handover sites depending on the delivery method, and returns to the shipping point. The travel distance is calculated using the bee-line distance between any two points.

Travel time includes both the truck running time and work time spent at the delivery points. The truck is assumed to run at an average speed of 20 km/h. Work time is determined as follows, based on data of existing home delivery services. In the house-to-house delivery method, work time at each customer house is uniformly 0.2 hour (12 minutes). In the site handover method, work time at each handover site is 0.1 hour (fixed) plus 0.1 hour times the number of purchasers. The latter 0.1 hour is shorter than 0.2 hour of the former method because the site handover method does not require interaction with purchasers.

4.2 Evaluation results and discussions

Table 2 compares the two delivery methods in terms of the number of orders placed, travel distance and travel time for three different average order placement intervals: 20, 10 and 5 minutes. Since these values vary from one delivery period to another, the table shows both the average value and the average of absolute deviations. **Figure 6** shows the travel distance ratio (i.e., the travel distance in the house-to-house delivery method divided by the travel distance in the site handover method) for the different delivery periods. **Figures 7** and **8** shows the “relative travel time” in the house-to-house delivery method, and that in the site handover method, respectively, for different delivery periods.

Average order placement interval		a) 20 mins	b) 10 mins	c) 5 mins
Number of orders per delivery period		9.6 (± 2.0)	19.0 (± 3.5)	37.6 (± 4.7)
Travel distance per delivery period (km)	<i>House-to-house delivery</i>	16.79 (± 2.92)	25.37 (± 4.34)	38.76 (± 4.25)
	<i>Site handover</i>	12.20 (± 1.34)	13.67 (± 0.49)	13.91 (± 0.17)
Travel time per delivery period (hour)	<i>House-to-house delivery</i>	2.75 (± 0.47)	5.07 (± 0.90)	9.45 (± 1.12)
	<i>Site handover</i>	2.12 (± 0.31)	3.26 (± 0.38)	5.15 (± 0.48)

Note: The number in () is a value obtained by applying the Excel function AVEDEV (average of absolute deviations).

Table 2: Evaluation results of the basic characteristics

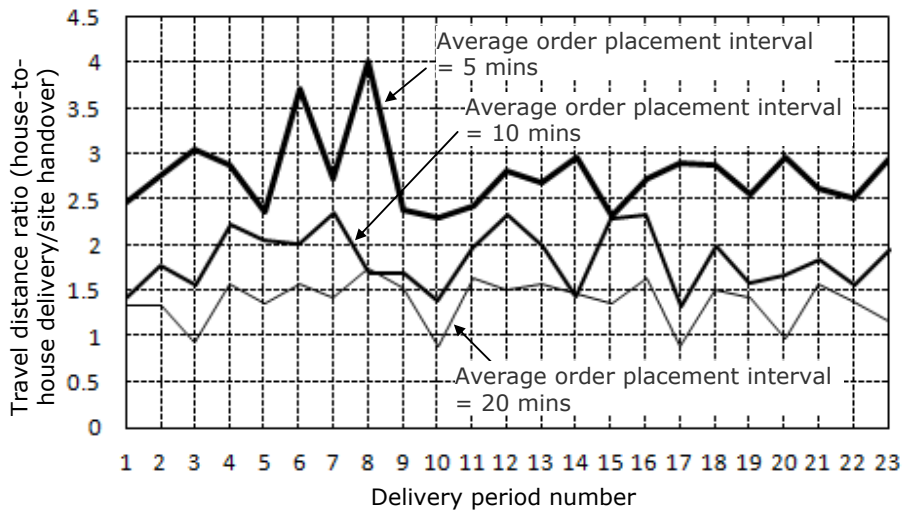


Figure 6: Comparison of travel distances for different delivery periods

The “relative travel time” is the ratio of the time taken for this delivery period simulation to the typical, acceptable time of 2 hours.

Microsoft Excel was used for the calculations in these evaluation simulations, with the function RAND being used to generate uniform random numbers.

Table 2 and **Figures 7** and **8** show that the site handover method requires a shorter travel distance and a shorter travel time than the house-to-house delivery method. **Table 2** indicates that the average differences between the two methods,

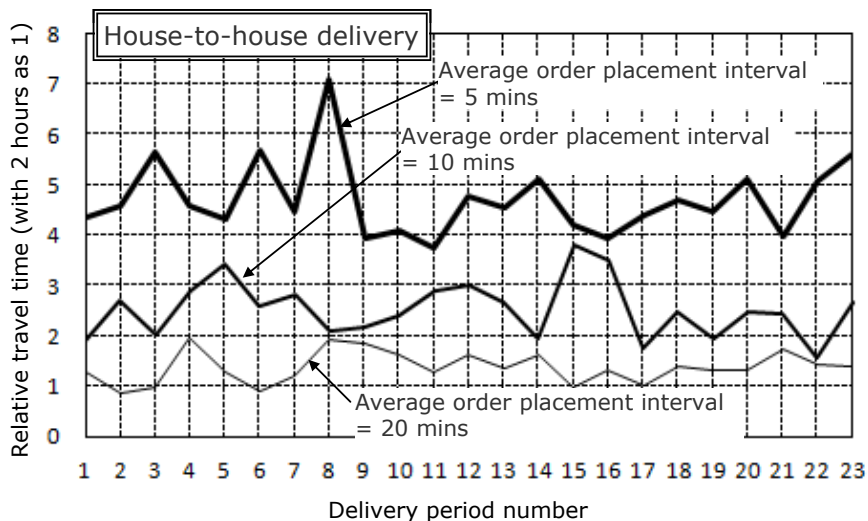


Figure 7: Relative travel time for different delivery periods

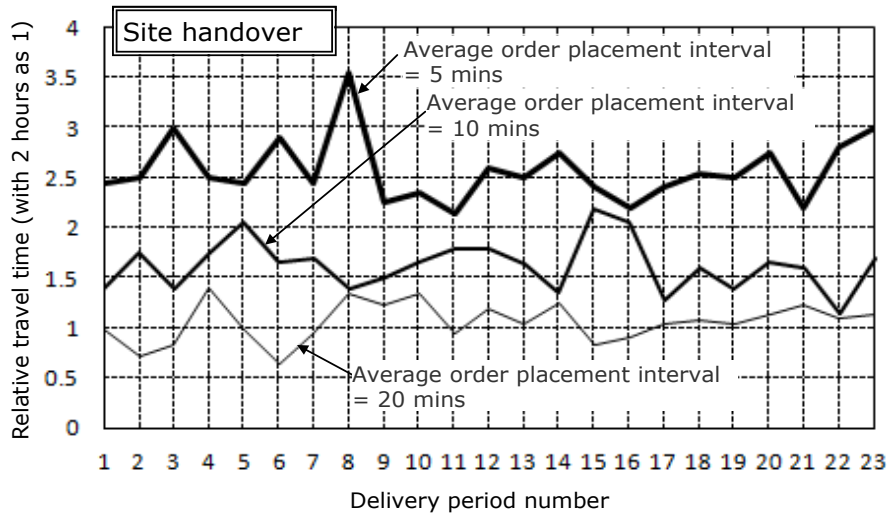


Figure 8: Relative travel time for different delivery periods

for both distance and time, widen as the order placement interval becomes shorter (i.e., as the number of customers increases). Online supermarkets normally have a fixed schedule for delivery periods and set a fixed delivery window length. If there is a wide variation in travel time or if travel time increases, they need to increase the numbers of trucks and drivers. For example, let's assume that products are to be delivered within a 2-hour delivery window, as is the case with Ito-Yokado, as shown in Table 1. In the house-to-house delivery method, more than one truck will be required if the average order placement interval is shorter than 20 minutes (**Figure 7**). In the site handover method, one truck will be sufficient even when the average order placement interval comes down to 10 minutes (**Figure 8**).

The above results indicate that the site handover method is advantageous in reducing travel distance and consequently fuel costs, and in suppressing the number of trucks and drivers required in each delivery period. This advantage becomes more pronounced as the number of customers increases.

5. ISSUES THAT NEED TO BE ADDRESSED IN ACTUALLY INTRODUCING THE PROPOSED DELIVERY METHOD

The above evaluation has assumed a basic model in which the customer density is uniform throughout the service area. Before actually introducing the proposed delivery method, it is necessary to compare the two methods in a model in which customers are distributed in a more realistic manner.

It is also necessary to study where to locate handover sites. Existing facilities that are located near customers, such as convenience stores, post offices, gas stations or parking lots, can be handover site candidates. To be successful in this arrangement, it is necessary to explore how a win-win relationship can be built with the operators of these facilities. Handover sites should be near customers from the customers' standpoint, but should not be far from a shipping site if the travel distance is to be reduced. Therefore, it is necessary to take both the customer distribution and the travel distance into consideration in selecting handover sites from existing facilities. The method of handing over products to customers at handover sites should be such that it will minimize personnel costs and still be safe and secure. Specifically, it is necessary to study how to notify each customer of the time when his/her products have been delivered to a handover site, how to confirm what time each customer collected his/her products, and what to do with products that are not collected. It is also necessary to consider the development of inexpensive, temperature-controllable storage devices in order to store perishable foodstuff.

Even when online supermarkets are widely accepted, it would still be necessary to use a mix of the site handover method and the house-to-house delivery method because two-income families and elderly people, who are likely to prefer the latter method, would represent a large portion of the customers. Furthermore, it would be necessary to study the relationship between the existing online shopping services in which ordered products are handed over at convenience stores and the proposed site handover method for the online supermarket service.

6. CONCLUSIONS

The profitability of online supermarkets is greatly affected by the way in which they deliver the products purchased online. This paper has compared two product delivery methods, particularly with regard to their ability to cope with an increase in the number of customers. It has been shown that the method of establishing handover sites and handing products to customers at these sites (site handover method) is more advantageous in terms of delivery costs than the method of delivering products to individual houses (house-to-house delivery method). Issues that need to be studied further include evaluation of the two methods assuming a more realistic customer distribution, the number of handover sites that is optimal when both the operational costs and operability are taken into consideration, determination of cases where one method is more advantageous and cases where the other method is more advantageous, and precise comparisons with similar existing delivery methods.

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SCHEDULING THE OPTIMAL LPG DISTRIBUTION USING PERIODIC VEHICLE ROUTING PROBLEM: A CASE STUDY IN INDONESIAN LPG DISTRIBUTION

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ABSTRACT

One of the biggest problems faced in distributing products is determining the scheduling of product delivery and delivery routing. Suboptimal delivery schedule and delivery routing of the products will impact seriously to distribution costs. Periodic Vehicle Routing Problem (PVRP) is one of the methods can be used to solve the distribution schedule and routing delivery. This paper studies the application of PVRP method with cluster first second round (CFSR) approach in distribution of Liquefied Petroleum gas (LPG) in Indonesia. The results show that the region of distribution should be clustered into two clusters. Three delivery frequencies of 1 and 2 clusters, gives an optimal solution. The results of delivery routing which are obtained from Lingo software using Ant Colony algorithm indicate that there is a decrease of distances, about 347.19 km from the previous distribution system and it reduces about 25% of the current distribution costs per week.

Keywords: LPG distribution, Cluster, Frequency of delivery, Routing.

INTRODUCTION

LPG is the only energy source used by households, commercials and industry. The conversion program converted the use of kerosene to LPG leads to increase the demand of LPG. The dramatic increases of LPG demand and LPG surplus in upstream level of LPG supply chain is not followed by managing the proper distribution system. Therefore, shortages and even scarcities occur many times in the downstream level (retailers and end-customer). This paper focuses on the distribution of LPG in downstream level (agents) in a residence of Eastern Java which distributes 3 kg LPG to retailers. Recently, LPG is distributed to retailers across the residence uses 10 vehicles which are placed based on the geographical location. For example, five of them are located in the northern and western of the residence, two vehicles are placed in the city and the rest are in the south. In order to meet the customer demand, LPG agents distribute LPG based on a periodical demand. Customer demands are satisfied by scheduling and visits routing every day along the period from Monday to Friday. Retailers are not visited each day with certain visits along the periods. Thus, that current situation causes some problems as suboptimal of the distance traveled among the retailers and unscheduled deliveries from agent to retailers which results delivery delays of LPG to retailers.

Based on the current situation, the problems faced by the agent can be categorized as Periodic Vehicle Routing Problem (PVRP) which the objective is to reduce distribution costs.

One of the methods can be used to solve PVRP problems is Cluster First Route Second (CFRS). There are two stages to solve the PVRP problems using CFRS, the first stage is clustering assignments the day of visits from agent to retailers and the results of the first stage becomes input of the second stage which use algorithm of Ant Colony System (ACS) to determine the route of visits to each retailer. The aim of the proposed methods and techniques used in this paper is that the customer demand could be met by optimizing the capacity of vehicles and also find the optimal delivery routes from agent to retailers.

METHOD

This research paper focuses on PVRP application on the distribution of LPG from agent to retailers using CFRS and ACS in an Eastren Java province. Required data in this paper are retailers' locations, the number and capacity of vehicles, quantity of deliveries, distance between agents and retailers, existing routes of LPG distribution and distribution costs. Data collected is a secondary data which is released by the company.

There are two approaches in solving Periodic Vehicle Routing Problem (PVRP), exact and heuristics. This paper uses exact approach to solve the routing problem in LPG distribution system. In the stage of visits to retailers from agents is done by modifying formulation mathematical PVRP model which has been developed by Rudiansyah and Tsao (2004). This paper considers visits frequency as a constant (not as variable decisions), omit inventory costs in the objective function and ignore constraint of tour duration and time windows so that the results of modified models of IPVRPTW results formulations as below:

The objective function of PVRP is to minimize total costs of transportation for m periods (days) and is stated as mathematical functions:

$$\text{Minimize } TC \sum_{i \in I} \sum_{t \in T} \sum_{k \in K} c_i q_i x_{itk} \quad (1)$$

Constraints

$$\sum_{t \in T} y_{it} = f_i, i \in I \quad (2)$$

$$\sum_{r=t+1}^{r=\frac{m}{f_i}+t} y_{ir} = 1, t = 0, \dots, \left(m - \frac{m}{f_i}\right), i \in I \quad (3)$$

$$\sum_{i \in I} q_i X_{itk} \leq C_k, t \in T, k \in K \quad (4)$$

$$\sum_{k \in K} X_{itk} - y_{it} = 0, t \in T, i \in I \quad (5)$$

$$y_{it}, X_{itk} \in 0,1 \quad (6)$$

Constraint (2) guarantees that each retailers is satisfied or visited as many as the frequencies of assigned visits. Constraint (3) is made to make sure that each retailers is only visited based on the days of assigned visits and the frequencies of visits. Constraint (4) is to

guarantee that the feasible schedule of visits not exceed the vehicle capacity. Constraint (5) describes that each retailer is visited by vehicle at the same day as the frequency of visits and the combination of visits which has been determined. Equation (6) is to constraint that the decision variable has binary value.

The next stage after determining the assignment schedule to retailers is finding the visit routing from agent to retailers. In this paper, ant colony system (ACS) technique is used to determine the route to each retailer based on the determined days of visits from agent. There are three main characteristics or rules in ACS technique, which are transition state role, local pheromone renew state role and global pheromone renew role (Mindaputra, 2009). Transition status in ACS is to determine initial pheromone for each ant, but we need to define the number of ants in this process and then determining the starting point for the ants [Dorigo dan Gambardella, 1996]. In this state, an ant placed on the point of t will choose its travel to point v , then given decimal random numbers q where $0 \leq q \leq 1$, q_0 is a parameter named a probability oof ant to explore in each state, which is $0 \leq q_0 \leq 1$ and $p_k(t, v)$ is a probability of ant k to choose moving from point t to point u . if $q \leq q_0$ then determine the proposed point by applying rule on the equation (8), while if $q \geq q_0$ will use equation (9).

$$temporary(t, u) = [\tau(t, u_i)] \cdot [\eta(t, u_i)]^\beta \quad i = 1, 2, 3, \dots, n \dots \dots \dots (7)$$

$$v = \max \{ [\tau(t, u_i)] \cdot [\eta(t, u_i)]^\beta \} \dots \dots \dots (8)$$

where v = proposed point

$$v = p_i(t, v) = \frac{[\tau(t, u_i)] \cdot [\eta(t, u_i)]^\beta}{\sum_{i=1}^n [\tau(t, u_i)] \cdot [\eta(t, u_i)]^\beta} \dots \dots \dots (9)$$

with

$$\eta(t, u_i) = \frac{1}{jarak(t, u_i)} \dots \dots \dots (10)$$

Where $\tau(t, u)$ is the value of pheromone at the point of (t, u) , $\eta(t, u)$ is the function of heuristics which is chosen as inverse of distance between point t and u , β represents a parameter that considers a relative value of heuristic information, where its weighted value is determined so that the solution is obtained based on the value of mathematical function. The value for parameter β is ≥ 0.2 . The rule to renew the local pheromone is done by change each pheromone which was found at the proposed point use the formula:

$$\tau(t, v) \leftarrow (1 - \rho) \cdot \tau(t, v) + \rho \cdot \Delta\tau(t, v) \dots \dots \dots (11)$$

$$\Delta\tau(t, v) = \frac{1}{L_{nn} \cdot c} \dots \dots \dots (12)$$

where :

L_{nn} = length of tour

c = location number

= value of 0 to 1

$\Delta\tau$ = changes of *pheromone*

After completing this process, we need to calculate the length of tour of each ant to find the minimal length of tour. The next rule of renewing global pheromone is to change pheromone at the previous minimal points in the tour. In this stage, the renewing of global pheromone is done by the ants which make a minimal tour. In the end, after all ants finish their tours, some of pheromone are put at paths' of ants. The role of renewing global pheromone is based on the following equations:

$$\tau(t, v) \leftarrow (1 - \alpha) \cdot \tau(t, v) + \alpha \Delta\tau(t, v) \dots\dots\dots(13)$$

$$\Delta\tau(t, v) = \int_0^{L_{gb}} \text{if } (t, v) \in \text{best tour} \dots\dots\dots(14)$$

where :

$\tau(t, v)$ = the value of final *pheromone* after local renewing.

L_{gb} = the length of the shortest route

α = parameter with the value of 0 to 1

$\Delta\tau$ = pheromone renewing

$\Delta\tau(t, v)$ has the value of $\frac{1}{L}$ if path (t, v) is a part of the best route but if $\Delta\tau(t, v) = 0$. α is a level of relative preference from pheromone or the value of weight given to pheromone, so that the solution tends to follow the previous route's ants, where the value of parameters α is ≥ 0 , and L_{gb} is the length of best tour globally. After all the processes are done, then the best route with the minimum distance is found.

FINDINGS AND DISCUSSION

In the stage of customer clustering which has the aim to classify demand customers into clusters, this paper decides to classify the clusters based on the number of vehicles, the distance of demand or customers and the existing distribution routes. The results show that the number of *clusters* is 2 clusters and by considering the distance between customer demand and real condition, then changing the member of clusters is done subjectively considering the closest of residences. By dividing clusters into two based on the route of each vehicle, it minimizes the total distance and transportation costs. The logic is that if overall customer demands are formed into one cluster, total distance and transportation costs increase because each vehicle had their destination based on their distribution routes. If they are formed into a cluster, the destination of distribution and delivery routes of vehicles would disperse and had implication to the length of delivery routes and could be out of the determined routes. In this paper, we use five vehicles to distribute LPG to demand customers.

Determining LPG Allocation and Frequency of Visits

In this stage, we determine q_i (delivery quantity), which is a value of allocation quantity sent to each customer demand. Along the periods, customers require f_i replenishments with delivery quantity $q_{i1}, q_{i2}, \dots, q_{ir}, \dots, q_{if_i}$. In this research, the length of periods used is 6 days in a week, so that the combination of frequency of visits (f_i) are 1, 2, 3, ... 6. The more customers are visited, the lower delivery quantity (q_i), and the lower customers visited, the more

delivery quantity. The determination of the feasible frequency of visits for each cluster based on the existing vehicle's capacity and the number of vehicles. In this paper, we use frequency of 2 and 3 for cluster 1. This is because of logic reasons that if we use frequency of 1, the delivery is over than the vehicle capacity while if use frequency of 6, all the existing number of vehicles will visit all customers in cluster 1 for six times in each period, so that increase transportation costs compared with the frequency of visits (f) = 2 and 3. The same thing occurs in cluster 2 in this paper as using frequency of visit 3. For frequency of visit 1, 2 and 6 are not used for the same reason with cluster 1. The quantity of delivery and the frequency of visits in cluster 1 and 2 can be shown in Table 1 and 2.

Tabel 1 the demand supply to cluster 1 (pcs)

Code	Average weekly demand	Delivery frequency		
		f1	f2	f3
PA1	150	150	75	50
PA2	50	50	25	17
PA3	88	88	44	30
PA4	93	93	47	31
PA5	123	123	62	41
PA6	35	35	18	12
PA7	90	90	45	30
PA8	50	50	25	17
PA9	60	60	30	20
PA10	40	40	20	14
PA11	130	130	65	44
PA12	74	74	37	25
PA13	1083	1083	542	361
PA14	76	76	38	26
PA15	799	799	400	267
PA40	69	69	35	23
PA41	228	228	114	76
Total	3238	3238	1619	1084

From table 1 in cluster 1 with frequency of visit of 2 shows that customer PA1 are visited for two times in a period. It means that delivered quantity to customer PA1 is $\frac{1}{2}$ (75) of total demand of 150 LPG cylinders per week in each delivery.

Table 2 The number of delivery to customers of cluster 2 (times)

Code	Average demand per week	The frequency of delivery		
		f1	f2	f3
PA16	50	50	25	17
PA17	1420	1420	710	473
PA18	258	258	129	86
PA19	425	425	213	142
PA20	427	427	214	142
PA21	63	63	32	21

PA22	1353	1353	677	451
PA23	837	837	419	279
PA24	57	57	29	19
PA25	986	986	493	329
PA26	261	261	131	87
PA27	36	36	18	12
PA28	40	40	20	13
PA29	786	786	393	262
PA30	883	883	442	294
PA31	120	120	60	40
PA32	168	168	84	56
PA33	33	33	17	11
PA34	816	816	408	272
PA35	153	153	77	51
PA36	30	30	15	10
PA37	1678	1678	839	559
PA38	426	426	213	142
PA39	385	385	193	128
	11691	11691	5846	3897

Table 2 indicates that with 3 times frequency of visits in a period had 1/3 *delivery quantity* of total demand, around 150 per week. It means that each delivery, the vehicle supply 50 LPG cylinders per delivery. In the cluster 2 with 3 frequency of visits, PA1 has been visited 3 times per week where each visit receives 17 LPG cylinders.

Visit Assignment

The outputs from LINGO software show the visit assignment for each cluster. It shows that the visit assignments of the vehicles in cluster 1 with $f_i = 2$, the vehicle 1 visits customer PA1, PA5 and PA15 for the first day, while the second vehicle visits PA1, PA5, PA15.

Tabel 3 visit combination *Cluster 1*.

Cluster 1 $f_i = 2$	Cluster 1 $f_i = 3$
Day 1, vehicle 1: PA1, PA5, PA15	Day 1, vehicle 1: PA5, PA6, PA10, PA15, PA41
Day 1, vehicle 2: PA1, PA5, PA15	Day 1, vehicle 2: PA13
Day 2, vehicle 1: PA13	Day 2, vehicle 1: -
Day 2, vehicle 2: PA13	Day 2, vehicle 2: PA1, PA2, PA3, PA4, PA7, PA8, PA9, PA11, PA12, PA14, PA40
Day 3, vehicle 1: PA2, PA3, PA4, PA6, PA7, PA8, PA9, PA10, PA11, PA12, PA14, PA40, PA41	Day 3, vehicle 1: PA13
Day 3, vehicle 2: PA2, PA3, PA4, PA6, PA7, PA8, PA9, PA10, PA11, PA12, PA14, PA40, PA41	Day 3, vehicle 2: PA5, PA6, PA10, PA15, PA41

Day 4, vehicle 1: PA1, PA5, PA15	Day 4, vehicle 1: -
Day 4, vehicle 2: PA1, PA5, PA15	Day 4, vehicle 2: PA1, PA2, PA3, PA4, PA7, PA8, PA9, PA11, PA12, PA14, PA40
Day 5, vehicle 1: PA13	Day 5, vehicle 1: PA13
Day 5, vehicle 2: PA13	Day 5, vehicle 2: PA5, PA6, PA10, PA15, PA41
Day 6, vehicle 1: PA2, PA3, PA4, PA6, PA7, PA8, PA9, PA10, PA11, PA12, PA14, PA40, PA41	Day 6, vehicle 1: -
Day 6, vehicle 2: PA2, PA3, PA4, PA6, PA7, PA8, PA9, PA10, PA11, PA12, PA14, PA40, PA41	Day 6, vehicle 2: PA1, PA2, PA3, PA4, PA7, PA8, PA9, PA11, PA12, PA14, PA40

Table 3 also shows the results of visit assignments for *Cluster 1*, with visit frequency $f_i = 3$. It says that the first vehicle in the first day visits PA5, PA6, PA10, PA15, PA41, while the second vehicle only visits customer PA13.

Table 4 Visit combination in *Cluster 2*.

Cluster 2 $f_i=3$	
Day 1, vehicle 3: PA18, PA22, PA25, PA28, PA34, PA35, PA39	
Day 1, vehicle 4: PA17	
Day 1, vehicle 5: -	
Day 2, vehicle 3:	
Day 2, vehicle 4: PA37	
Day 2, vehicle 5: PA16, PA19, PA20, PA21, PA23, PA24, PA26, PA27, PA29, PA30, PA31, PA32, PA33, PA36, PA38	
Day 3, vehicle 3: PA17	
Day 3, vehicle 4: -	
Day 3, vehicle 5: PA18, PA22, PA25, PA28, PA34, PA35, PA39	
Day 4, vehicle 3: PA37	
Day 4, vehicle 4: -	
Day 4, vehicle 5: PA16, PA19, PA20, PA21, PA23, PA24, PA26, PA27, PA29, PA30, PA31, PA32, PA33, PA36, PA38	
Day 5, vehicle 3: PA17	
Day 5, vehicle 4: -	
Day 5, vehicle 5: PA18, PA22, PA25, PA28, PA34, PA35, PA39	
Day 6, vehicle 3: -	
Day 6, vehicle 4: PA37	
Day 6, vehicle 5: PA16, PA19, PA20, PA21, PA23, PA24, PA26, PA27, PA29, PA30, PA31, PA32, PA33, PA36, PA38	

In cluster 2, $f_i = 3$, it shows that the vehicles used for delivering LPG cylinders each day are three which cover three different customers. Comparing with other f_i in the same cluster, the covered customer demands in each day are more than $f_i = 2$ and $f_i = 1$. Moreover, some of customer demands are visited more than twice with different vehicles in different day. For example, customer demand PA37 is supplied by vehicle 4 in the day 2, vehicle 3 in day 4 and vehicle 4 in the day 6.

CONCLUSION

The application of the proposed distribution routing indicates that there is a significant reduces in total distribution costs as comparing with the existing distribution system. Total distribution costs in this proposed model of cluster 1 with $f = 3$ is lower than cluster 2 with $f = 2$ and the existing distribution system.

Tabel 5 total distribution costs in cluster 1, f2 dan f3 and existing distribution system

parameters	PVRP		Existing distribution system
	Cluster 1, $f=2$	Cluster 1, $f=3$	
routes	12 routes	9 routes	11 routes
distance	227,72 Km	443,64 Km	254,43 Km

Moreover, the distance travelled by vehicles in the first scenario ($f = 2$) is also lower comparing to the existing distribution system and the second scenario ($f = 3$). However, in the number of required routes, the first scenario requires 12 routes to cover all the customer demands, three and one more routes than the second scenario and the existing distribution system.

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WASTE MANAGEMENT & CUSTOMER VALUE IN PETROLEUM LOGISTICS

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ABSTRACT

Waste is commonly associated with discard and unwanted bi-product of production. However, in industry waste is a source of revenue, and in the case of waste production, handling waste incurs cost that may be reduced. The purpose of this paper is to identify how value is created from waste handling, detecting challenges and barriers, and providing possible suggestions to increase value creation from waste handling including the perspective of reverse logistics. This is a qualitative single case study of waste flowed from an offshore oil platform through a supply base to waste end-users. Focus is directed to the upstream portion of this flow. Findings indicate that waste is transformed through logistics and processing into traded items on a marketplace associated with customer value perceptions. Waste is owned, not only produced and transformed in a physical flow. Waste is also associated with service and a specialised industry indicating the importance of networking in waste management. Waste management is revealed as a specific cross functional type of industry demanding adapted analytical frameworks for further study. It should not be considered a sub-component of reverse logistics studies.

INTRODUCTION

Motivated by the waste management industry's own conception that they are "value creating actors" in supply networks this study focuses on how "customer value" may be associated with physical waste items in the empirical realm of offshore petroleum logistics. We seek through this case study to ground this business conception of waste-as-value in both theory and empirical evidence. The analytical framework is created through literature associated with the following research questions:

1. What are the types of waste handled at the supply base?
2. How are these forms of waste managed?
3. What characterizes the reverse logistics processes of the types of waste managed through the supply base?
4. How do these reverse logistics processes create value in the supply network?

The literature review encompasses 1) waste, 2) waste management, 3) reverse logistics and 4) customer value to create a research model used to direct the case study and also providing foundation for a conceptually based analysis. The case study focuses on a supply base representing a node location & organisation in the studied upstream offshore-related petroleum logistics network with focus on material waste flows as reverse logistics processes at a supply base facility.

LITERATURE REVIEW

Waste

There are different views to the appropriate definition of waste (Smith, 1993). The conception of "waste" is important because of strict government legislation associated with waste handling (Fleischmann, 2001). The European Council (1991) defined "Waste shall mean any substance or object in the categories, which the holder discards or is required to discard". Pongracz (2002) stated that, one of the methods to define waste is by listing activities or substances that fall within the

range of abovementioned defined categories. Pongracz and Phjola (2004) argued that the term waste as "a thing that its holder is to discard" (p. 68), meaning that the waste is economically existent and the holders intend to throw this physical object away. Pongracz (2002) exemplifies that in case of industrial waste, mining waste, and electricity-generation waste, sometimes, agricultural waste, the waste is considered as a by-product of economic activity. Waste is accordingly created. The management of waste may also involve waste prevention, an economic activity since the waste definition has a clear negative connotation motivating avoidance of this material creation. Given that when waste is first created then it must be later logistically handled. This implies waste as an object that needs to be taken into logistical consideration, a material form that may be reused, resold, or remanufactured. "Waste" as concept is interwoven with its logistical features, its transformation. This supply of waste-items for different forms of use is illustrated in figure 1 below:

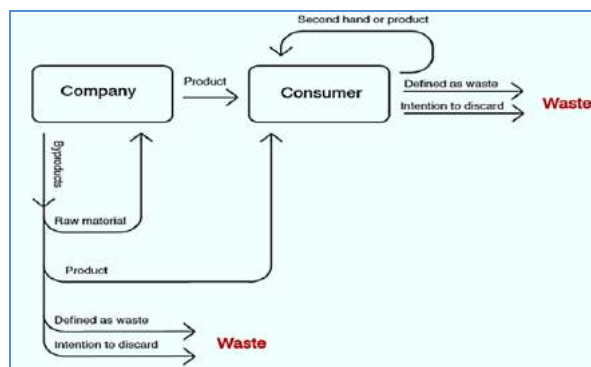


Figure 1. Illustration of EU legal definition of waste (European Commission, 2012, p. 6).

The figure illustrates how, when first created, waste is associated with different logistics activities. It may be cycled in a completely professional flow or it may be channeled to consumers. Furthermore, there is an important notion that the avoidance of waste also involves logistics, how production, transport, storage and handling in a supply network together may be organized and integrated to avoid or reduce waste-item volume. In addition, waste may be transformed through logistics giving technical and economic features making waste-items more or less adapted to logistics and other business and societal purposes. Waste has accordingly both technical features that are measurable and economic features that are perceived in a marketplace and the wider society.

Waste Management

Pongracz (2002) argues that waste management, as it is understood today is the collection, transport, recovery and disposal including the supervision of such operations and after-care of disposal sites. Waste management is clearly a business function that creates some form of value in the supply network. This notion that waste management is associated with value seems paradoxical since the object to be handled is associated with discard and avoidance perceptions. However, given the wider societal context of waste management, this function is becoming increasingly profitable. As a result of societal pressures waste may from an economic viewpoint no longer simply be discarded. From the perspective of waste producers, waste management involves specialized resources distinct from the main production of a firm. In addition, different firms and industries produce different types and volumes of waste-items as bi-products of their main production entailing varying approaches and costs in organizing waste management.

One of the most interesting aspects of waste management is how it is organized in the supply network. It can be carried out within a firm's boundaries or done by specialized firms. Outsourcing is accordingly an important issue in waste management. As the degree of specialization and outsourcing increase waste management emerges as a network entailing the need for efficient supply chain management (SCM) to integrate logistics resources to better coordinate these activities.

Finally the management of waste is closely associated with a hierarchy of waste illustrated in figure 2 below:



Figure 2: The WM theory or hierarchy (European Council, 2008, p. 1, directive 2008/98/EC on waste).

Waste prevention is the most desirable option. Riemer & Kristoffersen (1999) suggest, the following three criteria of waste prevention based on the OECD agreement. Preventing and or reducing generation of waste; improving quality of waste; and encouraging re-use, recycling and recovery. Waste prevention is the key factor in any waste management strategy. The highest priority is given to reduce the amount of waste generated at source and reduce the hazardous content of that waste. Waste prevention is closely linked with improving manufacturing process and influencing consumers to demand greener products and less packaging. Lox (1994) mentions, "Re-use is use, for the second or more time, of a product for the same purpose, under the same form and with the same properties of the material as the first use, the material having constantly remained under the same form between several uses" (p. 33). European Council (2000) defines, "Re-use means any operation by which components of end-of life vehicles are used for the same purpose for which they were conceived". Recycling is a process where waste material is transformed into new products for sale. The basic purpose of recycling is to reduce the use of potential useful material, reduce consumption of fresh raw materials, reduce energy use, water and air pollution. The European Council (1994) defines, "recycling shall mean the reprocessing in a production process of the waste materials for the original purpose, or for other purposes, including organic recycling but excluding energy recovery" (p. 34). Recycling is a complete closed and permanent cycle. Nonetheless, it is difficult to recycle some materials and bring back its original form for example, glass is not recycled to sand and limestone. Thus, the term recycling hardly compatible with its original contexts because recycling only occurs when a secondary material is converted into a new product or is utilized in another way. Therefore, recycling is one of the most important activities to reclaim value form waste. Incineration is "the main alternative disposal method to landfill". The council describes incineration as, "Incineration produces toxins, and heavy metals. To prevent their release, expensive filters must be installed in incinerators and used filters with highly concentrated contamination, together with the quarter of the wastes original weight, must still be landfilled". Disposal is the last activity in the WM hierarchy. Although landfilling technology is advanced and efficient, but it produces methane and that can be up to 60 times higher than CO₂. According to

European Communities (1999), both disposal and incineration of waste are potentially harmful for the environment and humans. Waste management involves at core accordingly transforming waste into materials that may be sold on a marketplace. Waste management involves there both exchange and production through value-creating flows that include logistics processes.

Reverse Logistics

In logistics waste management is often considered a form of reverse logistics. Rogers & Tibben-Lembke (1999) define reverse logistics as: "The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal" (p. 2). Likewise, Blumberg (2005) defines the same concept as the "full coordination and control, physical pickup and delivery of the material, parts, and products from the field to processing and recycling or disposition, and subsequent returns back to the field where appropriate" (p. 12). He develops a basic model to show how reverse logistics model adapted to waste management:

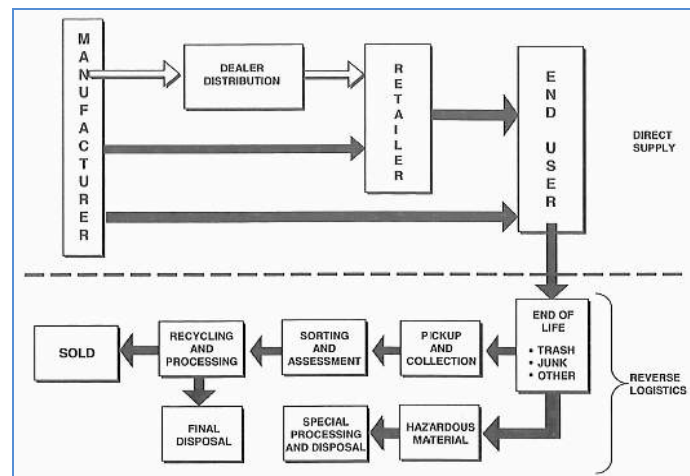


Figure 3: Independent reverse logistics processes (Blumberg, 2005, p. 13).

This figure clearly illustrates how logistics associated with waste is a reverse processes representing an afterlife of the goods produced through logistics processes.

Customer Value in waste handling networks

Customer value is associated with logistics as the purpose of the flow of goods. Customer value is associated with ownership, since this value is measured as ownership is transacted from one party to another through exchange within a firm or on a market involving monetary transfer. This indicates the existence of both internal and external customers. The type of value created and obtained by a specific collaboration is dependent on the degree of maturity of that collaboration (Bititci et al., 2004). The combined competencies of the parties in the supply chain affect and shape the value proposition of typical collaborative networks. Mollenkopf and Closs (2005) provide through a study examples of how improved reverse logistics flows, including handling waste-items, creates increased value at different stages of a flow of goods. Value associated with reverse logistics is accordingly a SCM issue since this value creation is dependent on supply chain collaboration. Value as purpose is associated with the concept of "customer value". According to Christopher (2011), customer value is the difference between the perceived benefits from a products or services from a purchase and the total cost of the customer and success or failure of any business. Thus, the success or failure of any business is ascertained by the level

of customer value that the company delivers in any specific market. Customer value indicates performance and quality of supply. In addition, Christopher (2011) argued that the performance of product or service is linked to the performance of the entire supply chain. Therefore customer value is sequentially dependent and is transformed as ownership of waste changes through a sequentially dependent waste flow with sometimes contradictory customer value perceptions between and within firms.

METHOD

This is a single case study design where waste is considered the unit of analysis. Through eight interviews of different actors associated with handling waste at the supply base an overview including details of waste management and reverse logistics processes was acquired. These informants came from four different companies: the supply base company, a company specialized in trading wastes handled at the base, a specialized waste management company and an oil company operating one of the major offshore oil platforms serviced by the studied supply base. A data saturation strategy was followed indicating that not more than eight interviews were needed. In addition, observations of waste-item types and their handling at the supply base were conducted. The duration of inquiry lasted approximately four months. All interviews are semi structured allowing novel insight. Informants were given enough room for the interview object to come forward with their own insight information during the conversations. Similarly, in case of qualitative data, for this study, several sources were used to obtain information. Each interview carried an average of 10 main questions. Each main question was further extended to several sub questions. A single interview lasted long an average of 1 hour. Regarding some already known facts, the respondents were still asked questions according to the interview protocol in order to confirm information from different sides. These sources include company websites from all the actors involved in the waste management process. Limitations are associated with the single case study format which allows deeper insight, but also limits generalization (Voss et al. 2002). This form of case study permits theory building (Eisenhardt 1989) and thereby theoretical generalizability (Meredith 1998). It may therefore contribute by generating theoretically founded ideas to discourse both in academia as well as in business practice; a foundation for waste management innovation based on new insight.

CASE DESCRIPTION

The investigation revealed a complex assortment of different types of waste-items being flowed through the supply base. These can be classified as industrial waste, bulk waste, metal waste and hazardous waste. In volume the amount of waste is comparable to the amount of materials flowing to the platform. A special form of waste is hazardous waste which is subject to special treatment in accordance with strict handling procedures.



Arial photo of the supply base in Norway

The supply base receives wastes from offshore oil companies. All materials are transported to the platform on specialized platform supply vessels (PSV) that are designed to handle different forms of materials in bulk, large component and smaller items in containerized forms. There are several downstream parties involve in the entire WM process. The waste handling and management process at the supply base happens in the following stages. Wastes are unloaded off the PSVs at the supply base and temporarily stored in the yard of the waste management company onwards transportation to processing at another firm. The waste management company only processes contaminated water at the base. The other wastes are after temporary storage and handling sent to processing outside the supply base, mainly by truck. Some types of waste are sent to the downstream parties for further treatment to recycle and recover energy; sold to consumers as goods or services consisting of in-part waste ingredients.

The supply base functions as an industrial park with harbor and terminal facilities. The flow of waste is managed by a conglomerate of different firms, all located at this supply base. There are currently more than 60 firms located with rented facilities on this base. A few firms regularly use the base without having a location there. In the case focus is directed to a major waste flow from a specific offshore oil platform through the supply base. All these firms are involved in either producing or handling at least miniscule amounts of waste. The major waste producer is the oil company. This is also the focal waste flow of this study. Waste management is an important function of the oil company. However, this company chooses to outsource most of its waste management procedures to other firms. Mainly it is the supply base that manages waste and coordinates their activities with the specialized waste management firm. To enable trading waste, facilitating the continuing downstream flow of waste, a specialized waste management firm is established. This firm is owned by the supply base company. In addition, transport firms, both road and shipping play an important role in waste management.

Inquiry reveals that waste is associated with value from two perspectives. First, wastes imply costs. When they emerge as a result of oil production they cannot be discarded at the platform due to environmental concerns fortified by litigation. This implies costs associated with handling the waste-items in an environmentally sound manner. From a logistics viewpoint the study revealed that waste processes are subject to process improvement likewise as outbound goods flows. Waste flows are in the case clearly reverse in nature in their first leg of transport to the supply base. This is possible since the specialized PSV vessels are designed also to handle return cargo where waste goods represent a substantial volume. In addition to the cost perspective, waste management involves importantly sales-transacting wastes on a marketplace. Waste is owned first by the oil company, then serviced by actors at the supply base, and sold to customers permitting the movement of waste goods off from the supply base. Waste therefore also involves a source of income, that is a not a main reasoning for oil production, but a way to facilitate waste removal. When asked, the different informants all saw this aspect of waste as value. Especially for the specialized waste management firms, managing waste is their main source of revenue.

ANALYSIS

Waste is traditionally associated with discard. The case reveals, however, that especially from a supply network prospective, specialized firms have developed this as a way of business. Clearly, the main value creating component in the described case is oil production. How waste is managed involves a cost component determined by government litigation and environmental concerns found in society. This is the realm of what we choose to term as "waste logistics".

This form of logistics is commonly in literature considered as a substantial part of reverse logistics. The notion of "reverse" is associated with an afterlife of goods. In this upstream supply network case oil is produced at the platform and loaded for a different flow to customers. The "reverse flow is only reverse in the manner that it returns with the supplies for the most upstream portion of the oil production flow. Furthermore, at the supply base waste management implies selling waste to customers sorting wastes for transport to destinations and use completely different from the origin of the waste. We therefore suggest that the term "reverse logistics" as inappropriate to describe waste management. Waste management includes a set of different functions, and is a specialized operation that involves a major service component.

Servitization concerns combining goods and service components in a market offering. This is a major issue in the waste management industry since they exist in a borderline are as owners of waste and service providers to waste producers and waste users. The question of "who does what" in the studied supply network is a major issue. This is especially pertinent since logistics processes vary greatly in accordance with differing technical features of waste. This implies that a set of different specialized resources is needed to handle waste entailing room for specialized operators providing waste handling services.

Although the service aspect of waste management is important, the case also indicates that waste ownership is an important issue. Wastes may when purchased by the waste management companies, be associated with transactions, thereby creating an exchange aspect of waste management. Waste, when transacted represents accordingly a basis for income rooted in customer value perceptions of the end-user. This end-user perspective is not considered in the case, but is envisioned to be very distant from that of the original waste producer focusing on oil production. This disparity of value perceptions also opens up for the view that transacting waste demands specialized competence, and therefore naturally outsourced since the oil company chooses to focus on its core competency; oil production.

Customer value in relation to waste management in the case is subject to different interpretations. First the customer value equation directs also empirical focus to either the cost side associated with logistics or the income side associated with waste ownership and exchange. Waste is managed in a supply network that in this studied upstream portion of the supply chain is located the same place as the outbound goods flow. The waste flow differs from the inbound goods flow in two aspects. First the goods are obviously different. Also, in the studied case, while the inbound flow is a part of an upstream supply chain, the reverse flow flows in an opposite direction, in line with a "reverse logistics" framework. However, after handling at the supply base the waste flows in directions that are not comparable to the inbound flow. The "reverse" feature disappears as waste is sold as goods to customers on a marketplace. Therefore, how customer value is perceived in relation to wastes is clearly sequentially dependent. Value is created stepwise and moved through logistics and processing to the end-user. This logic clearly resembles the inbound flow of supplies to oil production. Waste is transformed into a value object traded on a marketplace.

CONCLUDING REMARKS

Waste management creates value through logistics and processing; an activity supported by exchange processes. Waste is associated with industry sector and further studies of servitization, logistics services, transactions and customer value evoking particularities of the waste management industry are called for. This will enable more precise development of analytical frameworks for further qualitative and qualitative studies of waste management as both service and goods supply in

different business settings. Following the line of thought studying waste management as "reverse logistics" is clearly a dead-end, especially since reverse logistics does not take into account the supply network perspective of specialized waste management firms, that managing waste involves an industry consisting of a conglomerate of specialized firms working with waste producers and waste users. This inter-organizational network perspective of waste management also indicates that it is pertinent to, in addition to logistics, SCM as well as purchasing-related studies.

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FACTORS INFLUENCING THE OPERATIONS OF THE HALAL MEAT SUPPLY CHAIN IN AUSTRALIA

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ABSTRACT

The purpose of this paper is to discuss the factors that influence the operations of the halal meat supply chain in the environment of a non-Muslim-majority country – Australia. Australia, a non-Muslim-majority country, is a major producer and exporter of halal meat to Muslim countries. This study is based on 31 interviews of various stakeholders involved in the operation of the halal meat supply chain. This study found that out of the ten factors identified as affecting the successful operations of the Australian halal meat supply chain (AHMSC), 'segregation' and 'people' are the most dominant factors. These factors have different levels of influence in the domestic and export markets. The study concludes that there is a need to streamline the current AHMSC operations, particularly with regard to the regulatory framework and governance structure, to further enhance Australia's reputation in the world's halal meat industry.

1.0 INTRODUCTION

'Halal' means 'permissible' in Arabic (Al-Qaradawi 2007). The opposite of 'halal' is 'haram', which means 'forbidden'. It is widely understood that the followers of the Islam religion are required to consume only halal food in their daily life to preserve their spiritual purity.

During the last decade, the demand for halal food worldwide has been increasing and it is predicted to grow beyond the current annual value of USD650 billion (Omar & Jaafar 2011). The increased demand from the followers of the Islamic religion corresponds with the increased number of the Muslim population worldwide, which is estimated to exceed one third of the world's population (Pew 2011). This suggests that the market for halal food will continue to be strong and significant. Additionally, there is an emerging demand for halal food from the general population (Bruil 2010; Golnaz et al. 2010). They choose to consume halal food due to what they see as cleaner, more hygienic and healthier food due to its strict production process (Belkhatir, Bala & Belkhatir 2009; Nik Muhammad, Md Isa & Kifli 2009).

Known widely as having one of the highest safety and hygiene standards for meat production (MLA 2005; PricewaterhouseCoopers 2011), Australia has been producing halal meat for export since the 1960s (MLA 2012; ABC 2013). Australia is the preferred source of halal meat imported into the Middle East and the Southeast Asia markets (MLA 2012). Despite this fact, little research has been undertaken to understand the halal meat production and supply chain in Australia. This provides the motivation for this study.

1.1 Objectives

The objectives of this paper are to provide insights into the operations of the halal meat supply chain in Australia. In particular, this paper discusses the factors that influence the halal meat supply chain operations from the perspectives of the various stakeholders.

2.0 HALAL FOOD SUPPLY CHAIN

Due to the increased number of fraudulent cases in the halal food industry over the past few years such as the mixing of halal food with non-halal food (whether deliberately or unintentionally), the usage of fake or expired halal certificates and labelling non-halal food as halal (Norman, Nasir & Azmi 2008; Zailani et al. 2010; Mohd Albakir & Mohd-Mokhtar 2011), a new approach is required to manage the production and distribution of halal food. Studies by Tieman, Vorst and Ghazali (2012) and Tieman (2013) have suggested that robust supply chain management is the most suitable approach to address these issues as well as to ensure that the halal status of the food product is protected until it reaches the ultimate consumption points.

The halal food supply chain consists of the systematic process of managing the flow and storage of halal food, whether it is halal certified or not, from the point of origin/production to the point of sale/consumption with the goals of satisfying the halal consumers' requirements and ensuring that the halal status is protected throughout the whole supply chain. Definitions of the halal food supply chain are given in Table 1.

Author	Halal Food Supply Chain Definition
Che Man et al. 2007	Process of planning, implementing and controlling the efficient flow and storage of halal certified product from the source to the demand point.
Tieman 2009a, 2009b	Process of managing the procurement, movement, storage and handling of food products through the organisation and the supply chain in compliance with the general principles of Sharia law
Zulfakar Anuar & Talib 2012	Process of managing halal food products from different points of suppliers to different points of buyers/consumers, which involve various different parties, who are located at different places and who may at the same time be involved with managing non-halal food products, with the purpose of satisfying the needs and requirements of both halal and non-halal customers

Table 1: Halal Food Supply Chain Definitions

As the demand for halal food increases, so does the awareness and education of halal consumers, particularly the Muslim followers (Zurinna Raja 2006). Since the majority of the world's halal food producers are in non-Muslim countries such as Argentina, Australia, Brazil, Canada, New Zealand, the United Kingdom and the United States (Marzuki, Hall, & Ballantine 2012; Wan Hassan & Awang 2009), these Muslim followers are sceptical about whether the halal foods that are being produced are indeed halal and whether the halal integrity of the food is protected throughout the supply chain that can span the boundaries of many countries.

Due to the complexity of the supply chain and the amount of handling at various transit points, halal food is exposed to potential risks at various points along the supply chain that can jeopardise the halal integrity of that particular food product. These points are known as halal critical control points (Lodhi 2009). Halal food that has been exposed to non-halal elements at these control points is considered contaminated and therefore no longer fit for consumption by Muslim followers (Zailani, Arrifin, Abd Wahid, Othman, & Fernando 2010).

3.0 WHAT MAKES MEAT HALAL?

Various types of halal food are currently being produced. They include food categories such as meat and smallgoods, poultry, confectionery, food additives

and canned foods. However, the most well-known food category associated with the halal industry, as well as the most vulnerable to contamination, is the meat and smallgoods category (Sungkar 2008, 2009).

Meat can only be considered halal if it comes from halal species animals such as cattle, sheep and goats. These animals must be slaughtered according to the Sharia principles, which are: reciting a special prayer at the beginning of the slaughter, slaughter performed by a Muslim, humane treatment of the animal, usage of a sharp knife, clean and quick cuts of the major blood vessels, and full bleeding of blood after slaughtering (Evans 2006).

The meat will not be considered halal if the above requirements are not complied with. On top of that, livestock which is injured, sick or dead before slaughtering cannot be accepted as halal.

To ensure that the meat remains halal during transport and storage, halal meat must be kept separate from non-halal meat. Physical contact between these two types of meat, especially when the meat is shipped in the carcass form in which there is no outer packaging protecting the halal meat, causes the halal meat to be no longer religiously fit for Muslim consumption.

Often people, especially non-Muslims but even some Muslims, misunderstand the concept of halal. They wrongly believe that as long as the animal is slaughtered accordingly to the Sharia principles, the meat will always be halal and safe for Muslim consumption. However, theoretically and practically, the halal concept does not end there. The meat must remain halal until the point of consumption. All care must be taken to prevent any contamination with non-halal elements.

4.0 RESEARCH METHODOLOGY

Since there are limited studies in the field of the halal meat supply chain, especially in Australia, further studies are necessary to obtain a better understanding of the subject matter. This exploratory study adopted a qualitative research approach as recommended by Creswell et al. (2003) and Creswell (2009). By employing a single case study approach, valuable insights can be gathered to obtain a comprehensive understanding of the research problem (Nau 1995; McMurray, Pace & Scott 2004; Tashakkori & Creswell 2007; Creswell & Plano Clark 2011), which in this study is the factors affecting the operations of AHMSC.

Data for this study were obtained through the semi-structured interview method. Thirty one participants from various groups of stakeholders involved in the implementation of the halal meat supply chain operations in Australia were interviewed. The initial participants were selected from a list issued by the Department of Agriculture (DAFF) and published on the department's website. The list contained the details of recognised Islamic bodies for halal certification of red meat in Australia. Subsequent participants from the meat processors, industry association and small retailers were obtained through the recommendations and personal contacts of the initial participants as the authors faced difficulties in getting direct access to them. All the participants in this study had more than five years working experience in halal meat production and held senior positions in their organisations. Brief details of the participants are provided in Table 2.

Thematic data analysis was used to analyse the study data by using the steps suggested by Braun and Clarke (2006). Following the review of the interview transcripts, initial codes and themes were generated based on the literature on segregation, certification and cross-contamination, as well as new topics

emerging during the data extraction process such as halal program and non-halal output handling. The themes were later reviewed and categorised into the factors that the participants believed are important in the implementation of the AHMSC operations. These factors are discussed in the following section.

Stakeholder's Category	Stakeholder Category Assigned Code	Number of Participants
Meat Processor	HM	8
Halal Certifier	HC	7
Muslim Worker	HW	5
Halal Meat Retailer	HR	8
Industry Association	HI	2
Government Agency	HG	1
Total Participants		31

Table 2: Breakdown of Research Participants

5.0 FINDINGS AND DISCUSSION

5.1 Factors influencing the operation of the Australian halal meat supply chain (AHMSC)

Ten factors were found to influence the operations of AHMSC: halal program (HP), halal understanding (HU), halal governance (G), segregation (S), halal certification (C), people (P), trust (T), supplier selection (SS), religious and social responsibilities (RS), and consumer awareness and obligation (CA). The various factors are presented in Table 3.

Of these factors, segregation and people are identified as the dominant factors that strongly influence the successful operations of AHMSC.

		Influencing Factors									
		HP	HU	G	S	C	P	T	SS	RS	CA
Stakeholder Group	HC	X	X	X	X	X	X	X		X	X
	HM	X		X	X	X	X				
	HW		X		X	X	X			X	
	HR		X		X		X	X	X	X	
	HI	X		X							
	HG	X		X	X	X	X				

Table 3: Factors influencing the operations of AHMSC

5.1.1 Segregation (S)

Physical segregation of halal meat has been identified as the main measure to prevent the possibility of cross-contamination of halal meat from non-halal elements in the AHMSC operations. Segregation should occur in the production line, in the storage room and during transport. In the production line and storage room, segregation is easily achieved by processing only halal animal species in that particular abattoir or processing facility.

In the case of non-halal output derived from halal animal species, proper procedures are in place at the abattoirs to ensure that the non-halal output is physically separated from the halal output from the moment it is identified until it is stored in a separate area in the cold storage room with proper labelling. Some of the participants indicated that they even have a totally separate room for storing the non-halal output as well as separate handling and processing equipment.

Similarly with transport, non-halal meat is not transported together with halal meat. However, some concerns were raised with regard to segregation during transport. While halal meat destined for the export market is transported in a secure shipping container right from the meat establishment (abattoir or smallgoods processor) without any handling at any of the transit points, the transport of halal meat for the domestic market is quite different.

Since the volume of halal meat for the domestic market is small, most delivery services are reluctant to provide a dedicated transport fleet for halal meat. Most service providers combine the shipment of halal meat with non-halal meat to achieve economies of scale. This practice increases the possibility of cross-contamination. However, according to the participants, some simple solutions have been devised to minimise the cross-contamination risk. In the case where a dedicated truck is unavailable to transport halal meat, a combined shipment of halal and non-halal meat can be acceptable provided there is some effective separation such as a curtain dividing the two types of meat, putting each type of meat at different ends of the truck storage compartment or using a special cage.

5.1.2 People (P)

The people factor identified in this study is focused on the importance of the Muslims who are the halal supervisors and the halal slaughtermen. As required by the Sharia law and clearly stated in the halal program (including the Australian Government Authorised Halal Program [AGAHP]), only animals that are slaughtered by a practising Muslim can be deemed halal. Therefore, the meat processing establishments must comply with this fundamental requirement. With recommendations from the halal certifier, the meat processing establishments can recruit competent Muslim workers to fill the necessary positions. Not only is the role of the halal slaughterman important, but so is the role of the halal supervisor on behalf of the halal certifiers, the halal supervisor assists when there is any uncertainty regarding halal meat production and ensures that the religious requirements are being observed by the meat processing establishments on a day-to-day basis.

Participants in the study also referred to the halal certifiers and the abattoir management in relation to their roles in the AHMSC operations. Halal certifiers are responsible for providing advice to the management of meat processing establishments on matters related to halal meat production principles as well as being responsible for reviewing and endorsing the halal program. The management must ensure total compliance with the halal program at all times, including providing education and awareness to all employees about general halal principles and halal meat production.

5.1.3 Other Factors Influencing the Operations of AHMSC

Apart from segregation and people, the participants believed that the current success of AHMSC operations is a result of **systematic halal governance and monitoring** activities. The efficient and constant supervision by the federal government agency, halal certifiers and the internal halal committees of the meat processing companies, particularly with regard to the production of halal meat for export, has ensured that the supply chain integrity is maintained at the highest possible level. Although there is a lack of government participation in the domestic halal meat market, the meat processors along with the local halal certifiers give the necessary assurance that all the required halal requirements are being addressed diligently.

To assist the halal governance and to ensure that the halal meat production requirements are being complied with, meat processors producing halal meat in Australia are advised for the domestic market and required for the export market to develop and implement a **halal program** at their premises. This halal program, which must be approved by one of the halal certifiers in Australia, describes the specific procedures for halal slaughtering, storage, and the handling of halal and non-halal meat, and enables all personnel involved in the production of halal meat to have a uniform understanding and directives with regard to halal meat production.

Halal certificates provide a guarantee that the meat has been produced according to halal production guidelines and give confidence to the buying customers that the halal integrity of the meat has been protected from the beginning of the supply chain. The production and transport of halal meat will be considered halal only if they are accompanied by the endorsed halal certificates, which eliminate any uncertainties that perhaps might have occurred at any of the supply chain stages. To ensure the rightful issuance of halal certificates and to avoid the abuse of halal certification at the abattoirs, halal certifiers entrust the issuing and endorsement of each halal certificate only to the halal supervisors.

Despite the implementation of halal programs, there are still elements of uncertainty regarding compliance with the halal requirements at the meat processing establishments and therefore all parties have to **trust** that their supply chain partner will also comply. The halal certifiers interviewed said that they trusted all abattoirs producing halal meat to execute the halal meat production requirements with due diligence and to guarantee the protection of the halal status throughout the production process. However, they put greater trust in the Muslim workers working in the halal meat supply chain. Since these workers are working on a daily basis, they are entrusted to make sure that all religious aspects of the halal meat processing are being strictly followed.

Due to the uncertainty in the domestic AHMSC in which any organisation can claim that they are producing halal meat, it is crucial to **choose the right supplier**. The majority of local butchers and trading companies choose suppliers who have halal accreditation from well-known local halal certifiers, or suppliers who provide them with halal certificates for every shipment, or suppliers that they have some personal connection with, such as previous experience of working together or friends or family members who work for the suppliers.

In addition to the above factors, the participants indicated that **religious and social obligations** as well as **consumer awareness** do have some influence on the AHMSC operations. Most of the Muslim participants said that it is the responsibility of the Muslim sellers to make sure that the meat that they are buying is halal and that they will be held accountable if they sell non-halal meat

to Muslim buyers. The consumers of halal meat are also expected to play an active and investigative role in ensuring that the meat they consume comes from a trusted halal source. Due to the absence of local halal regulations, it is the obligation of the halal consumers to be attentive to detail and to avoid buying meat from the butchers or retailers that sell halal meat and non-halal meat in the same premises and to avoid buying meat from those with questionable halal status.

Lastly, in a multicultural country and in an environment where Muslims are a minority, such as Australia, a **comprehensive understanding** of what constitutes halal is crucial for successful halal food operations. It is important to understand that halal principles are not merely about animal slaughtering but encompass a lot more than that. According to the halal certifiers, the efforts of some non-Muslims to gain halal understanding are very impressive and in many cases these non-Muslims have a greater understanding of halal meat production than the average Muslim person.

5.2 AHMSC MARKET

From the findings of the study, it can be concluded that the operations of AHMSC can be divided according to two markets: domestic and export. Each market has its own characteristics. The major differences between these markets relate to the overall halal supply chain structure and governance. These differences affect the degree of influence of the ten factors described above (See Table 4).

	Factors	Domestic	Export
1.	Trust between stakeholders	√	
2.	Supplier selection	√	
3.	Religious and social obligation	√	
4.	Consumer awareness and obligation	√	
5.	Segregation	√	√
6.	People	√	√
7.	Halal governance		√
8.	Halal program		√
9.	Certification		√
10.	Halal understanding		√

Table 4: Factors influencing the operations of AHMSC in the domestic vs export markets

Due to the limited regulatory regime for halal meat in the domestic market, halal meat stakeholders, particularly consumers and certifiers, have to rely to a great extent on trust and to assume that the meat they procure and consume has undergone appropriate halal operations and that the halal integrity is protected along the supply chain. They rely more on the Muslims workers' religious and social obligations than on governance and regulatory requirements.

In contrast, in the export market, the participants strongly believe that the current Australian halal regulations governed by the Department of Agricultural, Fisheries and Forestry (DAFF) with active participation from the halal certifiers result in the most trusted and safest halal meat products in the world. As the halal governance in the export market also involves the mandatory implementation of the current halal program, i.e., AGAHP, the element of trust, the selection of suppliers, religious and social obligations together with consumer awareness do not seem to affect AHMSC operations nearly as much as they do in the domestic market.

6.0 RESEARCH LIMITATION AND FUTURE RESEARCH DIRECTION

While we managed to include the majority of Australia halal stakeholders in the study, two were not able to participate – the government agency DAFF and the logistics service providers.

A larger scale study using a quantitative survey instrument may provide a better understanding of the Australian halal meat supply chain. Additionally, investigating the relationships between the various factors described in this paper which impact on the overall performance of the supply chain could also provide insights into key elements of supply chain collaboration in the non-Muslim country context. Finally, a comparative study could be undertaken in a Muslim majority country to compare the outcomes.

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* Full list of this paper references can be made available upon request to the corresponding author.

GREEN CONSUMERISM: A STUDY ON THE PROSPECT OF CONSUMERS PARTICIPATION IN CORPORATE ENVIRONMENTAL MANAGEMENT PROGRAMS

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ABSTRACT

Purpose of this paper: In most industries, the bulk of the supply chain wastes occur post-consumption. Consumers participating in retailer-sponsored product recycling or renewal programs play a significant role in reducing supply chain wastes. Extant literature on green supply chain collaboration tends to focus on the business-to-business relationships between supply chain partners, paying little attention to the role of the individual consumers. This study examines factors influencing consumer intention to collaborate in retailer-sponsored recycling programs and green initiatives aimed at reducing post-consumption wastes.

Design/methodology/approach: Drawing on the tenets of Theory of Planned Behavior and Social Exchange Theory, a model of green consumerism was first developed comprising six constructs: Green Attitude, Subjective Norms, Perceived Behavioral Control, Incentives, Green Intention, and Green Collaboration.

The model was tested using data collected via a mixed-mode questionnaire from consumers aged 18 and above resident in Singapore and Australia. A total of 189 completed responses from both countries were obtained: Singapore (103) and Australia (86).

The analysis followed a four-step structural equation modeling (SEM) approach: unrestricted model, measurement model, structural model, and pre-specified model. An exploratory factor analysis on the unrestricted model resulted in Green Collaboration being divided into Green Purchase and Green Participation and Incentives split into Explicit Incentives and Implicit Incentives, producing a conceptual green consumerism model with eight constructs linked by seven hypotheses.

The validity and reliability of each factor from the unrestricted model of both the Australian and Singapore samples were then tested using multiple-group item response theory. The resulting measurement models were then employed to develop structural models using multiple-group SEM technique. The structural models were subsequently modified to increase their parsimony in the fourth pre-specified model stage.

Findings: Both the Australia's and Singapore's models indicate that green intention positively affects green purchase. Both models also reveal that the presence of implicit incentives will lead to a strong predilection toward green collaboration, implying more green purchase and a higher level of green participation.

The results suggest that in Singapore consumers normally purchase green products before participating in other green activities. In contrast, in Australia green participation need not be preceded by green purchase. These behavioral differences underscore the dissimilar approaches adopted by customers in the two countries in response to green supply chain collaboration.

Value: Studies that frame eco-friendly consumer practices within a green supply chain are rare. This study sheds light on how consumers in two dissimilar cultures could contribute to green supply chain collaboration through their individual behavior and through influencing the practices of firms which they patronise.

Research limitations/implications: The findings underscore the importance of embedding socio-cultural factors in studying consumer participation in green supply chain

collaboration. The applicability of the model should be further tested in other socio-cultural settings.

Practical implications: This study offers insights for retail managers in the two countries to develop effective policy and other measures to entice consumers to engage in green purchase and participate in green incentives.

INTRODUCTION

In most industries, the bulk of the supply chain wastes occur post-consumption. While much of the efforts expended on greening the supply chains, such as reverse logistics (e.g. Hazen, Cegielski, and Hanna 2011), product recovery (e.g. Ilgin and Gupta 2010) and remanufacturing (Chung and Wee 2011), are directed toward reducing post-consumption wastes, the focus tends to be centred on business-to-business collaboration between supply chain partners (e.g. Cao and Zhang 2011). Comparatively, less attention has been paid to understanding the contribution of individual consumers.

As new product development is increasingly mass customized (Alptekinoglu and Corbett 2008) and more supply chain operations are becoming demand-driven (Walters 2006), the role that consumers play in reducing post-consumption wastes also rises. Many studies have examined consumer motivation and intention to participate, as well as consumer participatory behaviour, in a variety of green practices. These studies, however, tend to explore only a particular aspect of green practices, e.g., to recycle household wastes (Vining, Linn, and Burdge 1992), to bring own bags when visiting a supermarket (Chan et al. 2008), and to consume green food (Zhu et al. 2013), rather than looking at green consumerism as a holistic construct.

This study examines factors influencing green purchase within the context of green consumerism. It focuses on a set of activities centring on individual consumption behaviour in their everyday life. Drawing on the tenets of Theory of Planned Behaviour (Ajzen 1991) and Social Exchange Theory (Hall 2003), we developed a model of green consumption behaviour linked to green purchase. Acknowledging that culture and legislations may play a role in influencing green consumption behaviour, we tested our model under two relatively contrasting settings. Our first sample comprised consumers aged 18 and above resident in Singapore and our second came from consumers of the same age limit resident in Australia.

GREEN CONSUMERISM: CONCEPTS AND MODEL DEVELOPMENT

Akenji (2014) defined green consumerism as “the production, promotion, and preferential consumption of goods and services on the basis of their pro-environmental claims” (p. 13). This definition brings out three interrelated concepts, depending on whether green consumerism is viewed from the perspective of the manufacturers, the marketers (and retailers), or the consumers. From the manufacturers’ perspective, green consumerism would imply green production, i.e., adopting production processes that use less natural resources, consume less energy, and emit less pollutants, as well as green product development, e.g., Toyota Prius, a petrol-electricity hybrid car (Akenji 2014). From the marketers’ (or retailers’) perspective, green consumerism means green marketing, e.g., eco-labelling products and services (Akenji et al., 2011). From the consumers’ perspective, green consumerism would imply purchasing and consuming green products and engaging in environmentally responsible consumption activities, such as recycling (Akenji et al., 2011).

Extant literature on green consumerism research viewed from the consumers’ perspective are generally directed to addressing a number of questions relating to how green consumerism could be achieved at different levels of society and, perhaps, even globally (Sparks and Shepherd 1992); whether the burden of increasing green consumption should be borne by individual consumers, as a moral obligation (Moisander 2007); and what factors affect individuals’ choice of green practices in their routine interaction with the environment.

Answers to these questions have also been explored in many different ways. For instance, to investigate how green consumerism could be achieved, Hirschl et al. (2003)

demonstrated how product life could be extended and product use intensified through a shift in use regimes in household washing and winter sports. Boström and Klintman (2008), on the other hand, illustrated how eco-labels could be made more trustworthy to increase consumer participation in environmental labelling as a means to increase green consumerism. To provide insights into the challenges that consumers may face in embracing green consumerism, Moisander (2007) developed a conceptual model of motivation to explain the limitations of framing and targeting environmental policy measures based on individual motivation and morally responsible decision making. Connolly and Prothero (2008) also addressed the same question by conducting in-depth interviews with green consumers in urban Ireland.

To understand how to target different types of consumers to increase their participation in green consumption, several studies have been carried out to profile consumers and determine their attitudes toward green consumerism (e.g. Autio, Heiskanen, and Heinonen 2009; Diaz-Rainey and Ashton 2011; Hirschl, Konrad, and Scholl 2003; Mintz 2011). Others have explored factors that affect specific types of green consumption intentions and/or behaviour, such as to recycle papers, glass and plastic containers, cardboard and motor oil (Vinning et al. 1992); to consume organic vegetables (Sparks and Shepherd 1992); to consume green food (Zhu et al. 2013); and to bring own shopping bags when visiting a supermarket (Chan, Wong, and Leung 2008).

To explore antecedents of green consumption behaviour, we invoked, first, the tenets of Theory of Planned Behaviour (TPB) (Ajzen 1991), supplemented, subsequently, by the precepts of Social Exchange Theory (SET) (Hall 2003). Ajzen (1991) suggested three antecedents for behavioural intention: *attitude toward the behaviour*; *subjective norms* or perceived social pressure from social reference groups, such as family and friends; and *behavioural control*, which denotes perceived ease, or difficulty, in performing the behaviour. The joint effects of these antecedents lead to behavioural intention.

In developing the measurement items for attitudes, subjective norms, behavioural control and intention, we focused on green purchase (i.e., buying green products), which we view as the root of green consumption. We believe that consumers with intention to purchase green products would have a pro-environmental posture, which would be consistently displayed in both their pre- and post-consumption behaviour.

Following Ajzen's (1991) TPB, we put forward four hypotheses:

H1: Green purchase intention has a positive impact on green consumption behaviour.

H2: Green purchase attitude has a positive impact on green purchase intention.

H3: Subjective norms have a positive impact on green purchase intention.

H4: Perceived behavioural control has a positive impact on green purchase intention.

In green marketing, Ottman (1998) argued that in situations where a consumer perceives two products equal on all aspects, except external environmental benefits, the preference and ultimate consumer choice may be determined by the size of those benefits. Andreoni (1990) also noted that when, or after, engaging in environmentally responsible behaviour actions, consumers experience a personal reward, which Andreoni (1990) calls the "warm glow of giving". Consumers experience the intrinsic warm glow, derived from moral satisfaction of contribution to the common good of the environment (Hartmann and Apaolaza-Ibañez 2012), suggesting that people's action is contingent upon the presence of incentives.

Drawing on the tenets of SET (Hall 2003), we added a new variable—incentives—to the model (see Figure 1) to capture the motivations that spur green purchase intention, resulting in a fifth hypothesis:

H5: Incentives have positive impacts on green purchase intention.

RESEARCH METHODS

We took the consumer perspective of green consumerism in this study, capturing the construct through the use of 13 measurement items that reflect green purchase and pre- and post-consumption green practices. These 13 items (Table 1) were developed based on our knowledge of the lifestyle choices that an average consumer resident in Australia or in Singapore would normally be confronted. They cover activities reflective of pro-

environment, pre- and post-consumption behaviour. A 5-point Likert scale was used to ask survey participants to indicate their agreement with the statements posed.

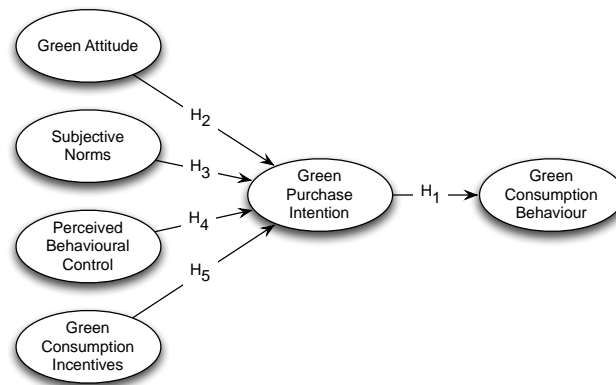


Figure 1: Green Consumption Behaviour Model (adapted from Ajzen 1991; Hall 2003)

Data was collected with questionnaires conducted in both Singapore and Australia. The survey constructs were designed based on the conceptual model (Figure 1). The questions utilised a 5-point Likert scale that allowed respondents to indicate their degree of agreement (or disagreement), or to provide their preferential subjective (or objective) evaluation, of the statements indicated in the questionnaire. The questionnaire was pilot-tested with five participants to ensure content validity. Feedback obtained from the pilot-test was used to refine the statements or questions that were unclear to the participants. The final measurement items used are as displayed in Table 1.

We used two approaches to determine the minimum sample size for testing our conceptual model: MacCallum, Browne, and Sugawara (1996) and Westland (2010). Based on the two power analyses, a minimum sample size of 180 is required.

The questionnaire survey was issued via online and face-to-face modes. Respondents were invited to participate in the survey by self-selection and snowballing techniques. The use of both hardcopy and online questionnaire allow us to provide more flexibility to respondents for answering the questions and to reduce coverage error. There were a total of 189 responses from both countries: Singapore (103) & Australia (86). Therefore, we have a sufficient number of observations for our analysis.

ANALYSIS

We conducted the analysis based on a four-step approach (Mulaik and Millsap 2000). For the first step, we carried out exploratory factor analysis (EFA) to explore the number of latent variables in each construct with SPSS 21. We found that every construct is uni-dimensional except constructs GCB and INC. For construct GCB, there are two factors which we named it as Green Purchase (PUR) and Green Practice (PRA), thereby splitting H_1 into H_{1a} (*green intention has a positive impact on green purchase*) and H_{1b} (*green intention has a positive impact on green participation*). For construct INC, there are two factors which we named it as Explicit Incentives (EXP) and Implicit Incentives (IMP), thereby splitting H_5 into H_{5a} (*explicit incentives have positive impacts on green intention*) and H_{5b} (*implicit incentives have positive impacts on green intention*).

For the measurement model (i.e. the second step), we used multiple-group item response theory to test validity and reliability of each factor resulting from the unrestricted model across the two samples (i.e., the Singapore and the Australia samples) simultaneously with Mplus 7.11. We used Cronbach's α , Ω (Heise and Bohrnstedt 1970), and Ω_w (Allen 1973) as measures of construct reliability. Coefficients Ω and Ω_w are mathematically equivalent to ρ_{η} (Fornell and Larcker 1981) and H (Hancock and Mueller 2001) respectively. We used $val_{X,Y(V)}$ as a measure of construct validity (Penev and Raykov 2006). Based on the results, all measurements are reliable (α , Ω , $\Omega_w > 0.600$ with $p < 0.05$) and valid ($val_{X,Y(V)} > 0.700$ with $p < 0.05$).

Table 1: Measure Items used

<p>Green Consumption Behaviour (GCB) GCB1: I am in charge of my household grocery shopping. GCB2: I buy organic products. GCB3: I buy products with certified logos showing that they are green. GCB4: I buy products that do not contain any chemical harmful to the environment. GCB5: I buy product from green suppliers. GCB6: I buy products made from recycled materials. GCB7: I have switched products/brands for environmental reasons when there is a choice. GCB8: I do not buy products that have excessive packaging. GCB9: I keep separate piles of rubbish for recycling (e.g. paper, glass or plastics). GCB10: I use my own bag when go shopping. GCB11: I participate in recycling initiatives offered by retailers (e.g. recycling mobile phones or laptops). GCB12: I participate in donation drives for unwanted used goods (e.g. old clothing, toys or appliances). GCB13: I support the carbon tax.</p>	
<p>Green Purchase Intention (INT) INT1: I have a greater inclination to buy green products whenever possible. INT2: I have a greater inclination to buy new green products that contribute greater positive impact toward the environment. INT3: I have a greater inclination to go to places where I can buy green products. INT4: I have a greater inclination to replace products that I normally buy with greener products. INT5: I have a greater inclination to choose the product that causes the least pollution. INT6: I have a greater inclination to pay more for green products.</p>	
<p>Green Purchase Attitude (ATT) Please your opinion of buying green products: ATT1: Bad–Good ATT2: Cheap–Expensive</p>	<p>ATT3: Harmful–Beneficial ATT4: Meaningless–Meaningful ATT5: Unpleasant–Pleasant ATT6: Unimportant–Important</p>
<p>Subjective Norms (SUB) SUB1: My family members would approve me buying green products. SUB2: People who are important to me would approve me buying green products. SUB3: My friends would approve me buying green products. SUB4: My acquaintances would approve me buying green products. SUB5: I feel under social pressure to buy green products. SUB6: People who influence me would approve me buying green products.</p>	
<p>Perceived Behavioural Control (PBC) PBC1: I am confident that I know where to find green products. PBC2: I am confident that I know the impact of green products which I buy. PBC3: I am confident that I can recognise which products are green. PBC4: I buy green products under my own accord. PBC5: I can afford green products.</p>	
<p>Green Consumption Incentives (INC) INC1: Green practices allow me to save money. INC2: Bringing my own bags/containers reduce the cost of my transactions. INC3: I learn more about green products from others through collaborating in green supply chain. INC4: Green practices provide me a healthier lifestyle. INC5: Buying green products enhances my reputation. INC6: Buying green products gives me a feeling of satisfaction. INC7: Recycling allows me to contribute to the welfare of the environment. INC8: Buying green products promotes this practice further. INC9: Buying green products makes me become a part of a better community. INC10: Buying green products gives me a better standing within my social circle.</p>	

For the structural model (i.e. the third step), we then used the measurement models to estimate the latent scores of these factors to conduct multiple-group structural equation modelling. Our original model (M1) did not fit the data (i.e. $\chi^2(20)=3.839$ at $p=0.021$,

RMSEA=0.089 at $p=0.102$, SRMR=0.057, TLI=0.915, CFI=0.953, $BIC_{adjusted}=1019.502$, Power=0.012) and was rectified (i.e. $\chi^2(12)=10.727$ at $p=0.552$, RMSEA=0.000 at $p=0.736$, SRMR=0.025, TLI=1.012, CFI=1.000, $BIC_{adjusted}=1011.983$, Power=0.630) by adding five new parameters (H₆–H₁₀) into the model (M2). These parameters were hypothesised as follows:

- H6: Green purchase has a positive impact on green participation.
- H7: Subjective norms have positive impacts on green participations.
- H8: Perceived behavioural control has a positive impact on green participation.
- H9: Explicit incentives have positive impacts on green participation.
- H10: Implicit incentives have positive impacts on green purchase.

For the pre-specified model (i.e. the fourth step), we further modified M2 to make it more parsimonious. The results (model M3) show that the parsimonious model also fits the data (i.e. $\chi^2(24)=15.385$ at $p=0.909$, RMSEA=0.000 at $p=0.976$, SRMR=0.032, TLI=1.041, CFI=1.000, $BIC_{adjusted}=991.750$, Power=0.906). Comparing the values of sample-size adjusted BIC led us to choose M3 since it has the lowest value. Furthermore, *post hoc* power analysis indicates that M3 has sufficient statistical power, meaning that M3 has a higher level of generalisability than M1 and M2.

To test the generalisability of the M3 model, we used Bayesian SEM with 2 chains of Metropolis–Hastings algorithm. For the Singaporean sample, the model converged after 500 iterations. We then observed potential scale reduction (PSR) to ensure that all parameters converged with Kolmogorov–Smirnov (KS) test by comparing posterior distributions across 2 chains. All parameters converged after 2,000 iterations with $p_{KS} > 0.05$, producing a total of 206,000 random observations. Posterior predictive $p = 0.896$ indicates that there is no difference between our and replicated data.

For the Australian sample, the model converged after 1,700 iterations. We then observed PSR to ensure that all parameters converged with KS test by comparing posterior distributions across 2 chains. All parameters converged after 3,400 iterations with $p_{KS} > 0.05$, producing a total of 292,400 random observations. Posterior predictive $p = 0.444$ indicates that there is no difference between our and replicated data.

Figure 4a, Figure 4b, and Table 3 show the results of the structural models performed across the two samples from Bayesian SEM. In the Singaporean context, hypotheses H_{1a}, H₄, H_{5a}, H_{5b}, H₆, H₇, and H₁₀ are supported. On the other hand, in the Australian context, hypotheses H_{1a}, H_{1b}, H₂, H₃, H_{5b}, H₆, and H₈ are supported. Although H₉ is statistically significant at $p < 0.05$, it is not supported since we hypothesised it to be positive. The thickness of the lines in the figures highlights the strength of the effect size. The thicker it is, the higher the effect size. Dot lines signify no impact or $p > 0.05$.

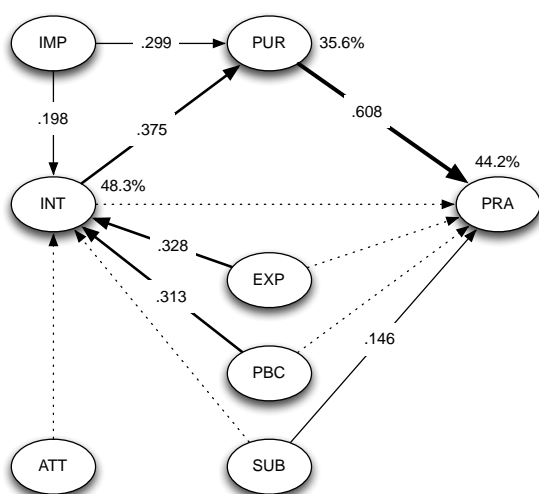


Figure 4a: Singapore Sample

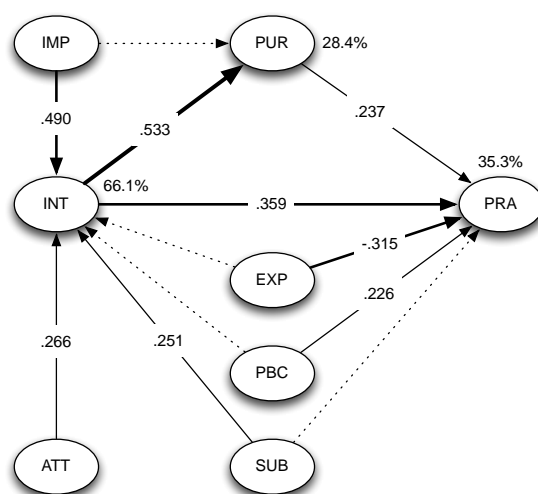


Figure 4b: Australia Sample

We also carried out the equality test of effect sizes across the two samples using the formula proposed by Paternoster et al. (1998). The results in the table above show that all effect sizes across the two samples are different at $p < 0.05$ except H_{1a}.

Table 3: Results of Bayesian SEM

	Parameter	Singapore			Australia			Equality Test
		Estimate	S.D.	p	Estimate	S.D.	p	p
H _{1a}	INT → PUR	0.375	0.086	0.000	0.533	0.079	0.000	0.176
H _{1b}	INT → PRA	0.000	0.000	1.000	0.359	0.113	0.000	0.001
H ₂	ATT → INT	0.000	0.000	1.000	0.266	0.069	0.000	0.000
H ₃	SUB → INT	0.000	0.000	1.000	0.251	0.067	0.000	0.000
H ₄	PBC → INT	0.313	0.076	0.000	0.000	0.000	1.000	0.000
H _{5a}	EXP → INT	0.328	0.082	0.000	0.000	0.000	1.000	0.000
H _{5b}	IMP → INT	0.198	0.083	0.014	0.490	0.061	0.000	0.005
H ₆	PUR → PRA	0.608	0.059	0.000	0.237	0.111	0.009	0.003
H ₇	SUB → PRA	0.146	0.069	0.016	0.000	0.000	1.000	0.034
H ₈	PBC → PRA	0.000	0.000	1.000	0.226	0.109	0.038	0.038
H ₉	EXP → PRA	0.000	0.000	1.000	-0.315	0.096	0.000	0.001
H ₁₀	IMP → PUR	0.299	0.085	0.001	0.000	0.000	1.000	0.000

DISCUSSION

Overall, the empirical results confirm the positive influence of green intention on the purchase of environmentally friendly products (H_{1a}). This is evident from both the Singaporean and Australian samples. Although the effect sizes have different values in two countries, the equality test supports that the effect sizes are statistically the same across two countries ($p = 0.176$).

Other hypotheses being consistent across the two countries include H_{5b} and H₆ although the values of the effect sizes are statistically different. These differences may be due to the differences in the laws, governmental incentives, and societies. In addition, H₆, which was identified during model fitting, reveals the depth of green consumption behaviour. In fact, our final model shows that customers normally purchase green products first before participating in additional green practices.

Inspecting hypotheses H_{1a}, H_{5b}, and H₆ simultaneously highlight interesting information: IMP → INT → PUR → PRA. Since data from both countries supports these hypotheses, it means that, regardless of the contextual differences, as long as customers perceive some sorts of implicit incentives, they will have a higher level of intention to be involved in green consumption behaviour, which subsequently leads to purchase more green products and to participate in green practices.

In contrast to H_{1a}'s finding, H_{1b} is only supported in the Australian context. It means that when Australian consumers intend to engage in green consumption behaviour, they are likely to both purchase green products and participate in green practices. On the other hand, in Singapore, when customers intend to be involved in sustainable consumption collaboration, they tend to only purchase green products, which subsequently leads to participating in green practices. In other words, green purchase is a mediator of the relationship between green purchase intention and green practices in Singapore. This perhaps is an indication of the contextual effect: customers in the two countries adopt different approaches to partake of green consumption behaviour.

The findings of H₂, H₃, H₄, and H_{5a} contrast the contextual difference between the two countries on what other factors, besides implicit incentives, affect customer's intention on sustainable consumption collaboration. Interestingly, while H₂ and H₃ are supported by the Australian sample, H₄ and H_{5a} are supported by the Singapore sample. This means that green purchase attitudes and subjective norms prompt consumers' intentions to be involved in green consumption behaviour in Australia. However, to increase consumers' intention to take part in green consumption behaviour in Singapore, we need to improve perceived behavioural control and explicit incentives.

In the same way as the aforementioned hypotheses, H₇, H₈, and H₉, which were also discovered during the model fitting process, also highlight the contextual difference between the two samples. In Singapore, only subjective norms of consumers increase their green consumption behaviour. On the other hands, in Australia, both explicit incentives and perceived behavioural control affect consumers participation in green

consumption. Interestingly, H₉'s results contradict our initial hypothesis, especially in the Australian context. In fact, the findings show that explicit incentives decrease consumer participation in green practice. A possible explanation is that a confounder, which is not a part of our model, is causing this negative value. We suspect that it may be price which is a common cause of explicit incentives and green consumption behaviour.

The final, new hypothesis found during the model fitting process was H₁₀. Based on our findings, the relationship between implicit incentives and green purchase are only valid in the Singaporean context. Specifically, in Australia, this relationship is fully mediated by consumer intention to carry out sustainable consumption activities.

With respect to the cognitive expectation of a person's green purchase intention on the willingness of consumers to participate in product recycling or renewal programs (H_{1b}) the study shows differing results in Australia and Singapore. While there is a positive and significant association between sustainable consumption intention and participation in sustainable consumption activities in Australia, the study shows no significant relationship between these two constructs in Singapore. In other word in Australia, those who are in charge of purchasing green products for household would also participate more in sustainable consumption practices, such as using their own bag when shopping, or separating different types of rubbish for recycling.

As hypothesised in the literature, e.g. Hartmann and Apaolaza-Ibáñez (2012), favourable attitude toward the green behaviour increases the cognitive expectation of a person to buy green products or pay more for environmentally friendly products supporting H₂ in Australia. However the findings do not support this linkage in Singapore.

IMPLICATIONS

Our findings show distinct differences between Singapore consumers and their Australia peers in terms of the factors that prompt them to purchase green products and to engage in green practices. This contrasting finding points to the effects that culture, environment and customary practices have on individual consumption practices. It underscores the importance of understanding social norms and economic incentives in inducing green consumption behaviour. Perrels (2008) argued that transition to sustainable consumption should be triggered, rather than enforced, and not upset socio-economic fabrics. To the extent that social norms, cultural influences as well as incentives could all contribute to inducing green consumption behaviour, understanding the disparate effects these factors have in helping to trigger a culture of green consumption practices would auger well with Perrels' (2008) call. These understandings would enable appropriate policy measures be formulated to transition different communities to attain a greater level of consumption behaviour without undue disruptions to local socio-economic fabrics. This study has provided a starting point on which antecedents of sustainable consumption behaviour in different socio-cultural contexts could be separately explored.

CONCLUSION

Green supply chain collaboration is gaining currency as an imperative to achieving superior supply chain performance. This paper argues that green supply chain collaboration cannot ignore the contribution of consumers. Neither can it afford to adopt a narrow view of green consumerism that focuses merely on "the production, promotion, and preferential consumption of goods and services on the basis of their pro-environmental claims" (Akenji 2013; p. 13). Understanding the role consumers play in sustaining green supply chain operations goes beyond green consumerism, it requires an appreciation of the lifestyle choices consumers make in everyday activities that meet the definition of sustainable consumption, including decisions that have a long term impact on the environment. This paper presents our research findings of a SEM model in which antecedents of individual sustainable consumption behaviour in two cultural contexts are explored.

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PHYSICAL BARRIERS TO SEAMLESS MOVEMENT OF RAIL FREIGHT ACROSS ASEAN BORDERS: AN EMPIRICAL STUDY.

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ABSTRACT

This paper aims to discuss the physical barriers, which hinder the seamless cross border rail freight movements in ASEAN mainland. In the cross border rail freight movements' area of study, there are limited resources of literature review pertaining the subject matter. Nevertheless, the official agreements of transportation of ASEAN, such as 2010 Master Plan on ASEAN Connectivity, 2005 ASEAN Framework Agreement on Multimodal Transport and 1998 ASEAN Framework Agreement on the Facilitation of Goods in Transit, had provided some goods information, although not so much, regarding the said barriers. Thus, the main data for this particular paper had been gained through the experience of the stakeholders.

1. INTRODUCTION

The Association of South East Asia Nation, or commonly known as ASEAN, is a very well known for its working groups. The agreements made between the members had showed the commitments that the members willing to put forwards for the developments of this sub-region collectively. As for the transportation industry, this sub-region had translated the commitments into action by ratifying the 1998 ASEAN Framework Agreement on the Facilitation of Goods in Transit (AFAFGIT). Also as for the 2005 ASEAN Framework Agreement on Multimodal Transport (AFAMT), the ratifications had started to be made by the members to put it into force. Eventually, the agreements made between the members emphasize on generality rather than specification. Protocol 6 of AFAFGIT, which touched on the Railways Border and Interchange Stations, had yet to be ratified by any of ASEAN members. This indirectly showed that ASEAN is still not ready for the cross border rail movements in a bigger scale. The agreement alone could not be the only problem preventing the cross border rail freight movements in this sub-region. Before the regulation or agreement could be enforced, it is better to touch on the physical barriers, which hinder the cross border rail freight movements, seamless journey specifically. In making the intention of connecting this sub-region physically, which emphasized under the 2010 Master Plan on ASEAN Connectivity, analysing the said physical barriers could be a starting point where the connectivity construction should start, especially for cross border rail freight movements.

2. ASEAN CROSS BORDER RAIL FREIGHT MOVEMENTS

In this sub-region, for land transportation, as compared to the road mode, the rail mode transportation is less popular in term of selection by the consignors for cross border carriage of goods. The rail transportation, or referred to also as the train mode, is still a developing mode of transportation in this sub-region. Even though the said mode of transportation is included in the physical connectivity category, under the 2005 Master Plan on ASEAN Connectivity, but the current developments, especially in term of facilities, for rail transportation, is still at the early stages although the appearance of this mode in the sub-regional carriage industry is acknowledged for quite some time already.

The current cross border rail freight movements, which currently only take place between Malaysia and Thailand, are operating on the managements of two

different rail companies between two different states, namely Keretapi Tanah Melayu Berhad (KTMB) for Malaysia and State Railway of Thailand (SRT) for Thailand. These companies are the only service providers for rail freight service in their respective countries. The cross border rail freight movements' in ASEAN mainland, as for now, need to undergo changes prior to entering into another country. Practically, that is the procedures that need to be undergo as the countries involved, which currently only Malaysia and Thailand, limiting the number of service provider for rail freight to only one in their respective country. Normally the freight train will stop at Padang Besar station in Perlis, Malaysia to undergo the said change. If the goods coming from Malaysia and heading to Thailand, the KTMB train will be detached and leaving only the wagons to be picked up by SRT train to continue the journey in Thailand. The situation is vice versa if the goods originated from Thailand, which destined for Malaysia.

Previously, there were also another cross border rail freight movements, which took place between Malaysia and Singapore. Eventually, the cross border rail freight movements between Malaysia and Singapore ended somewhere in 2011, (Nur Adila Abdul Wahab, 2011), after serving the countries for almost a century (Tan, 2004). Comparing to the Malaysia-Thailand cross border rail freight movements, the Malaysia-Singapore rail freight movements did not have to undergo physical changes, locomotive changes specifically. It was due to the fact that KTMB was the service provider for rail freight back then for both countries. No conflict in term of service provider occurred as the facilities, previously owned by the original Singapore rail company, known also as the Singapore Government Railway, had been purchased by Government of the Federated Malay States in 1918, prior to its first cross border rail freight movement. Then, the name of the service provider had been changed to Federated Malay States Railway (FMSR) which later, in 1948, been changed again into KTMB (Tan, 2004).

As for the timeframe require for changing of locomotive, according to one of the KTMB officers who works at Padang Besar, the waiting time for such changes is vary. It is vary depending on the commitment of the service providers, or carrier. In a best-case scenario, the changing time could be less than an hour. But as for the worst-case scenario, the said changes could take days to be completed. It is depend on how fast the carrier from across the border could provide the locomotive. According to Rizat Rahim in an interview, an employee of Multimodal Freight (M) Sdn. Bhd., on the timeframe for locomotive changes "Due to the problem with locomotives, even though we (the rolling stocks) reached here within a few days, but (we) got stuck up to weeks. Thus, it creates problems for the shipment. At that point of time (previously), we could make it (rail freight shipment) in record time. Due to the efficiency of the service, there were a lot of customers coming for the service. But due to the stuck issues, a lot of the customers left the service for other services especially vessel."

The time requires for the changes of locomotive is influenced by various surrounding factors including some of the physical barriers. In the case of physical barriers, they had influenced the seamless journey from the physical perspective

In term of regulations changes, which touch on the documentations for the movements, it could be said that the changes are very minimal, for both, previous and current cross border rail freight movements, and also for both end of peninsular Malaysia cross border movements, which between Malaysia and Thailand and Malaysia and Singapore. Either in term of documentation of transportation or regulation of the authorities, both changes are minimal. The documentations for the journey normally will be done by the freight forwarding agents appointed by the consignor and the documentations are prepared ready

for cross border movements, for all countries that the goods will go through. Even so, the inspections by the Customs departments for both countries are compulsory. Indirectly, the current cross border rail freight movements in ASEAN could be said as not seamless movements.

3. SEAMLESS MOVEMENT OF RAIL FREIGHT

Conceptually, a seamless cross border rail freight shipment suggested that the train move from the place of origin towards the destination without the need to undergo any changes, neither documentations nor transportation. The idea behind the seamless journey is to enable the cross border rail freight movements to be made in the most efficient way with the shortest time period by avoiding unnecessary procedures. Accordingly, there are two types of seamless movements, which are related to cross border rail freight movements namely physical and regulatory, seamlessness. The physical seamlessness means that the movements of train are seamless physically without need to undergo physical changes. Secondly, the regulatory seamlessness involved the aspect of regulations imposed over the cross border rail freight movements. This particular type of seamless movement could also be more accurately described as the 'soft seamlessness' as it touches on the aspect of regulations. The example of seamless under this category is that the train need not undergo any changes in the documentations of shipments, which could include the regulations of the country such as the customs regulations.

4. PHYSICAL BARRIERS

The physical barriers for cross border rail freight seamless journey touches heavily on the physical seamlessness aspect.

4.1 Train availability

The rail industry in this sub-region, ASEAN, had shown very little growth for the past years in term of facilities. Nevertheless, the growth in term of service also is not that obvious. In the case of Malaysia, for example, the locomotive available could not cover both the passengers and freight transportation demand accordingly. In an explanation by the KTMB Gemas station Operation Executive, Basri Abu Bakar, the intention of KTMB, especially the passenger branch, in the first place is to provide commodity services to the citizens of Malaysia. Business is not its primary intention. Thus, meeting the intention of KTMB, the service of passenger train will always be the priority for the company when balancing the demand between the passenger and freight train. In another country, Vietnam, according to the director of the railway in the central province of Quang Binh, Nguyen Ngoc Le, the priority of service in that nation has almost the same modus operandi as in Malaysia. According to him "The market trains have brought about great benefits for locals in remote areas, not in terms of profit, but in social welfare (Tre, 2014)."

Being the other responsible and committed party of Malaysia-Thailand cross border rail freight movements, the shortage of locomotive from SRT is also influenced by the priority of service factor. Commenting on the issue of shortage of locomotive from Thailand for the cross border rail freight movements, Rabi Kassim, Padang Besar KTMB employee stated that, in an interview, "As for SRT, they put more weight on their passenger carrier."

It could be seen that the pattern of train service lean more towards prioritizing the passenger carriage train services. Although the said priority might not be the case for some of ASEAN members, since the cross border rail freight movements require the mutual commitment by the members, the said unavailability or shortage of transportation, would definitely influence the rail freight movements.

4.2 Facilities

The factor of commitment in term of prioritising the train service not only limiting the availability of train, but also limiting the availability of the railways facilities for freight train usage. The railway facilities are another physical barrier for seamless cross border rail freight movements. Under the scope of facilities, there are various parts of facilities that amount to physical barriers, which prevent a seamless journey for rail freight. Breaking the facilities into smaller more focussed categories, these individual categories then could be more conveniently classified into 'railways' and 'facilities technologies'.

4.2.1 Railways

Under the categories of railway, there are a few parts that had and still become the physical barrier for the seamless cross border movements. The parts are rail availability and the rail gauge.

4.2.1.1 Rail links availability

Commenting on the reason of non-connectivity of ASEAN members through rail, Ruth Banomyong agreed on the unavailability of rail links had and still has contributed towards the non-connectivity of rail connectivity. Answering the question on the availability of rail links for cross border rail freight movements, touching on Thailand's situation, he mentioned in an interview that "No, because the one between Thailand and Cambodia, you still have missing links. Between Cambodia and Vietnam I think you have 200km. The other one that exist is between Vietnam and China. Hanoi to Kunming and also Hanoi to Nang Ning. But that's not ASEAN. That's with China. In fact you only have this one, which is between Padang Besar (Malaysia) and Hatyai (Thailand)."

According to ASEAN Connectivity: Project Information Sheet (2012), the incomplete rail links in this subregion are the combination of incomplete links internally and externally for the ASEAN members. Below are the missing links according to ASEAN as on 2012:

Country	Missing sections/ route & spur lines	Rail length (km)		Pre-feasibility (Pre-FS) or Feasibility Study (FS) status	Implementation status	Planned completion year
		Existing length of section	New construction			
Cambodia	Poipet (Thailand border) – Sisophon	-	28	Completed	On-going	2015
	Phnom Penh – LocNinh (Vietnam border)	32	254	On-going	Not commenced (under negotiation for funding)	2015
Vietnam	LocNinh (Cambodia border) – Ho Chi Minh City	20	129	FS Completed	Not commenced	2020
	Mu Gia (Lao PDR border) – Tan Ap	-	53	Pre-FS Completed	Not commenced	2020

	Tan Ap – VungAng	6	66	FS On-going	Not commenced	2020
Thailand	Aranyaprathet – Klongluk	-	6	FS Completed	The budget for the rehabilitation had been allocated and is now in the process of bidding its contractor	2014
Lao PDR	Vientiane - Thakhek	-	330	FS Completed	Not commenced	2020
	Thakhek – Mu Gia (Vietnam border)	-	136	FS Completed	Not commenced	2020

Source: ASEAN Connectivity: Project Information Sheet (2012).

Table 1: ASEAN mainland rail missing links.

Facing the problem of unavailability of links, Arjun Goswami, the director for Regional Cooperation and Operations Coordination Division (SERC) of Southeast Asia Department at Asian Development Bank, mentioned that, the real work that need to be done by the countries in connecting the intended SRKL should begins at home first, which is within their respective state territory (Viboonchart, 2012). The rail links are the basic necessities for the train to move. It is obvious that without the rail links, the intended movements could not be completed. Thus, the completion of internal railway links will indirectly contribute to the completion of sub-regional rail links.

4.2.1.2 Gauge size

In ASEAN, the constructions of the new facilities and improvements of the existing facilities is very much influence by the current facilities and the history of the railway facilities developments in the member countries. With the nature of the train, which requires specific gauge size, it is important to ensure that the members of ASEAN are using the gauge with the same size. The different in term of gauge size will prevent the seamless movements of rail freight. This particular problem had been emphasised in the paper made for Global Forum on Transport and Environment in a Globalising World (Woodburn, A., et al. (2008)). Taking the example of Mongolia. The construction of railways in this country is influenced by the close historical ties that it has with Russia. The gauge build are according to Russian size. In reality, the economic benefits that the country gain from its other neighbour, China, is bigger than what they received from Russia (Kohn, 2013). According to United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP, 1996), the rail gauge size for available rail links in ASEAN mainland countries is fixed at a metre gauge. The said gauge does not include the links that Vietnam has with its northern neighbour, China. If those links included, then, Vietnam is the only country having more than one gauge size used. But, the upcoming constructions of new rail links might or might not follow the current rail gauge size. The different size gauge had also been highlighted as the rail connectivity problem under TEM and TER revised Master Plan Final Report Volume 1: Main Text (UNECE, 2012).

4.2.2 Facilities compatibility

Other than the issue of availability, the aspects of compatibility of facilities also need to be looked into. With the commitment of constructing the railway facilities vested on the country itself, the phase of the constructing is basically depends on

the need and affordability of the said country. David H Bill of Railway Industry Association of United Kingdom mentioned in an interview "...cross border is a major issue in Europe because technology is different in the other side of the border..."

The developments of rail facilities in this sub-region have not been in a synchronize method between members neither. One country might have all the resources needed to carry with advance developments and it is not the case for some others. In the case between Malaysia and Thailand, Ruth Banomyong through interview mentioned that the facility in "...Malaysia is electrified its rail system but Thailand they still using diesel locomotive. So that means that you can't even cross the border. You stuck because you don't have any energy."

Rizat Rahim mentioned on this issue as follow "For example here in Malaysia, we are a little bit advances. We use a lot of automatic stuff. For example, we use a lot of light rather than the traditional methods of signalling. But at the Thai side, they are still using the traditional way of signalling. The principles are the same but the part of implementation, it is different."

For the Malaysia-Thailand cross border rail freight movements, the compatibility issue had emerged as an obvious physical barrier for the seamless cross border rail freight movements.

4.3 Geographical landforms

The connectivity of rail links, which is the core of railway movements, is also influenced by the geographic landforms of the countries. These landforms had contributed to the impossibility of connectivity without any support facilities been made. In the case of Lao PDR, a huge scale constructions need to be done in order to provide the country with the ample facilities that could connect the country with its neighbours. 76 tunnels and 54 bridges required by Lao PDR to ensure the connection of the rail links with its neighbours due to mountainous nature of its northern part (Radio Free Asia, 2012). In ensuring the connectivity through that particular part of the country, the options available are either to construct the suitable facilities for train movements or to choose other mode of transport for transportation. But, the latter could not contribute to the cross border seamless rail freight movements.

5. CONCLUSION

The intention of connecting this sub-region physically might be the opportunity for the rail freight industry to improve itself and become among the important mode for cross border freight movements. The idea of having seamless cross border rail freight movements might increase the reliability of rail transportation in this sub-region specifically, which could possibly put the rail industry in a position where it eligible to compete with other modes of transportation, especially road transport (i.e. road haulage). Looking at the physical barriers, they are the first problems that need to be addressed accordingly in preparing ASEAN rail industry for seamless journey. Every project must begin somewhere and talking the physical barrier, as the starting point for physical developments of rail industry, will ensure that the ide of seamless journey could be turn into reality. Until these problems are been looked into, the freight train might not be able to have seamless journey, physically.

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DEVELOPMENT OF FORECASTING METHOD CONCERNING WATER DEMANDS IN THE OKINAWA PREFECTURAL WATERWORKS SERVICE AREA

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ABSTRACT

Forecasting the water demands is very important for pure-water reservoirs. Because the value of water supply to the water supply stations cannot be changed frequently according to the variation of water demands. The goal of this study is to propose forecasting method of water demands applying all over the country in Japan. In previous studies, we proposed four kinds of methods of forecasting the water demands using data of value of water supply per day offered by two of self-governing bodies. And, forecasting precision is leded approximately 2%. In this study, to improve forecasting precision, development of forecasting method concerning water demands is examined using data of value of water supply per day of Okinawa prefectural. In Okinawa prefectural, there are some unique matters as compared with other prefectures in Japan. Therefore, it considers that if forecasting precision of this examination becomes higher than that of previous studies, forecasting method concerning water demands is developed. As the results of this examination, it is found out that forecasting precision of this examination is equivalent to the forecasting precision of previous studies.

INTRODUCTION

The value of water supply to the water supply stations cannot be changed frequently according to the variation of water demands, because management of water resources, e.g., river water, has various restrictions (e.g. the amount of extracted water from a river around unit time, etc.). Therefore forecasting the water demand is very important for pure-water reservoirs. The goal of this study is to propose forecasting method of water demands applying all over the country in Japan. In previous studies, we proposed methods of forecasting the water demands in the small scale water works area (Kanagawa prefectural) and large scale water works area (Tokyo metropolitan). These proposed methods were based on a multivariate regression analysis, and be considered variations in economic conditions for the service area. We called this method "M method". In this study, we use the data of water supply per day of Okinawa prefectural, and we forecast the value of water supply per day. In Okinawa prefectural, there are some unique matters as compared with other prefectures in Japan. The major unique of Okinawa prefectural is that the most of water resource for pure-water is not river water but rain water stored to dams. Because there is no a big river which be able to extracted water resource for pure-water in Okinawa prefectural. Therefore, the higher forecasting precision of the water demands is needed.

In this paper, the value of water supply is forecasted applying proposed forecasting method using the data of water supply per day of Okinawa prefectural. And, it shows that this forecasting precision is equivalent to the forecasting precision of previous studies. Moreover, factors which are improved forecasting precision are examined. In next section, the characteristics of water supply of Okinawa prefectural are described. In third section, the proposed method of forecasting the demand for water supply per day is explained. In forth section, the results of the demand for water supply per day are shown. In fifth section, the factors which are improved forecasting precision are examined.

CHARACTERISTICS OF WATER SUPPLY OF OKINAWA PREFECTURAL

In this section, the characteristics of water supply of Okinawa prefectural are described. As mentioned above, in Okinawa prefectural, there are some unique matters as compared with other prefectures in Japan. Firstly, the characteristic of weather information is described. Only Okinawa prefectural belongs to the subtropical zones, other prefectures belong to the Temperate Zones. So, the mean air temperature of Okinawa prefectural is higher than that of other prefectures. In previous studies, it is significance that there is correlation between the maximum temperature and the value of water supply. However, there is no a big river which be able to extracted water resource for pure-water in Okinawa prefectural. Although, an amount of precipitation per one year of Okinawa prefectural is more than the average amount of that of Japan, an amount of precipitation is secured instability through a year. Therefore, it is considered that forecasting the water demand of Okinawa prefectural is very important.

Next, the characteristic of the water supply system and the value of water supply are described. In Okinawa prefectural, most of water resource for pure-water is not river water but rain water stored to twelve of dams. The water supply system of Okinawa prefectural waterworks service area, Kanagawa prefectural waterworks service area and Tokyo metropolitan waterworks service area is following.

- In case of Okinawa prefectural waterworks service area
rain water stored to dams -> a water purification plant -> a clean water reservoir -> a regulating pondage (*) -> a distributing reservoir -> each home
- In case of Kanagawa prefectural and Tokyo metropolitan waterworks service area
river water -> a water purification plant -> a clean water reservoir -> a distributing reservoir -> each home

Thus, in the process of the water supply system of Okinawa prefectural, a regulating pondage (*) is existed. And, in this study, collected data of the value of water supply per day at a regulating pondage are used. In previous studies, those at a distributing reservoir are used. Then it is assumed that these data are equivalently. In Figure 1, a transition of the value of water supply per day of Okinawa prefectural for one year is shown. In Figure 2, a transition of the value of water supply per day of Tokyo metropolitan for one year is shown. Still a transition of the value of water supply per day of Tokyo metropolitan and that of Kanagawa prefectural are similar tendency.

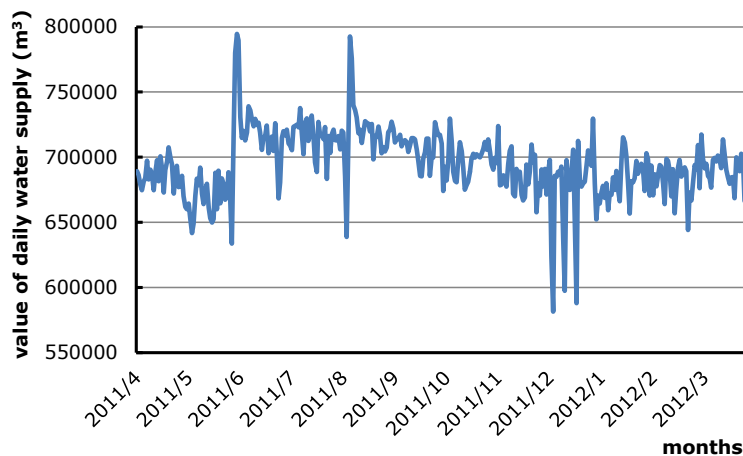


Figure 1: Transition of the value of water supply per day of Okinawa prefectural

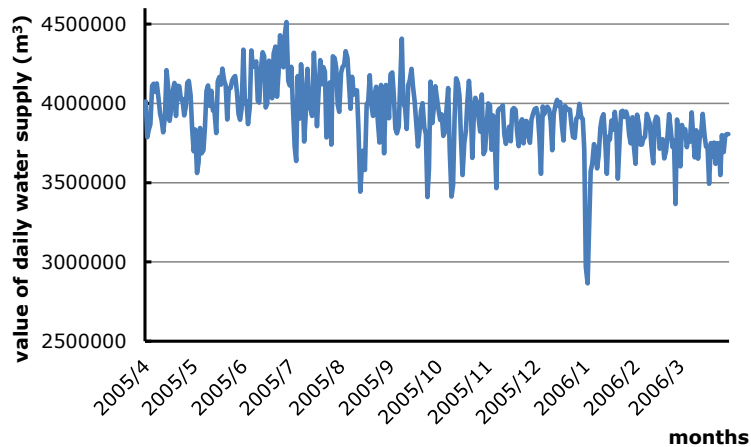


Figure 2: Transition of the value of water supply per day of Tokyo metropolitan

As shown in Figure 1 and Figure 2, although scale of the value of water supply per day and used data period between Okinawa prefectural and Tokyo metropolitan is different, characteristic of transition of the value of water supply per day is that the value of water supply per day in the summer period tends to increase than that in the other seasons period. Thus, a transition of the value of water supply per day of Okinawa prefectural and that of Tokyo metropolitan are similar tendency. In Figure 1, increasing the value of water supply per day rapidly is the following day of heavy rain or typhoon. And decreasing the value of water supply per day rapidly is the day of heavy rain or typhoon.

In Figure 3, the average value of water supply per day of each day of the week of Okinawa prefectural for one year is shown. In Figure 4, the average value of water supply per day of each day of the week of Tokyo metropolitan for one year is shown. As shown in Figure 3 and Figure 4, although scale of the average value of water supply per day between Okinawa prefectural and Tokyo metropolitan is different, characteristic of the average value of water supply per day of each day of the week is that the amount of scatter of the average value of water supply per day among each day of the week of Okinawa prefectural is smaller than that of Tokyo metropolitan. Especially, in Tokyo metropolitan, the amount of scatter of the average value of water supply per day between weekday (from Monday to Friday) and holiday (Saturday and Sunday) is large (** in Figure 4; ** means 1% significance by t-test; * means 5% significance by t-test). By this condition, in previous studies, we proposed the forecasting method of water supply per day for a weekday and that for a holiday, respectively.

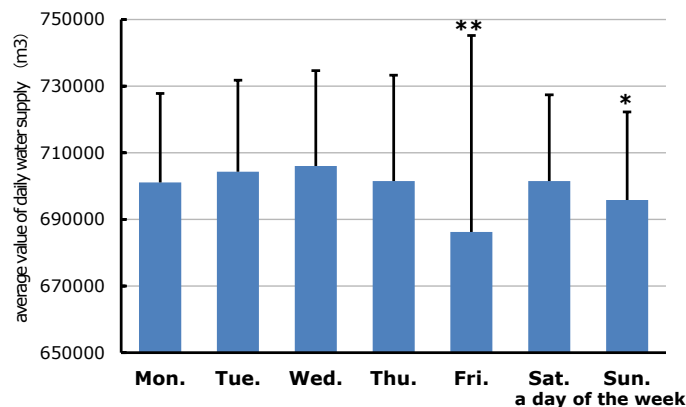


Figure 3: The average value of water supply per day of each day of the week of Okinawa prefectural

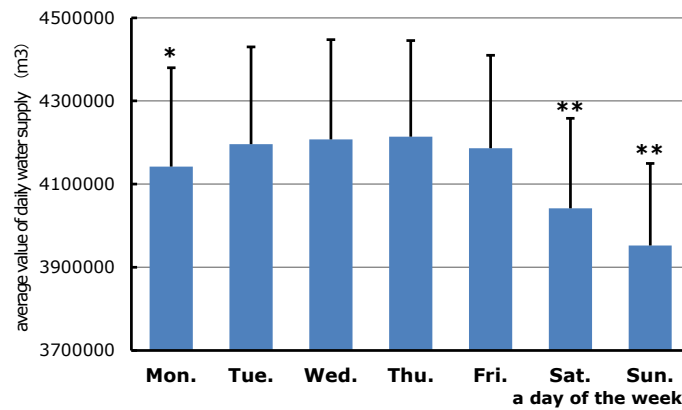


Figure 4: The average value of water supply per day of each day of the week of Tokyo metropolitan

OUTLINES OF FORECASTING METHOD OF WATER SUPPLY PER DAY

In this section, outlines of proposed forecasting method of water supply per day in previous studies are explained briefly. In this study, only proposed forecasting method of water supply per day for a weekday is applied. Because, the amount of scatter of the average value of water supply per day among each a day of the week is small as shown in Figure 3. The point of this forecasting method is following three matters. 1) Based multivariate regression analysis. 2) Using multiple years data of the value of water supply per day. 3) Correcting the obtained multivariate regression formula by single regression analysis. The notations are defined as follows:

- Y : A variable representing the year in the western calendar.
- M : A variable representing the month ($M = 1, \dots, 12$)
- D : A variable representing a specific day of the year ($D = 1, \dots, 366$). A value of $D=1$ corresponds to January 1st, and $D=366$ corresponds to December 31th. The date on February 29th is assumed to exist even in non-leap years, and is treated as a missing day in the actual data
- D_M : The first weekday of the year and month of the date of forecasting
- t : A variable representing period of using data to make forecasting formula. In this study, this variable is called "regression period".
- x_i : Explanatory variables ($i = 0, 1, \dots, m$)
- $\hat{a}_i^{(Y-j)}$: Estimator of the partial regression coefficients for $Y-j$ year ($i = 0, 1, \dots, m, j = 1, 2, \dots, n$)
- m : Numbers of explanatory variable
- n : Numbers of past year

And, the procedure of this forecasting method consists of following five steps.

Step 1 is collecting the data of weather information and so on which are correlative to the value of water supply per day by correlation analysis for regression period as shown in Figure 5. In Figure 5, horizontal axis represents date, and vertical axis represents year.

Step 2 is making the multivariate regression formula for each year using collected data in Step 1. The obtained multivariate regression formula is expressed in equation (1).

$$\hat{Z}^{(Y-j)} = \sum_{i=0, j=1}^{m, n} \hat{a}_i^{(Y-j)} x_i (x_0 \equiv 1) \quad (1)$$

Thus, n of multivariate regression formulas are obtained by multivariate regression analysis.

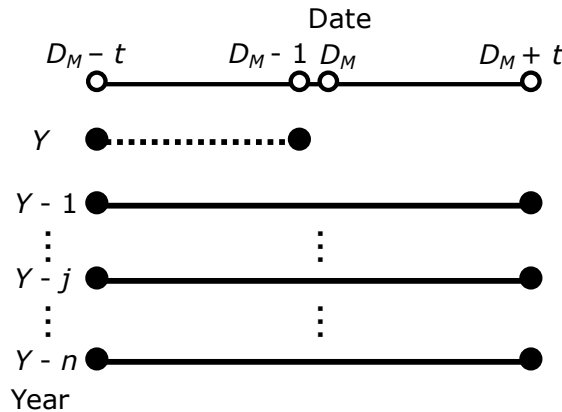


Figure 5: Used data range for multivariate regression analysis

Step 3 is calculating the temporary forecasting value of water supply per day from $D_M - t$ in Y year to $D_M - 1$ in Y year (period of a dotted line in Figure 5) using obtained n of multivariate regression formulas.

Step 4 is correcting each obtained multivariate regression formula by three correction methods with correlation between the actual value of water supply per day and the calculated temporary forecasting value of water supply per day in Step 3. In Figure 6, the concept of correction method is shown.

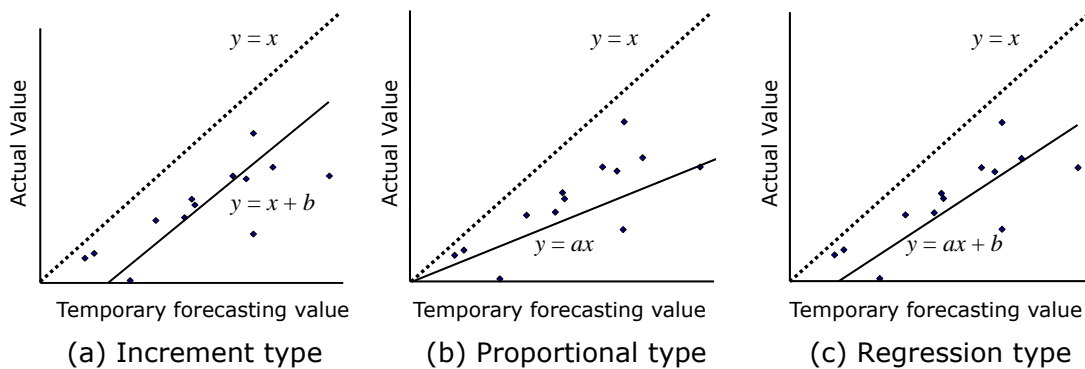


Figure 6: The concept of correction method

In each figure, horizontal axis represents temporary forecasting value, and vertical axis represents actual value of water supply per day. And the relationship of these values is examined. About this examination, the obtained temporary forecasting values should be ideally exhibited the actual value of water supply per day ($y=x$). As shown in this figure, however, the obtained temporary forecasting values are deviated from actual value of water supply per day. One of the reasons can be considered an annual fluctuation of economic variations and so on. Then, it assumes that a linear relationship is established between the temporary forecasting values and actual value of water supply per day. In order to minimize this deviation, the obtained temporary forecasting values are corrected by assumed three kinds of linear relationship. In this study, each correction method is called "Increment type" (Figure 6(a)), "Proportional type" (Figure 6(b)) and "Regression type" (Figure 6(c)), respectively. In "Increment type", it assumes that an annual fluctuation ensures constant increase to past years (it is assumed $y=x+b$). The obtained multivariate regression formula is corrected applying the obtained estimator of increase amount by single regression analysis. In "Proportional type", it assumes that an annual fluctuation ensures constant ratio to past years (it is assumed $y=ax$). The obtained multivariate regression analysis is corrected applying the obtained estimator of ratio by single regression analysis.

In "Regression type", an annual fluctuation ensures constant increase and ratio to past years (it is assumed $y=ax+b$). The obtained multivariate regression formula is corrected applying the obtained estimators of increase amount and ratio by single regression analysis. Thus, n of corrected multivariate regression formula are obtained.

Step 5 is averaging the corrected n of multivariate regression formula. And this averaged formula is the forecasting formula. The forecasting formulas of each correction method are expressed in equation (2) to (4), respectively.

- Incremental type

$$\hat{W}_1 = \frac{1}{n} \sum_{j=1}^n (\hat{Z}^{(Y-j)} + \hat{\gamma}_1^{(Y-j)}) \quad (2)$$

- Proportional type

$$\hat{W}_2 = \frac{1}{n} \sum_{j=1}^n \hat{\beta}_1^{(Y-j)} \hat{Z}^{(Y-j)} \quad (3)$$

- Regression type

$$\hat{W}_3 = \frac{1}{n} \sum_{j=1}^n (\hat{\beta}_2^{(Y-j)} \hat{Z}^{(Y-j)} + \hat{\gamma}_2^{(Y-j)}) \quad (4)$$

Actually, one correction method is selected from three kinds of correction method. A forecasting value of water supply per day is calculated substituting weather information and so on of forecasting day for the forecasting formula.

RESULTS OF FORECASTING VALUE OF WATER SUPPLY PER DAY

In this section, results of forecasting value of water supply per day of Okinawa prefectural are shown. Firstly, used data period and evaluation period are set.

- Used data period

The data of the value of water supply per day offered by Okinawa Prefectural Enterprise Bureau are used from April 1st 2007 to March 31th 2012 for five years. And, the data of weather information for used data period are downloaded from website of Japan Meteorological Agency. Regression period sets 42days ($t=42$ in Figure 5). Past year sets 4 years ($n=4$ in Figure 5).

- Evaluation period

The forecasting values of water supply per day are evaluated from April 1st 2011 to March 31th 2012 for one year. Still, the forecasting values of water supply per day for this evaluation period are calculated assuming no data existence of water supply per day for this evaluation period.

Next, the explanatory variables of the forecasting formula are selected. These factors related to the value to water supply per day are selected. In this study, following nine of factors (two kinds of categories) are selected.

- Category of weather information (seven of factors)

Maximum daily temperature, maximum daily temperature squared, temperature difference, rainy in the morning, rainy in the afternoon, cloudy in the morning, cloudy in the afternoon

- Category of a day of the week (two of factors)

Friday, Sunday

On these conditions, forecasting formula is led, and forecasting values of water supply per day are calculated. In Table 1, a part of result of forecasting value of water supply per day in evaluation period of this study is shown.

As shown in Table 1, result of forecasting value of water supply per day is different among correction methods and among dates.

Date	Actual Value	Incremental	Proportional	Regression	No correction
2011/4/1	689200	681532.30	679866.83	707422.87	660972.01
2011/4/2	686300	718464.54	718152.91	707458.74	697904.25
2011/4/3	678700	713863.96	713413.23	706943.93	693303.67
2011/4/4	674600	707235.49	706733.79	703551.18	686675.20
2011/4/5	681400	715175.61	714816.41	706002.33	694615.32
2011/4/6	683900	717808.03	717485.66	707198.78	697247.74
2011/4/7	697200	718971.12	718667.75	707658.92	698410.83
2011/4/8	682800	686382.69	684812.25	708991.60	665822.40
2011/4/9	690400	722953.93	722735.53	708779.05	702393.64
2011/4/10	686800	718149.34	717789.58	708165.78	697589.05

Table 1: A part of result of forecasting value of water supply per day (Units: m³)

EVALUATION OF FORECASTING PRECISION

In this section, forecasting precision is evaluated. In this study, the evaluation method is expressed in equation (5).

$$q = \frac{|(\text{forecasting value}) - (\text{actual value})|}{(\text{actual value})} \times 100 \quad (5)$$

As shown in equation (5), forecasting precision (q) is evaluated using the absolute value of relative error ratio of forecasting value of water supply per day to actual value of that. In Table 2, forecasting precision in evaluation period of this study is shown.

Months	Incremental	Proportional	Regression	No correction
Apr. 2011	3.42	3.39	3.09	1.93
May. 2011	4.61	4.60	4.00	4.04
Jun. 2011	2.24	2.25	2.46	2.33
Jul. 2011	2.25	2.23	1.24	2.21
Aug. 2011	2.86	2.87	2.11	2.93
Sep. 2011	1.13	1.13	1.18	1.22
Oct. 2011	1.17	1.18	1.19	1.41
Nov. 2011	1.55	1.56	1.48	2.02
Dec. 2011	3.83	3.82	3.70	3.81
Jan. 2012	2.02	2.03	1.69	1.93
Feb. 2012	2.75	2.82	1.70	2.73
Mar. 2012	2.53	2.53	1.65	2.45
All	2.54	2.54	2.13	2.42

Table 2: Forecasting precision in evaluation period (Units: %)

In table 2, forecasting precision is evaluated using the absolute value of averaged relative error ratio for each month in evaluation period of this study. And the absolute values of relative error ratio drawn background represent highest forecasting precision in each month. As shown in Table 2, forecasting precision of "Regression type" of correction method becomes highest in evaluation period of this study. And forecasting precision of "Regression type" of correction method becomes highest in all evaluation period of this study. Moreover, this forecasting precision is 2.13%, and this precision is equivalent to that of previous studies (approximately 2%).

CONCLUSION

In previous studies, we proposed four kinds of methods of forecasting the water demands using data of value of water supply per day offered by two of self-governing bodies. And, forecasting precision is leaded approximately 2%. In this study, the value of water supply is forecasted applying proposed forecasting method using the data of water supply per day of Okinawa prefectural. In Okinawa prefectural, there are some unique matters as compared with other prefectures in Japan. For example, most of water resource for pure-water is not river water but rain water stored to twelve of dams. The amount of scatter of the average value of water supply per day among each a day of the week is small. Therefore, only proposed forecasting method of water supply per day for a weekday is applied. And, forecasting precision is leaded approximately 2% in evaluation period of this examination. As the results of this examination, it is found out that forecasting precision of this examination is equivalent to the forecasting precision of previous studies.

The feature tasks are considered following subject.

- Improvement of forecasting precision using data of value of sewerage
- Development of correction method

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AN ANALYSIS OF MULTIMODAL TRANSPORT ROUTES FOR CONSTRUCTION EQUIPMENT IN VIETNAM

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ABSTRACT

Purpose of this paper: The purpose of this paper is to analyse intermodal systems in Vietnam in respect of the movement of large units of construction equipment to building projects in northern Vietnam.

Design/methodology/approach: The basis of analysis is the application of a time-cost-distance model which allows different routes to be compared directly. The paper is case-study based, using data supplied by logistics companies and their transport sub-contractors. Data were collected through interviews and questionnaires. Routing options for the movement of oversized construction equipment from southern to northern Vietnam are compared, and strengths and weaknesses within the respective supply chains identified.

Findings: The main contribution of the paper is to identify the most suitable route for the cargo taking account of operational constraints. In Vietnam, domestic transport is shown to be complex, and under-developed because of infrastructure weaknesses and a regulatory framework which is incomplete. The cargo characteristics lead to specific requirements which elevate security, safety and avoidance of damage to high priority considerations. There are shown to be four main routes which can fulfil the overall needs of shippers but each route is shown to be sub-optimum in terms of one or other consideration.

Value: The paper provides an analysis of multimodal transport routes for 'over-sized' cargoes not previously undertaken in this form for Vietnam.

Research limitations/implications: As often occurs with studies of this type the acquisition of data is difficult and the number of routes studied limited. Future research could be undertaken to explore a wider range of multimodal transport corridors and solutions.

Introduction

The shipment of over-sized construction equipment from southern Vietnam to northern Vietnam by Nhu Han Transport Service Co Ltd (Nhu Han Transport) forms the core of a case study analysing the issues faced in the movement of over-sized cargoes. Moreover, this paper explores the problems and issues facing the different transport modes used for this transport. The main contribution of this study is to identify the most suitable route and mode combination for shippers of over-sized cargo. In Vietnam, domestic transport is both complicated and under-developed because of two principal factors; obsolete infrastructure and incomplete regulation. Despite increasing Vietnamese prosperity, transport infrastructure is still under-developed, furthermore, the disadvantages of geography create some negative effects for transport operators. The complex and turbulent political situation have also impacted many of the traditional transport systems. However, over the last two decades, the government of Vietnam has been making fundamental regulatory and institutional changes in order to ensure a more market-oriented economy (Ruddle, 1998).

In Vietnam, there are numerous developments taking place. Large corporations transport used construction equipment between developments using obsolete transport infrastructure. This study is focused on the transport of over-sized machines and equipment that are owned by Nhu Han Transport, which is the third biggest construction company in Vietnam. The paper is based on the intermodal concept and it uses an established Cost Model to analyse and explain the current issues (Beresford, 1999). Before Nhu Han Transport began to supply transport services for this equipment, the shipper specified some special requirements in order to protect the shipment and ensure delivery to schedule. Practically, there are four main routes that could fulfil the

requirements of this project, however; many restrictions and inconvenient regulations cause some difficulties. This research explores all four routes in order to highlight both the benefits and drawbacks.

In order to find the most efficient alternative solution for Vietnamese domestic transportation of large unit load cargo, 3 main research questions were asked:

1. What are the critical factors which can influence intermodal transport operators in their choice of solution in order to eliminate barriers and enhance operational effectiveness?
2. What are the main elements which can influence shippers, consignees and carriers using intermodal transport operation in Vietnam?, and;
3. Can intermodal transport solutions eliminate some transport cost for over-sized construction Machinery, tools and equipment?

Intermodality is very suited for ASEAN countries, because of the geography (Fontaine and Workman, 1998). However, in Vietnam, the barrier of developing intermodal transport is the under-developed transport infrastructure and this is likely to be quite a significant problem facing Vietnamese transport in the future. Currently, with Vietnamese transport and investment policy being more transparent, there are many foreign investors trying to establish intermodal transport infrastructure in order to develop the domestic market. Intermodal transport in Vietnam hinges on the effectiveness of road, rail, and coastal shipping. For North – South transport, distances are sufficiently long for combinations of these three to be commercially viable. However, the transport modes have specific problems.

Road: Road transport usually provides the simplest transport solution, moreover, road transport is often used as both the starting and finishing mode in transport systems (Beresford, 1999). Door to door service is the most advantageous aspect of this mode; however, there are still some disadvantages which can impact on road transport as the mode of choice. High driver turnover can cause problems for carriers, because the cost of road haulage in comparison to other transport modes is much higher (De croon, et al, 2004; Morrow, 2005). Also, with the increasing use of container transport, congestion problems are becoming more severe, not only in the vicinity of seaports but also in some central cities (Stopher,2004). In Vietnam both recurrent and non-recurrent congestion occurs; recurring congestion because of under-developed infrastructure and the rapid development of Vietnamese economy; non-recurring because of wider problems with the infrastructure and inappropriate road development (Caramia and Guerriero, 2009).

Rail: For developing countries, infrastructure establishment is critical for economic development. Railway building is a critical part of increasing a country's prosperity. Beneficial rail facilities can enhance capital transport and reduce cargo delivery costs. Moreover, rail transport can facilitate other transport modes, for instance rail is more competitive for the hinterland transport of containers than semi-trailers, and the integration of rail transport and inland waterway can increase the efficiency of each other (Woxenius and Bergqvist, 2010). As result, compared to road transport, rail has advantages such as reducing environmental impact and decreasing transport distance costs (Roso, et al., 2009). In Vietnam, the mountainous geography confines rail mainly to the eastern coast. Recently the Vietnamese government has completed some railway construction in order to shorten the development gap between southern and northern Vietnam. Nevertheless, insufficient financial support and the special construction technology limits rail infrastructure development.

Sea: Port terminal facilities cause significant barriers for short-sea shipping. Many ports still use human power to load and unload ship cargoes; moreover, many seaports have serious draught restrictions. While Vietnam has a long coast line and should be able to develop a strong maritime transport sector, the Vietnamese seaport system has not been able to compete with neighbouring countries ports such as the ports of Singapore, Bangkok and Port Klang (Do, et al, 2011). Hence, Vietnam has no hub port in this

region. Recently, with the growth of world trade carried in containers, shipping liners, port users and port service providers are beginning to develop.

Case study

This case study considers the shipment of over-sized construction equipment from southern Vietnam (Ho-Chi-Minh) to northern Vietnam (Bac Giang). Many construction contractors consider transporting both new and second-hand over-sized construction equipment from southern construction sites in Ho-chi-Minh to northern construction sites. The Full Power Joint Stock Company (FPJSC) is one of the largest Taiwanese and Vietnamese joint ventures and has various construction sites in Bac Giang. The company needed the over-sized equipment moved on their behalf by Nhu Han Transport. This type of equipment is usually difficult to transport due to poor transport services and infrastructure. However, the Vietnamese government has already reformed some customs clearance procedures and inspection processes, as well as expanded IT systems in order to improve transport facilities and infrastructure. Table 1 identifies the key aspects of the shipments as identified by the shipper, consignee and carrier.

Table 1 Interview Results for Shipment Characteristics

Opinions of:	Shipment Value	Shipment Volume	Shipment Weight	Time Limitation
Shipper	Rare equipment in Vietnam - High value	Very large but not the biggest	Normal weight for construction tools	At most 10 days for transport
Consignee	Same as shipper	Same as shipper	Same as shipper	As soon as possible
Carrier	High value	Large construction equipment	Heavy construction equipment	Must deliver the shipment within 7 working days

There were four routes that could be used by FPJSC involving:

- Route 1.** All Road No intermodal transfer
- Route 2.** Road – Rail – Road Two intermodal transfer points
- Route 3.** Road – Rail – Road - Rail – Road Three intermodal transfer points
- Route 4.** Road - Sea (Coastal Shipping) – Road: Two intermodal transfer points

Route 1. All Road: It takes at least five days to travel to Ho-Chi-Minh from Bac Giang by road. One of the primary issues is that trucking companies avoid daytime driving to evade a surcharge by traffic police. In Vietnam carriers call this surcharge a 'Coffee Fee'. This situation is similar to that highlighted in Banomyong (2001) who named the surcharge in Thailand as a 'Tea Fee'. In order to reduce these unpredictable costs, many carriers demand that drivers pay half of this fee. Many drivers detest this regulation, thus they choose to drive during the night and use remote routes to avoid traffic police road inspection. This situation not only increases the transport time but also increases the risk within the transport process and ultimately the total transport cost is more expensive than the other three routes.

Route 2. Road – Rail - Road: This route includes both road and rail modes. The biggest problem with this route is that there are only a few flexible schedules available. In 2008, there was only one railroad service that could accommodate such shipments but the appropriate train only runs every two days. Geographically, the mountainous territory is the severest problem in developing a railway service in Vietnam. In this case, the shipment is over-sized, and halfway to the destination the rail route encounters a tunnel height restriction. Furthermore, the transport cost of this freight train service was almost the same as the uni-modal transport road service. Although it may be safer than only using road transport, the freight cost and long transport time are big issues for both shippers and consignees.

Route 3. Road – Rail – Road - Rail – Road: The third route still integrates the road and rail service but on this route there are two transfers at two different rail terminals to change to different rail tracks in order to avoid the tunnel height limitation. This meant that the transport time has to be extended and the risk is thus higher. The other noticeable issue was that the shipment was difficult to load and unload. In 2008 the basic loading and discharging superstructure at the Vinh rail terminal was not adequate. However, in order to avoid travelling along the ‘tunnel’ route, the shipment had to be transferred from the largest central rail terminal - Da Nang to the second largest rail station - Vinh. Over this 472 km route, Nhu Han Transport Service had to hire other heavy cranes and hoists to lift the cargoes at the Vinh transfer. The road transport fees were also expensive because there are fewer trucks available in this remote and under-developed region. Mostly, in this region, carriers had to hire specific truck companies. All of these extra costs were higher and more complicated. In addition, the transport time had to be extended for more than three days. In Vietnam, the weather can also be unstable and there are many rain affected days after May. These problematic factors also cause some unpredictable operational risk when using this route selection.

Route 4. Road - Sea (Coastal Shipping) – Road: The last route uses coastal shipping. According to Lowe (2005), this transport mode is the most efficient and most cost effective. In Vietnam, coastal shipping is a very common and convenient method of transport. This mode can be employed between Ho-Chi-Minh new port (coastal shipping port) to the northern main feeder and barge port of Hai-Phong. The vessels used are essentially Roll on/ Roll off (Ro/Ro) ships and therefore the transfer facilities do not need specific and complex superstructure. This can not only save a significant amount of transport time but also reduces risk. Further, the competitive freight costs of coastal shipping also contribute to the low overall transport costs compared to the other three routes. Nevertheless, this service still has cost and time disadvantages. The door to door service depends on road transport. Adverse maritime conditions can lead to service delays or cancellations. The port terminal equipment and superstructure also could not entirely accommodate loading and unloading of this type of cargo. The Ho Chi Minh new port facilities were not sufficiently robust enough to handle such over-sized cargoes. Further, Ho Chi Minh new port only opens four hours per day on average for bulk and RO/RO services, thus ships and trucks have to queue, increasing lead times and adding delay possibilities.

Cost Model Analysis of the case study routes

Route 1: According to the cost model concept, the most important factors are cost, lead-time and risk. For this route, only road transport is used. Commonly, road transport is the most expensive method (Beresford, 2001) and this is confirmed here as this is the most expensive routing option of the four routes examined here. On the other hand road transport is more dependable and offers lower risk under normal circumstances. However, the special inspection fee (‘Coffee Fee’) and the inferior quality of road infrastructure in Vietnam leads to some risk of damage and delay. The data for this route are presented in Table 2. The total cost is \$US 2953.33 and the total transport time is 122 hour, but unpredictable traffic police inspections increases the risk of delay. In addition, poor weather also degrades the road conditions and the delivery time becomes more unpredictable.

Table 2. All Road: Cost, Distance and Time

Flat Rack Unit	\$US	Kilometres	Hours
Loading Operation	117.64		2
District 9 to Bac Giang	2835.69	1197	120
Total	2953.33	1197	122

Route 2: For this route the main transport mode is rail. The geographical limitations present immense difficulty and the tunnel heights lead train schedules being less frequent. Thus the transport time is too long and the costs are high. In terms of the risk,

this route has lower risk because it only requires a small level of road transport, but the long transport time creates other unexpected risks such as construction project delays. The data for this route are presented in Table 3. The total cost is \$US 2364.64 and total transport time is 116.5 hours. The risk is lower than the Route 1 and time, cost and distance are all lower.

Table 3 - Road – Rail – Road: Cost, Distance and Time

Flat Rack Unit	\$US	Kilometres	Hours
Loading operation	117.64		2
Road - (District 9 - Song Than rail station)	184.66	12	1
First intermodal transfer	90		1.5
Waiting time			82.5
Rail. (Song Than rail station - Hanoi rail station)	1647.05	877	26
Second intermodal transfer	90		1.5
Road (Hanoi rail station - Bac Giang)	235.29	52	2
Total	2364.64	941	116.5

Route 3: For the third route option, the main transport mode is also rail. In order to avoid rail restrictions due to the difficult geography, there are two transfer points. Time, cost and risk are increased due to transfer processes. Especially, in central Vietnam, the loading and discharging equipment is difficult to acquire, thus the transfer cost is much higher than in normal circumstances. The data for this route are presented in Table 4. For this route the total cost is \$US 2563.61 and the total transport time is 129 hours. This route therefore takes the longest and the risk is also higher than the previous two routes. In this case study, it was apparent that the complicated transport processes lead to the transport cost being more expensive and of higher risk of delay.

Table 4 - Road – Rail – Road – Rail - Road: Cost, Distance and Time

Flat Rack Unit	\$US	Kilometres	Hours
Loading Operation	117.64		2
Road (Dist 9 - Song Than rail station)	184.66	12	1
First intermodal transfer	90		1.5
Waiting time			20
Rail (Song Than rail station - Da Nang rail station)	705.88	882	36
Second intermodal transfer	90		1.5
Waiting time			17.5
Road (Da Nang rail station - Vinh rail station)	470.58	322	28
Third intermodal transfer	325.45		8
Road (Vinh rail station - Hanoi Rail station)	254.11	295	10
Fourth intermodal transfer	90		1.5
Road (Hanoi rail station - Bac Giang)	235.29	52	2
Total	2563.61	1563	129

Route 4: Coastal shipping is the cheapest of the three transport modes. The transport time is also the shortest. The risk of using this route is lower, although the port facilities are an issue for carriers. There are the possibilities of delays which could add up to 48 hours to the transport time during rainy seasons. For shippers and consignees the unpredictable shipping schedules are also an issue. As a result, coastal shipping has advantages of cost and time and even risk, but improved port infrastructure would make this mode transportation more stable and attractive. The data for this route are presented in Table 5. The total cost of this route is the lowest at \$US 1288.21 and the transport time is only three days (72 hours). While this route offers the most suitable

transport method for this shipment, nonetheless some risks remain. However, this route is still more stable in comparison to the others.

Table 5 - Road – coastal shipping - Road: Cost, Distance and Time

Flat Rack Unit	\$US	Kilometres	Hours
Loading Operation	117.64		2
Road (Dist 9 – New Port)	73.52	2	0.50
First intermodal transfer	55		2
Coastal Shipping (New Port – Hai Phong)	840	1628	72
Second intermodal transfer	55		2
Road (Hai Phong – Bac Giang)	147.05	75	1.50
Total	1288.21	1705	80

Interpretation and Conclusions

The four routes utilise different transport modes, paths and terminals. The cost and time are the most vital factors for shippers, consignees and carriers. However; the specific circumstances and weather conditions can also play significant roles. For the first route, poor road conditions have impacted on the transport operators' confidence. Traffic police practices also indirectly increase the risk of this route with drivers responding by choosing to operate at night to avoid additional charges and delays. The second and third routes combine road and rail services. In theory, this is standard intermodal transport. Unfortunately, the obsolete rail terminals, disadvantages of railroad geography and inflexible train schedules diminish the merits of intermodal transport. Vietnam's mountainous geography and out-of-date equipment mean such services are less than satisfactory. The final route has cost and time advantages. The greatest weakness of the coastal shipping service in Vietnam is the poor quality of port infrastructure and insufficient number of ports. For the quality element, the craneage and port congestion issues are important. The Vietnamese government has some projects to improve port productivity, and in those plans the most important concept is to increase the port cargo volumes and cooperate with foreign companies to develop more modern port facilities.

In this case study the shipment features are critical, and as a result some fundamental elements of transport such as cost, lead time and distance are, perhaps, not so obvious. Risk and safety evaluation have greater emphasis in this analysis. Certainly, for under-developed and developing countries, all of them have greater restrictions in developing intermodal transport. Regulation, operation and infrastructure are negative factors in developing intermodalism. The Vietnamese freight rail services still require more foreign investment, especially to expand the rail network and to increase performance and therefore to improve rail competitiveness in the future.

The coastal shipping service offers the lowest costs and the most convenient transport mode for certain intermodal operations. The risk of unstable weather conditions, however, has a negative effect. Inflexible shipping schedules also decrease the opportunities for this transport mode to shippers and carriers. The most advantageous feature of coastal shipping, in Vietnam, is that there are many natural harbours which can be developed as transfer nodes to improve intermodal operations.

An interesting aspect of this study is the interplay of trade-offs between cost, speed and risk which can be highlighted as in Table 6.

Table 6. Cost, Distance, Time and Risk by Route

Route	Cost \$US	Cost / Km \$US	Distance (km)	Time (hrs)	I-modal transfer	Speed / Cost/ Risk
1	2953	2.46	1197	122	0	2 nd quickest, most expensive but least risk
2	2364	2.51	941	116.5	2	Med. speed, Med. cost, Med. risk
3	2563	1.64	1563	129	3	Slowest, Med. cost, highest risk
4	1288	0.76	1705	80	2	Quickest, cheapest, Med. risk

Three of the four routes are rather similar in terms of total cost, whereas route four (coastal shipping option) is clearly the cheapest. Measured by time, however, routes one, two and three are similar with route two offering slightly the quickest service. These are all slower than route four which is comfortably quickest and cheapest. Therefore, there appears to be no clear cut reasons for preferring routes one, two or three over route four as several also have inherent risk of loss, damage or delay at intermodal transfer points. However, the coastal shipping option suffers from significant and unpredictable delays during the rainy season. These delays, both at sea and in the ports, have the effect of substantially reducing the reliability of the price competitive coastal shipping option.

To conclude, the Vietnam case-study shows clear trade-offs between cost and time which suggest that the quickest option is generally also the cheapest but there is substantial risk of delay at certain times of year. On the other hand, rail-road intermodal solutions are rather expensive with some risk attached mostly to the intermodal transfer activities. The all road alternative is probably the most reliable (built on the traditional advantage of door-to-door service) but is expensive and not particularly quick.

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LOGISTICS IMPLICATIONS OF THE EUROPEAN FREIGHT TRANSPORT DEREGULATION

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ABSTRACT

The European freight transport deregulation heavily impacts supply chain and logistics strategic network planning. Considering the impact, surprisingly little research addresses the European freight deregulation. In the study presented, we address the strategic restructuring of a Swedish retailer's network in order to explore the effects on costs and CO2 emissions. We found that the deregulation makes an entirely road-based and further centralised distribution structure more cost-effective than an intermodal solution with a larger number of terminals. However, the effects on the strategic network come at the price of strongly increasing CO2 emissions. As this study represents one of the very first empirical contributions to logistics and the European freight deregulation, we have proposed some interesting venues for further research in the area.

INTRODUCTION

In today's rapidly changing supply chains, companies face an increased challenge to design, produce and distribute products for a global market and simultaneously manage their global networks of operations as efficiently as possible. The strategic planning of a company's logistics network is a trade-off between manufacturing, warehousing and transportation costs (Simchi-Levi et al., 2007), where companies strive long term to find an optimal solution taking into account these and other factors and trends (Ferdows, 1997). Mangan et al. (2008) outline freight transport deregulation as one factor that strongly affects strategic planning. Hence, for both policy makers and supply chain managers, understanding the impact on supply chains of various changes in transport policies is highly important (Sanchez-Rodrigues et al., 2008).

The European Commission outlines the benefits, such as increased efficiency, reduced environmental impact and reduced administration, from deregulating the road transport freight market (European Commission, 2011, European Commission, 2014). Cost effective transportation is an enabler of economic growth (Woodcock et al., 2007). Despite the strong impact on strategic planning of logistics networks, as well as the major political debates and media attention to the matter, European freight deregulation has received very sparse attention in academic literature. This is in contrast to the amount of literature that has addressed the American road freight deregulation through the Motor Carrier Act of 1980 (e.g. Corsi, 2005). Logistics and in particular transportation have a large environmental and societal impact (Wu and Dunn, 1994) and freight transportation societal costs are rarely internalised, causing concern among policy makers (Runhaar and Heijden, 2005, Stern, 2008). Runhaar and Heijden state: "Transport costs are increasingly traded off against other logistical costs and seem to have lost importance in strategic decision-making (2005, p.35)".

Cooper et al. (1990) predicted large changes in Europe's freight distribution, including relocation of production and distribution facilities. Pfohl (1993) also examined the logistics implications of the unified European market and found that the decreasing costs from low-level motor hauliers, would enable a centralisation of companies' manufacturing and distribution sites. From a German perspective, Pfohl also predicted that logistics managers would increasingly have to rely on outsourcing logistics and in particular transport operations. Kummer et al. (2014) carried out a longitudinal study in Austria, showing the dynamics of transport services and the ease of both flagging out and the extent of heavy goods vehicles (HGVs) being flagged out. They found that over a period of 10 years, 50% of the Austrian vehicles had been flagged out to East Europe. The price

differences between a Western/Northern European haulier and an Eastern European is typically around 20-40%, depending on the type of haulage and countries compared (European Commission, 2013, Kummer et al., 2014). The cost difference is to a large extent an effect of lower wages, but also due to lower fixed costs, for example.

Some similarities can be found between the American road freight deregulation through the Motor Carrier Act of 1980 and the ongoing European freight deregulation. For example, Belman et al. (2005) and found that the shippers benefited from the developments, but not the hauliers themselves. Ying and Keeler (1991) analysed the actual cost reduction for shippers and found it to be in the 25-35% range. Allen (1990) found that though the freight rates strongly decreased, the shippers' transaction costs (mainly information costs) increased as a result of the deregulation.

In 1995, Wu and Dunn (1995) discussed logistical decisions in light of their environmental impact and the importance of environmental sustainability is slowly, but steadily increasing. Related to European freight deregulation, some investigations have pointed out a potential modal shift from rail to road as an effect of the deregulation (for example, Visser and Francke, 2010, Ministerie van Infrastructuur en Milieu, 2013). When considering company strategies to reduce transport emissions, changes in network planning as an effect of deregulation become important to consider.

This paper empirically explores the logistics effects of the European road freight transport deregulation, with a focus on cost. Our perspective is that of the shipping company. The underlying assumption is that companies continually strive to optimise their networks in line with theories of strategic network planning (Geoffrion and Graves, 1974) based on potential scenarios. In the three scenarios described, the resulting CO2 effects of strategic network changes are presented in addition to cost effects. The paper is organised as follows. The first subsection explains the current state of the European freight deregulation and the applicable rules. The methodological approach is then explained, followed by the results of the scenario analysis. This is followed by a concluding discussion of the implications of the results and suggestions for future research.

State of deregulation – May 2014

International traffic between EU countries is completely deregulated, whereas the domestic freight transport markets are still regulated, currently through Regulation (EC) 1072/2009 (2009). The Regulation states: "Community licences provided for in this Regulation and hauliers authorised to operate certain categories of international haulage service should be permitted to carry out national transport services within a Member State on a temporary basis in conformity with this Regulation, without having a registered office or other establishment therein".

A foreign haulier carrying out national transports is generally referred to as *cabotage*. "Temporary" in the Regulation is defined as three cabotage transports in another country within one week, upon the completion of an international trip. Notably, the Regulation's definition of temporary cabotage does not exclude systematic cabotage, which means that in practice a foreign haulier can spend 365 days in another EU country, as long as the haulier ensures having an international trip every week. Schramm (2012) suggests the conceptual definition of "big cabotage", meaning that large-scale international hauliers with a critical mass of international trips, can act as domestic hauliers and rotate their trucks.

METHODOLOGY

Since the literature, to our best knowledge, contains no actual quantitative studies on European freight deregulation from a logistics perspective, an explorative approach has been applied. An in-depth, quantitative case study of a large Scandinavian retailer's entire logistics network (inbound and outbound) was carried out to analyse the

environmental and economic impacts of changing from domestic to foreign hauliers. The parameter data was collected from the case company's data files, from haulier interviews, and from information in various trade magazines.

Case company

Scandinavia, and in particular Sweden, was chosen as a focus area due to long transport distances and consequently, potentially larger effects of deregulation on the logistics network. A large retail company with customers spread throughout the entire country of Sweden (with a Swedish market share of approximately 25%) was selected as being representative. This is because the company is well-known for intermodal solutions and for applying factory gate pricing for a majority of their suppliers inside and outside Sweden. Being a cooperative, that is, the company¹ is customer owned, it has a stronger customer pressure to act sustainably.

Case company characteristics	Amount
Central terminals	3
Regional terminals	10
Urban stores	Over 80
Rural stores	Over 500
Inbound flow (pallets/month)	Over 87,000
Inter-facility flow (pallets/month)	Over 80,000
Distribution flow, urban stores (pallets/month)	Over 18,000
Distribution flow, rural stores (pallets/month)	Over 200,000

Table 1. Characteristics of the case company

The characteristics of the company modelled are presented in Table 1. A distinction has been made between urban stores and rural stores. The stores in urban areas, with corresponding flow, are only able to receive goods with smaller vehicles. Consequently, this flow is not affected by the freight deregulation, at least not in the short term. All inbound and inter-facility transports in the supply chain are carried out by long vehicles (maximum length of 25.25 metres and maximum load 60 tonnes), or by train, except transports connected to and from the train which are carried out by trailers. The company has a supply chain organisation where virtually all inbound goods go through the central terminals. These terminals consolidate the inbound flows for delivery to the stores and are not affected by any freight deregulation. Thereafter, the distribution flow can either go directly or via a regional terminal to the stores. As can be seen in Table 1, the two distribution flows are more than twice the size of the inbound flow, due to the different density between the distribution and the inbound pallets. There is no exact figure of this difference, but in general the volume of a pallet doubles after the consolidation at the central terminals.

Data collection for the scenario model

Due to the complexity of the network of the case company, several steps were taken in the data collection process. Firstly, an Excel template was sent out for the company to fill in, including information about facilities, volumes and transport characteristics. This was then compiled by the authors and presented to the company where they had the opportunity to correct any misunderstandings or fill in missing links. Based on both quantitative and qualitative data from the case company, the model was constructed and fine-tuned in order to create a data model that was as close to reality as possible. The complexity of the cost structure of the transport network was discussed thoroughly with the case company, and all nodes were assigned a specific freight rate (cost per kilometre) depending on the attributes of the transportation. Since the company does not own any proprietary trucks, they contract a large number of logistics service providers (LSPs) and hauliers. Sweden is one of many countries with major freight imbalances (e.g. the

¹ Technically the shipper studied is a non-profit organisation, but because it is organised just as any other retail company, we refer to it as a company.

demand for goods in Stockholm is much higher than the produced volumes), resulting in strong freight rate differences. To produce a valid model, it is important to use the appropriate rates in an origin-destination matrix (Holmberg et al., 2014). Hence, a large number of contracts were consulted.

Since the case company is a retailer, the freight transported is of a great variety and has different requirements on transports. The flows have been categorised as three different main flows, which are separated from each other: frozen, chilled (tempered), and dry. To collect alternative costs for foreign hauliers the following were consulted: trade magazines, freight portals, two managers of two Romanian hauliers (one operating large-scale cabotage operations) and one manager of a Polish haulier. Conservative, rounded up freight rates were used. Interviews with managers revealed that foreign drivers may result in some additional handling costs. It was found that cabotage driving generally differs from the Swedish domestic operation type. Cabotage is usually carried out with tractor trucks only hauling semi-trailers belonging to an LSP or shipper. Such transports ("trailer pulling") are carried out by only 7% of the Swedish hauliers – the majority of hauliers hauling general cargo do so with truck and trailer combinations (max. 25.25 metres), were the haulier owns the whole equipage.

Scenario analysis using a linear programming model

A linear programming model of the logistics network of the case company was constructed in an advanced supply chain optimisation program. The model is based on flow and cost data of all transports made inbound, inter-facility, and distribution in one month. The application used for modelling the networks in the case study is the commercially available *Supply Chain Guru*, developed by *LLamasoft*². Previous researchers have mainly used custom made optimisation models (e.g., Palmer and McKinnon, 2011). As off-the-shelf supply chain optimisation programs are very expensive (approximately 100 000€ for 1 license), custom made software typically is an inexpensive alternative to solving the problem at hand. The authors' use of the software was sponsored by Optilon (Swedish agent for LLamasoft) and LLamasoft.

The computer model in *Supply Chain Guru* takes several attributes into consideration: information on volumes, flows (origin-destination), time, transport characteristics (frozen, chilled, dry), transport and handling costs. The model then optimises the movement of goods with consideration of the prerequisites given by the user. When the model of the flows was correctly calibrated (i.e. the model displays the same results as the case), the company once more was given the opportunity to comment on how the cost was distributed over the network in order to detect if the model was directing volumes accurately.

Since the distribution network design is affected by the prerequisites of the transport market, four scenarios were created to visualise the difference in cost and CO2 emissions. November 2012 was used as a basis for the data collection.

Scenario 1

Firstly, an as-is scenario was created to verify that the model was an accurate representation of the actual network. In general, transports are carried out by Swedish trucks with a length of 24 meters (below the maximum length of 25.25 metres) and thus this was used as the default transportation asset in the model. The exceptions are transports carried out by train and in city distribution. Trailers hauled from intermodal terminals are pulled by a tractor truck, resulting in a total length of 18.75 meters maximum and a maximum capacity of 40 tonnes. In city distribution, smaller distribution trucks (typically <10 meters, max. 7.5 tonnes) are used. The costs and CO2 emissions of this model were used as reference values in the other scenarios in order to determine the effects of the changes in the network.

² <http://www.llamasoft.com/wp-content/uploads/2013/01/BR-LLamasoft-Supply-Chain-Guru-US.pdf>

Scenario 2

The second scenario investigates how the deregulation of the transport market affects the network in the short term. In this scenario it is assumed that there are cabotage transports available for all inbound and inter-facility flows. Since distribution to stores is considered to be carried out by Swedish trucks, the regional terminals remain in use. The cost of a cabotage transport is defined as 0.91 €/Km and a handling cost that is 0.21 €/pallet more expensive than for domestic drivers. The higher costs incurred are because the shipper-haulier collaboration is a key factor effecting the efficiency of loading and unloading (Fugate et al., 2009) and due to language difficulties.

Scenario 3

In the third scenario, the long-term effects are investigated. The possibility of using cheaper transport over the whole network is enabled, with some restrictions. The majority of the urban stores are in the three largest cities of Sweden: Stockholm, Gothenburg, and Malmö. In connection to each city there is a regional terminal from which smaller distribution vehicles are necessary for the last leg. The use of these three regional terminals was considered a constraint in supplying the smaller vehicles needed in urban areas. All stores outside of urban areas are assumed to be able to receive their goods directly from the central terminal and there is no need for the flows to go through a regional terminal if it is not the most inexpensive way. Thus, the seven regional terminals that are not near a larger city are optional and can be left out of the optimal solution.

RESULTS

Scenario 2

Even though the costs for handling pallets is assumed to rise, the overall cost decreases by 16.7% and the CO₂ emissions rise by 4.6% because volumes are transported by smaller vehicles (18.75 metres instead of 25.25 metres).

Scenario 3

The availability of inexpensive cabotage transports results in a cost saving of 32%, but also an increase in CO₂ emissions of 30.4%. The largest factor increasing CO₂ emissions is the modal shift from train to road. Smaller vehicles (as shown in Scenario 2) contribute, as do longer trip distances. In this scenario a large majority of the distribution trips are transported directly from the central terminals to the stores, instead of going via a regional terminal where the flow can be split as late as possible. This is because the same volume as before is now transported by a larger number of smaller vehicles and several regional terminals are no longer profitable to maintain. This applies in particular to terminals in rural areas where smaller distribution trucks are not required by law or road conditions.

Validation and generalisability

As outlined in the methodology, continuous validation of the data and the model was carried out over the entire duration of the data collection. Scenario 1 generated a total distribution cost that was approximately 1% lower than the actual total distribution cost.

A team from the company consisting of the supply chain development manager, the transport manager and some of the development staff were shown the model and the various scenarios. One of the managers commented: "These figures are very similar to our own calculations".

The scenarios represent cost optimised networks. To further validate the model, an attempt to optimise the company's network without changing the current policies for transport purchasing was carried out (basically an optimisation of Scenario 1), resulting in a minor potential for cost reduction (around 1% lower cost and unchanged

environmental impact). Hence, we can assume that the scenario results are largely a result of changing policy and rate parameters, rather than existing network inefficiencies.

This research is based on a Swedish retail company with high sustainability demands. The stretched-out and sparsely populated geography of Sweden in combination with large freight imbalances, result in relatively high distribution costs and a large impact of freight deregulation. Furthermore, the case company's intermodal setup used on longer inter-facility distances signifies that a modal shift due to decreased total cost for trucking has a strong impact on CO₂ emissions. Finally, Swedish hauliers' fleet composition of longer and heavier vehicles, compared to cheaper smaller foreign equipages, is yet another factor limiting generalizability of these results.

CONCLUDING DISCUSSION

We conclude that the European freight deregulation has, despite having far-ranging effects on both efficiency and sustainability, received very sparse attention in the academic literature. This paper represents a first modest contribution aimed at elucidating some of the effects of the deregulation on the distribution networks.

We proceed from previous research showing that substantial transport cost differences between Eastern and Northern/Central European hauliers already create large opportunities for shippers to cut costs today (Kummer et al., 2014), if they are able to balance international and domestic freights under the current Regulation. Our findings imply that, *ceteris paribus*, logistics networks will continue to depend on even more centralised distribution structures as a result of the trade-off between increasing warehousing and handling costs on the one side, and decreasing freight transportation costs on the other.

Our research implies that supply chain and logistics managers should be cautious of investing in and maintaining intermodal solutions that risk being unprofitable already in the short term.

Based on current elasticity of mode choice, major incentives for cutting intermodal transport in favour of cheaper and more flexible road transport is prevalent. Nevertheless, social and environmental aspects make the use of cheaper, foreign hauliers a delicate matter (Hilal, 2008, Kummer et al., 2014) and the case company example shows that some companies are hesitant to take advantage of the deregulation. Not only social aspects are outlined as reasons for refraining from foreign low-cost hauliers, but also increasing transaction costs, as shown by the North American freight deregulation (Allen, 1990). Analysing changes in transaction costs in the deregulation may provide interesting findings for both supply chain managers and scholars.

The effects of the European road freight regulation have important implications for options in supply chain design and firm policy, and highlight the complexity in designing supply chains (Abbasi and Nilsson, 2012). The European Commission is pushing several initiatives to promote modal shift from road to rail, which to us appears to be in contrast to the effects of the deregulation. This offers interesting opportunities for transport policy research. Moreover, analysing the similarities and differences between the North-American deregulation and the European road freight transport deregulation may offer interesting implications for both areas, in particular considering the existing barriers, such as those for Mexican hauliers to operate in the US.

There are considerable differences between different types of road haulage. Inter-facility transportation can be accomplished without almost any competence (Hilal, 2008). As European hauliers are continually sourcing drivers from outside EU (e.g. Macedonia, Turkey, the Philippines), little is known about the ability to use low-cost hauliers in an area such as city distribution, which has remained largely unaffected by the deregulation.

Knowledge on how low-cost carriers can work in city distribution would potentially have a very strong impact on logistics management.

The scenario analysis implies large environmental differences, but further large-scale empirical investigations over a larger number of companies in various countries will be needed to more fully understand the logistics implications of the European freight deregulation. Knowledge of how consumers respond to cost savings achieved by dissolving domestic hauliers in favour of foreign hauliers with drivers spending months in their trucks would have important implications for supply chain sustainability. The fragmented market represents a strong challenge to analyse sustainability (Sternberg et al., 2013), in particular as transparency is lacking.

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ON THE ROAD TO SUSTAINABLE FUTURE: A ROADMAP FOR THE UK ROAD FREIGHT TRANSPORT SECTOR

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ABSTRACT

The aim of the research presented in this paper is to develop a roadmap of the sector's path to meeting the Government's goal of an 80% reduction in UK GHG emissions by 2050. This roadmap will define a long-term strategy, as well as the sequence of tactical steps and abatement measures that need to be taken along the way to achieve this goal. A conceptual framework underpinning the roadmap is presented and tested on one component of the map, i.e. the introduction of methane as an alternative fuel for diesel in trucks.

INTRODUCTION

The Kyoto protocol and other intergovernmental treaties have sought to address the issue of global warming by driving down greenhouse gas (GHG) emissions. Heavy Goods Vehicle (HGV) operations account for around 6% of the UK's carbon footprint (Piecyk and McKinnon, 2010). A stated intent by the UK government to reduce GHG emissions by at least 80% by 2050, against a 1990 baseline, has created new economic and environmental pressures on the freight transport sector. To achieve this ambitious target innovative and radical interventions at both the vehicle and logistics operations levels will be required.

The logistics system has many components, such as vehicle technology and the design of logistics operations, which combine to describe a complex web of dynamic interactions. For example, longer heavier vehicles (LHVs) or double deckers (DDs) offer a potential to significantly increase logistics efficiency on onward journeys, but, at the same time, may constrain backhaul opportunities. If we are to answer the critical question of what is needed to get from the current to the desired state of the freight transport system, we must first develop a map of how the various components of the system relate to each other, the impact of these relationships and the impact of any interventions on these relationships. By developing this map, we can develop a robust understanding of what interventions must take place and when, in order to transform the system to the desired, sustainable future state envisaged by the UK government's carbon reduction commitment for 2050.

RESEARCH BACKGROUND

There are number of tried and tested approaches to predicting future states in technology/operations, these include: trend analysis, technology readiness levels, and adoption rates.

Trend analysis is useful if the change mechanisms remain consistent. In other words, by assuming the basic mechanisms do not change and the externalities remain constant, the past becomes a reasonable predictor of the future. In a world faced with looming energy crisis and unsolved sustainability challenge, it is very doubtful that past circumstances will endure a foreseeable future. For example, just because diesel prices have increased consistently over the last decade, does not necessarily mean they will continue to rise over the coming decade. Externalities, such as the ability to extract shale gas economically, have resulted in lowering overall energy costs in the United States. Although the full impact of this is still hard to quantify, it seems possible that the base price of oil may fall, inferring that diesel prices may also drop without interventions from government. Step changes are not constrained to the social and political arenas:

technological innovations can also result in step changes in trends. For example the sales of paper books showed a consistent increase right up until the point where e-readers became practical. At that point paper book sales started to decline, whilst e-book sales started to increase. Trend analysis cannot predict the impact of disruptive innovations per se, or when they will occur. However, previous disruptive innovations can be used to predict the impact of future disruptive innovations of similar character.

These examples illustrate how trends can become punctuated by events that disturb predictions and create step changes. By scanning technological innovations and using a process which incorporates technology readiness levels into a consideration of trends, it is possible to predict where step changes in available technology may occur. The mechanisms or circumstances that combine to develop a context that triggers a step change is a combination of the readiness of the technology, the accessibility of the technology, and the motivation to invest. Of course not all innovations are successful, consider for example VHS and Betamax, some get adopted and others fail to generate traction. Adoption rates describe the rate at which technologies are deployed, and are a reflection of the investment, risk, and alternatives. Technology readiness levels describe how market-ready an innovation is, and the nature of the technology characterises it as a development (a trend) or a disruption. Adoption rates can be applied to both disruptive and incremental innovations; however, the former requires a deeper understanding of fundamental behaviours.

Any methodology used to predict how technologies and behaviours combine in a perpetually changing environmental context needs to incorporate robust descriptions of technology readiness levels, adoption rates and trends. The crucial process is therefore that which uncovers the factors that should be considered - this cannot be achieved through analysis, and a process that embraces a wide source of data is likely to be better than one which does not. The next section explains the methodology adopted in this research.

RESEARCH METHODOLOGY: ROADMAPPING

Roadmapping has been effectively used for projecting future technology, business or policy planning, and product development (Phaal et al., 2010, Carvalho et al., 2013, Kerr et al., 2013, Lee et al., 2013). The two main components of roadmapping are the application, i.e. the roadmapping process, and the result of the application, i.e. the roadmap (Carvalho et al., 2013). 'Roadmaps provide an extended look at the future of a chosen field of inquiry drawn from the collective knowledge and imagination of the groups and individuals driving change in that field' (Galvin, 2004, p.101). A roadmap can be defined as a dynamic system framework, which enables the evolution of the system to be mapped from a multitude of perspectives, and the relationships between those perspectives to be explored. The aim of the roadmapping process is to answer three key questions: 1) where do we want to go?, 2) where are we now?, and 3) how can we get there? (Phaal et al., 2010).

Previous roadmaps have focused on aspects of systems such as selected vehicle technologies, IT systems, or alternative fuels (e.g. SMMT, 2009, RICARDO, 2010, IEA, 2011). This project uses the same process but with the objective of developing a set of nested and inter-related maps. Our approach is innovative and unique in targeting the problem at the system level (Carvalho et al., 2013), integrating roadmaps for technology development, strategic planning and operations redesign in the road freight transport sector into one comprehensive, multi-layer macro map. We developed an iterative process that more robustly captures the nature of interactions between maps. This process ensures the integrity of the micro maps, and a solid foundation for the macro map of the system. Also, most of the existing roadmaps are constructed solely at a conceptual level. At the next stage of the research project, we will aim to further advance the roadmapping methodology by attempting to operationalise the conceptual map into a roadmapping model.

Data Collection: Populating the Roadmap

There are three perspectives that need to be considered in the roadmapping process: historical trends projected into future space, the consideration of consequences that have not yet materialised, and system response in terms of technology adoption, research and policy.

The use of trends in any roadmapping model requires an interpretation of how the system perceives those trends, in other words what trends are considered in the organisational design of road freight operations. The best way to expose how organisations design responses to trends is to firstly identify the trends that have the greatest impact. This can be done through research of extant literature, and where gaps exist, through the collection of primary data through workshops involving leading practitioners.

Having identified the trends with greatest impact it is possible to characterise these trends through analysis and extrapolation. By considering the trend over a relatively short term it is possible to test the sensitivity of these trends to technologies that exist but may mature over the short term. Trends can be used as a focal point for workshops with domain experts representing academia and practitioners. Trends can then be modified and scenarios constructed. Conceptually the modified trend analysis can be used to develop a number of possible future states. Each state will drive a different set of research and policy interventions, as well as operational changes. It is important to assess the probability of each scenario occurring and to reject unlikely scenarios if unwieldy models of the long term are to be avoided. Probability of future scenarios developing are guided by considerations of technology readiness levels, adoption rates, policy manifestos, and domain relevant research activities.

Roadmapping Workshops

A number of workshops were held with a carefully selected panel of experts drawn from both industry and academia. To ensure relevance to the macro map all workshops shared a common long term vision of 80% reduction GHG emissions from road freight transport by 2050.

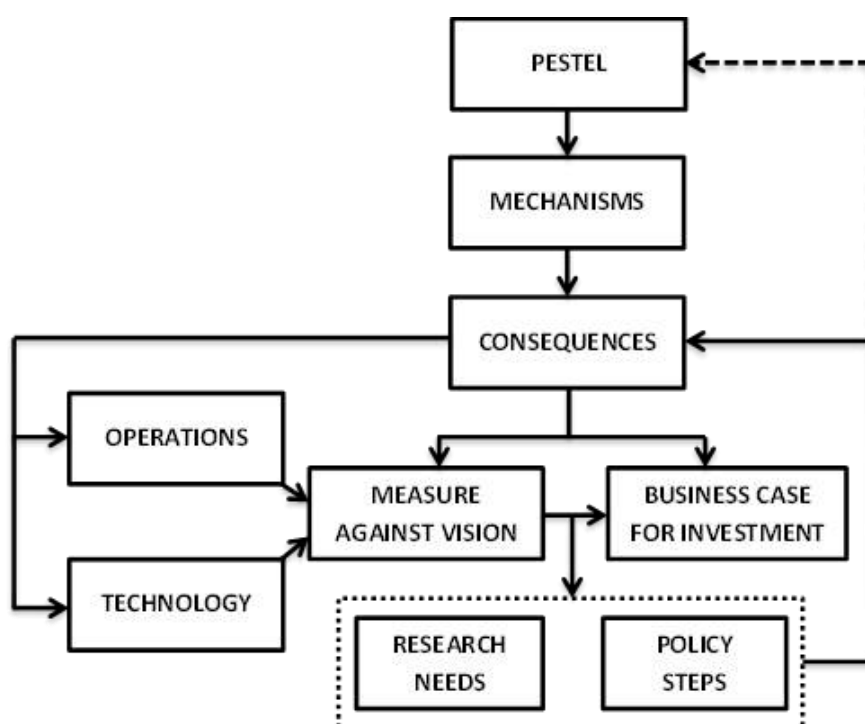
The first workshop focused on developing the structure (i.e. layers) for the conceptual map. The structure was tested on an exemplar topic. The agreed approach is reflected in the conceptual framework shown in Figure 1. Subsequent workshop focused on a current context described by political, economic, technological, social, environmental and legal characteristics/trends. An essential component of this workshop was the inclusion of academics as they are trained and equipped to scan the time horizon for the impact of research and the identification of emergent technologies. The third workshop concentrated on both developing the interdependencies between the characteristics of the system (consequences, research needs, policy steps, and business case status) and their impact on technology and operations. This workshop extended the previous and current context to reveal a rolling context for future years. The introductory workshops aimed to develop a draft macro roadmap, but the approach and concepts were also tested on a micro map topic such as the introduction of methane as an alternative fuel to diesel.

The next workshop will focus on developing micro maps for 12 key topics, which were identified as fundamental to the achievement of the long term vision for the sector. Next, we will validate the map by using scenarios to test its robustness and expose sensitivities. This step will also facilitate the parameterisation of the underpinning model which ultimately can be used in a structured design of experiments for sensitivity analysis and the development of stochastic predictions. This workshop will fulfil a vital role in the refinement of assumptions and the identification of system sensitivities such as adoption rates.

CONCEPTUAL FRAMEWORK

The conceptual framework is shown in Figure 1. It maps the relationships between the external environment, the components of freight transport system, and the research and policy context. PESTEL analysis is widely accepted as a robust framework for considering the environmental context for strategic decisions. It was adopted as a systematic approach to exposing factors that influence the system's response to changes. In this project we use PESTEL analysis, but the use of other context scanning frameworks is also possible. For example, McKinnon et al (2014) proposes TIMBER framework (Technology, Infrastructure, Market, Behaviour, Energy, Regulation) for a systematic review of the external factors affecting the logistics system.

Figure 1. Roadmap for road freight transport sector- conceptual framework



The changes in the context, as described by PESTEL, will trigger the market mechanisms, which, in turn, change the state of the system. This will have consequences which in a logistics system are an expression of supply and demand. Supply is characterised as production and logistics whilst demand is expressed as segmented (by product and location). The conceptual framework links context to consequences, which are addressed by operations and technology. If the efficacy of the technology and operations is considered adequate to meet the vision, no research or policy changes are required. However if the existing operations and technology is not considered adequate then research and policy steps are required. Changes to policy will change the political, economic, legal, and social aspects of PESTEL. Research will modify the technology, and social aspects, whilst informing policy. Thus research and policy are the fundamental levers used to deliver vision.

FRAMEWORK IN PRACTICE: DUAL-FUEL VEHICLES

The above methodological framework was applied to a consideration of the introduction of methane as an alternative fuel for diesel in HGVs. This consideration represents a component of the overall future map for road freight in the UK but reflects the application of the methodology suitable for description in a conference paper of this sort. The above observations of the expert panel can be mapped into future map diagram, which is shown in Figure 2. This figure shows the future map diagram for the

introduction of methane as an alternative fuel. This map is one of 12 maps that will be developed to support the integrated future map for road freight from the current day to 2050.

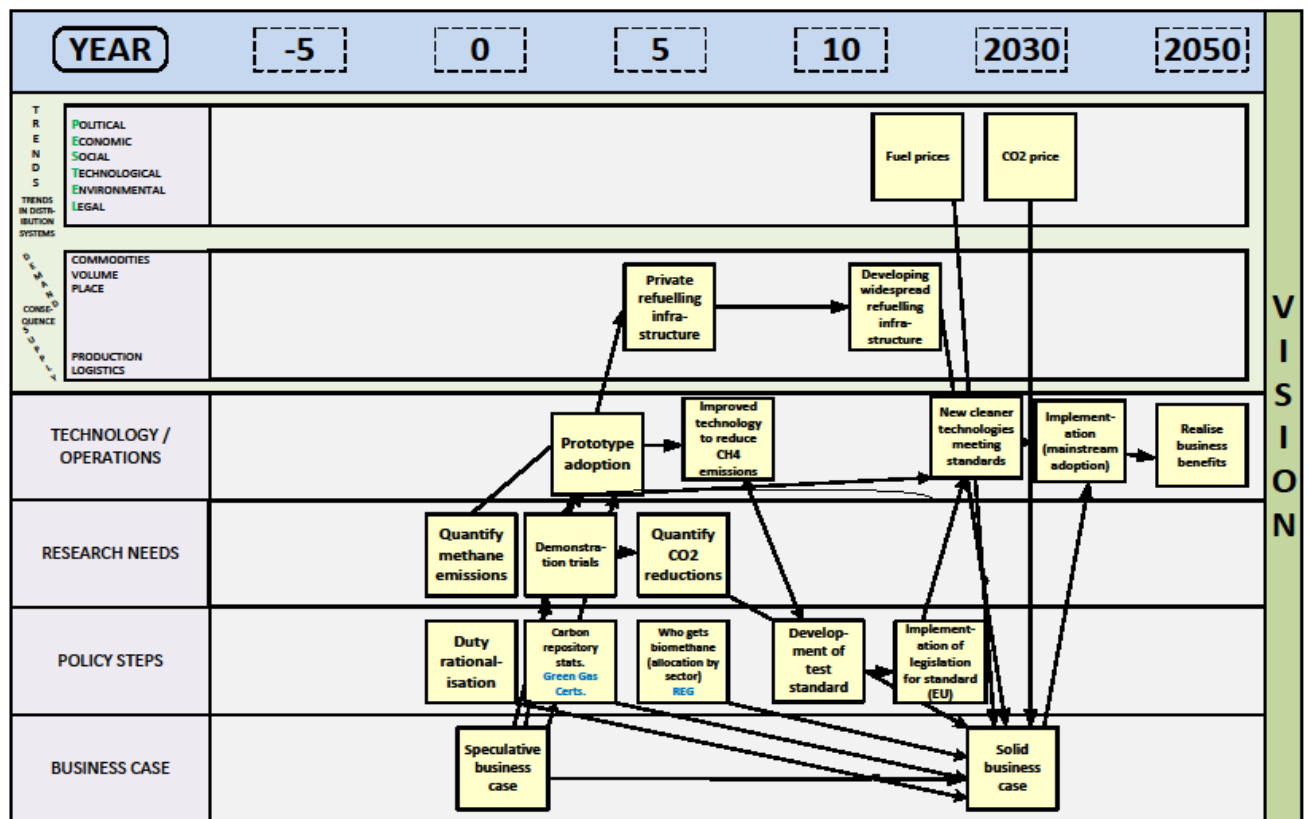


Figure 2. Roadmap for introduction of methane as an alternative fuel for diesel in HGVs

Trends Affecting the System: PESTEL Analysis

The **political** climate is characterised by continuing pressure to reduce GHG emissions, and it can be reasonably assumed that the global target of 80% reductions will be applied to road freight which continues to be a significant contributor to the overall emissions.

Economic pressures continue to drive efficiency into all aspects of logistics operations which continue to be a source of costs, rather than a generator of value. This pressure forces alignment between economic and environmental interventions and prioritises measures that satisfy both.

From a **social** perspective, customers continue to prioritise purchases from green suppliers and the triple bottom line plays an increasingly significant role in triple bottom line reporting. Corporate social responsibility now regularly embraces environmental measures, often promoting them alongside ethical practices. Furthermore the risk of adverse publicity relating to environmentally unfriendly practices continues to drive effective environmental interventions.

The next layer are **technologies** that may dramatically change the shape of logistics systems. Big data is one of such trends. There is a growing trend of increasing data availability, both in terms of breadth and depth of data. Organisations continue to develop capabilities to process data into valuable information; this capability extends to all aspects of operations, including freight transport planning. However, the increase in

in-house ability to process data is often off-set against outsourcing non value adding activity such as freight transport. The low margin and short term contracts experienced by this sector further inhibits investment in data processing capability.

The **environment** for organisations is described by its competitive landscape and it is broader more literal consideration of green issues. The competitive landscape for most freight operations in the UK is intensifying as a consequence of low barriers to entry and low switching costs. This trend is set to continue in the short term.

The current political context tends to avoid **legislation**, preferring instead to facilitate self-regulation, which is generally perceived as being more effective and lower cost burden to industry. However, European regulations have tightened, and vehicle certification schemes continue to increase in stringency. This is likely to drive the introduction of new technologies. Despite the perceived undesirability of increased regulation, it seems the trend of increasing regulation is likely to continue in the short to medium term.

Experts agreed that the two key external trends that will influence adoption of methane as a fuel will be diesel fuel prices and, in a longer term, a possibility of expanding emission trading schemes to the road freight transport sector.

Consequences

The **demand** consequences of the context described were described by the selected academic panel as a static trend of increased consumption but with biases towards green suppliers. Within the geographical constraints of the UK this is unlikely to change the pattern of journeys undertaken in the provision of freight logistics. However, the increasing need for companies to report environmental performance, and the continued alignment of economic preference with environmental impact will drive the uptake of new environmental technologies.

On a **supply** side, the impetus to adopt environmental and economic efficient freight transport strategies is driving the development of not just more efficient engines, but a range of vehicle design interventions such as aerodynamic measures, light weighting and perhaps more radically alternative fuels such as methane. This latter change in emphasis in the type of fuel used is significant because it requires a substantial investment in supply infrastructure.

Implications on Operations and Technology Development

The technology readiness level of methane fuelled engines is at a stage where prototypes are required to advance the technology further. The expert panel suggested that the advancement of the technology to a level that would significantly accelerate adoption may have a time horizon of between 2 and 5 years. However, this would require research to firstly quantify methane emissions from existing engine technology to justify demonstration trials (a step beyond the prototype technology readiness level). As there is already active research in this area the panel felt that a 1-2 year horizon was realistic.

Operations are not anticipated to be significantly effected until the prototype and demonstration phases of the technology have demonstrated that a robust business case can be developed and investments justified. These investments are far from trivial and an implementation timeline of 5 years was considered realistic by the panel. Aggregating the timelines for research, prototyping and widespread infrastructure availability suggests that methane fuel could not become invasive for approximately 12 years.

Research Needs

The absence of a basic understanding of the likely impact of methane as a fuel requires fundamental research regarding the phenomena of methane slippage and the net CO₂

equivalent benefit of using this fuel. The fundamental research would be used to inform the regulatory framework and be a significant enabler of widespread adoption.

Policy Steps

As previously stated the policy steps regarding the regulation of methane fuel usage will be informed by research but is likely to have the effect of specifying minimum technology standards. As the market for such technology is worldwide these standards are likely to have at least a European if not global reach. As a consequence the timeline for the development of the appropriate policy steps is likely to be 2-3 years, extending the previous timeline for widespread infrastructure availability to 15 years.

Business Case

As a consequence of the above considerations it is possible to develop the timeline for the maturation of the weak current business case to one that is robust enough to make the introduction of methane as a fuel into fleet operations invasive. This timeline becomes the driver of activity and its revision deepens understanding of the basic mechanism at play in the system. The future business case has to take into account emerging scenarios and changing contexts predicted by the mapping process.

ANALYSIS

The map is particularly useful in highlighting dependencies. For instance the map suggests that a widespread fuelling infrastructure is dependent on a robust business case being developed for the use of methane as a fuel, which, in turn, is dependent on research and appropriate regulation. This narrative may feel like common sense, however it should not be forgotten that a substantial value of the road map is the sequencing and timing of interventions, this is of elevated importance when considering long time horizons and complicated sets of interdependencies.

The future mapping process also highlights the importance of research rigour, making the design of the panel of prime importance. Academics are ideally situated to appraise future technologies and their impact. They are also uniquely equipped to understand the potential organisational impact of emerging technologies. It is therefore vital, that appropriately qualified academics have some constituency on the panel, being responsible for scenario generation. In contrast, practitioners can contextualise decisions and identify the important business parameters that decide whether or not context changes investment decisions or trends. Finally, policy makers can interpret the trends and step changes presented by the analysis described previously, converting them into emergent practical policies. Therefore, the panel should comprise academics, practitioners, and policy makers.

The developed future map becomes the focal point for ongoing discussions and an iterative process of revision. More importantly, it provides a framework for parameterising the system. Through recursive discussions the sensitivities of the system, it can be understood better, and the central mechanisms that determine system behaviour explored. The future map therefore becomes a central aspect of developing a model of the system which can be used to explore its dynamics and more complex emergent responses.

DISCUSSION AND CONCLUSIONS

Complex and complicated systems are difficult to describe as the fundamental mechanisms, and are often obscured by multitudinous interactions and emergent characteristics. When tasked with predicting the future development of such systems the researcher needs to develop a methodology that is inclusive and rigorous, and permits parameterised experiments to identify persistent and emergent characteristics. This paper has presented the application of a roadmapping methodology to the complex, complicated and dynamic road freight system. In a series of structured workshops a

consensus across a diverse community of experts was achieved in terms of expressing the current state and the emergent scenarios of short, medium and long term.

Although it is beyond the scope of this paper to present the complete future map for road freight, the application of the methodology to the introduction of methane as an alternative fuel has shown that its development to high TRLs and its adoption is dependent on a raft of research and policy activities.

Inclusion of this future map into the overall future map will undoubtedly expose more dependencies, however the stepwise development of the overall map permits consideration of what would otherwise be an overwhelmingly complete and complicated system.

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Section 11: Port Logistics

DEPARTURE SIDE PLATFORMS: A MEASURE TO MITIGATE ROAD CONGESTION

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ABSTRACT

This research investigates traffic congestion at railway level crossings adjacent to or in the close proximity of railway stations. Traffic congestion at railway level crossings has many implications on logistics and can significantly delay urban deliveries. We propose that a reduction of boom barriers down time periods at these locations can be derived by making alterations to the infrastructure of the railway station. These infrastructure alterations relate to the platform arrangements at stations, and present an opportunity to minimise the time of roads closure periods at level crossing, thus mitigating road traffic congestion. To test this theory, the station environment is simulated using traffic simulation software. The simulation process is conducted in two phases, one to emulate the current environment and the other to emulate the proposed environment. Early simulation results testing single train arrival and departure at both the current and proposed environment have been most positive. Further simulations are yet to be conducted to test the operation of multiple train arrivals and departures.

INTRODUCTION

This study investigates road traffic congestion at railway level crossings adjacent to or in the close proximity of railway stations. Vehicular traffic congestion is increasing in most urban areas (OECD/ECMT 2007; SKM, Maunsell, & Evans&Peck 2008; Taylor & Crawford 2010; VicGov 2013) and in locations where populations and city economies are growing and it is likely to continue to increase (COAG 2006; OECD/ECMT 2007; Taylor 2002; VicGov 2012).

Melbourne, like many metropolises around the world, is suffering from the effects of traffic congestion, delays and bottlenecks (BTRE 2007; VicGov 2013). These are caused by a number of factors including network limitations (DoT-Vic 2008); a severe underinvestment in transport infrastructure during the decades of the 1980's and 1990's (Stanley & Barrett 2010); restrictions and capacity constraints within the road and transport networks (VicGov 2007); inability for increases on public transport services after long periods of low patronage (DoI 2007); and from the ever increasing demand for more capacity derived from population growth and from the increasing dependence on the motor vehicle as a mode of transport (Cervero 1998; DoI 2007; DoT/DoI 2006; Mees & Groenhart 2012; VAGO 2012); all of which exacerbate the road traffic congestion problem. From a logistics perspective, this can delay delivery of goods and services in urban areas.

One area where vehicular traffic congestion is prevalent in most Australian capital cities, and specifically in Melbourne, is at railway level crossings (Hall & Somers 2012; Lucas 2010; Taylor & Crawford 2010; VicGov 2009; Webb & Gaymer 2009). There is evidence that vehicular traffic congestion at Melbourne's metropolitan level crossings is getting worse, and any potential additional train services to cope with commuters growth demand, will only contribute to the ineffective operations of the road transport network (Taylor & Crawford 2010).

There are approximately 9,400 level crossings in Australia (Henley & Harrison 2009; RISSB 2009; Wallace 2008). According to the latest count, the Greater Melbourne area has the largest number of level crossings in metropolitan areas in Australia, 182 level crossings (Hall & Somers 2012; PTV 2013; Taylor & Crawford 2010). Given the large number of level crossings in Melbourne, the focus of this research is metropolitan level crossings next to or in close proximity of railway stations, where the closure of roads for

any length of time, creates road traffic congestion, which is specifically worse during peak-hour periods.

The purpose of this study is to test a new proposition that deals with the problem at level crossings in the vicinity of railway station precincts. Specifically, the research question is: *How does modifying platform configuration at railway stations mitigate level crossings road closure times?* This proposition addresses the legacy of railway level crossings and specifically its links to the position of platforms at railway stations. Accidents at level crossings resulting in death and injury of commuters and pedestrians are currently the main reason for level crossing remediation and a topic of much research (Taylor & Crawford 2010; Wallace 2008). Safety at level crossing and road traffic congestion at these locations are also the focus of some research (Hall & Somers 2012; Roberts 2005; Tydlacka 2004).

LITERATURE REVIEW

The first railway line in Australia opened in Melbourne on 12 September 1854. By the turn of the 20th century, the main mode of transport in Australia was largely by rail. This mode of transport was carrying about 90% of the total workforce to work (Cosgrove 2011). By 1910 and with a population of about 600,000 people, Melbourne rail network patronage was close to 120 million passengers boarding per year (Webb & Gaymer 2009).

However, patronage changed with the introduction of the motor vehicle as a means of transportation (Cosgrove 2011). The proliferation of the motor vehicle as a mode of transport for business, work and pleasure, immediately after World War I, necessitated the building of sealed roads (ABS 2009). The proliferation of the motor vehicle dictated the introduction of safety equipment at level crossings, the point where rail and road compete for the same ground space. Today, Melbourne's network consists of 16 radial lines divided into five separate groups currently servicing more than 210 stations (PTV 2013). The Melbourne metropolitan rail network is home to 172 level crossings (PTV2013b).

Intersections Level Crossings

The legacy of railroad level crossings remains unresolved to this date. The introduction of both modes of land transport, rail and road, particularly when the modes cross each other's path at the same grade or level, continue to present a dilemma. The legacy of a large number of level crossings has had detrimental impact on road transport networks, more so in capital cities urban areas, such as Melbourne, contributing to accidents and road traffic congestion (COAG 2006; Edquist et al. 2009; Lucas 2010; Maslen 2010). At the time when authorities in Sydney decided to grade separate all level crossings, authorities in Melbourne decided to start a program of equipping and upgrading metropolitan level crossings with safety devices such as boom gates or boom barriers (Tey, Ferreira, & Dia 2009; Wigglesworth & Uber 1991).

The boom barriers program in Melbourne was initiated due to high mortality rate of accidents at level crossings equipped with flashing lights and/or fixed signs (Wigglesworth 2001; Wigglesworth & Uber 1991). The program, over time, replaced safety equipment installed at many locations, including flashing lights, wig-wags (pendulum-like motion signal), give-way and stop sign devices. The program was slow to start and only eight level crossings had replacements installed between 1971 and 1978 and a further 64 crossing replacements were completed between 1983 and 1989 (Wigglesworth 2001). Nowadays, all 172 Melbourne metropolitan level crossings are fully protected with boom barrier systems (PTV 2013).

Taylor and Crawford (2010) indicate that by 2021, some Melbourne rail lines would carry almost 40 trains per hour during peak periods, close to double the present volume levels. One problem facing transport authorities is that additional train traffic exacerbates traffic

congestion at most level crossing locations (Guzman 2011, 2012; Guzman, Peszynski, & Young 2014).

Platform Positioning

The issue of platform positioning has only come to light recently and its implication have not been fully researched or understood (Guzman 2011). The issue of platform positioning is considered to cause worsening motor vehicle traffic congestion at level crossings adjacent or in the vicinity of railway stations (David 2009; Guzman 2008, 2012; Higgs 2009). The impact of the platform position relates to the long periods of boom barrier closures being experienced at level crossings locations (Cooper 2012; Guzman 2011, 2012; Hall & Somers 2012). In addition, road traffic congestion worsens during peak hour periods, creating further disruption for road commuters (ENVICT 2005; VAGO 2012).

The Costs of Congestion

The cost of congestion is said to be the difference between the total cost of travel and the benefits resulting from such travel (VCEC 2006b). It is suggested that the more appropriate name for the road congestion phenomenon is '*the avoidable cost of congestion*' (BTRE 2007), as it is a cost that can be avoided, when suitable measures are taken. Road traffic congestion is expensive in resources and there are indications of at least four external costs associated with traffic congestion: extra travel time costs, environmental pollution costs, traffic accident costs and fuel consumption costs, and there are also additional costs of wear-and-tear for the running and travel (Luo et al. 2007). Other effects from traffic congestion include increased fuel usage, higher vehicle maintenance cost, idle time of commuters including public transport and emergency services, lost productivity, longer delivery times, undelivered goods, delays and supply chain disruption (Coyle et al. 2010; Gargett & Gafney 2005).

Studies indicate urban road congestion already costs Australia about 2% of GDP (PJPL 2005), and there are reports that indicate the annual cost of congestion to be \$9.4Billion (BTRE 2007; COAG 2006). In Victoria, VCEC estimates the current economic cost of congestion in Melbourne is in the range of \$1.3Billion to \$2.6Billion per year (VCEC 2006a).

ANALYSIS OF CURRENT SOLUTIONS

This section addresses some of the methods adopted to assist in minimising road congestion at level crossings.

Level Crossing Closure

The elimination of level crossings '*is the only way to truly address catastrophic risk*' (VicGov 2009). Elimination of level crossings is suggested to be the most effective measure of improving safety and reducing the risk of collision at these locations (LCSC 2013; Wigglesworth 2008). The closure of roads or tracks at level crossings as remediation to the problem is impractical in urban areas because most rail lines carry hundreds of train services per day. Affected roads carry many thousands of road commuters; closing one of these would have the effect of closing that arterial or major road and transferring the problem somewhere else in the road network (Ogden 2007; PTSV 2009).

Level Crossing Grade Separation

Grade separation of level crossings creates safer and more reliable travel for commuters, vehicular traffic, walking public and the community in general; it reduces road congestion and its bi-products. Grade separation, in most cases, is the Victorian Governments preferred solution to resolve level crossing problems, but while grade separations is the most effective alternative, it is also an extremely costly solution (CfM 2011; VicGov 2009). For example, the cost of removing all level crossings in Victoria, while an unrealistic proposition, has been calculated to cost between \$60Billion and

\$80Billion (NPV) (Lucas 2009). The Committee for Melbourne estimates indicate that, based on \$100Million per level crossing removal by way of grade separation, it would cost \$17.2Billion (NPV) to remove all level crossing from the Melbourne metropolitan area (CfM 2011).

The railroad level crossings remediation process, called grade separation, can be achieved by one of the following engineering solutions: (a) lowering the rail line by tunnelling under the road; (b) lowering the road by tunnelling under the rail line; (c) building a road bridge over rail line; and (d) building a rail bridge over road (NewAustralia 2010; VicGov 2009; Wallace 2008).

During the last two decades, grade separations have seen the removal of four train stations level crossings from metropolitan Melbourne. Current plans and developments are underway for eight or nine train stations level crossings grade separations over the next ten years, costing Victorian taxpayers \$1.28Billion (Freemantle 2011; VicRoads 2011).

This study is about introducing and presenting an alternative not otherwise investigated or implemented anywhere in the world. The alternative could be theoretically simple to implement, and one that could cost a small fraction (about 1% or 2%) of the costs involved with each grade separation.

The proposed alternative is to explore other potential causes of congestion at level crossings. It is believed that congestion at station level crossings is not caused by the level crossing boom barriers operation, but rather by trains at the platform and/or arriving, forcing boom barriers to remain closed for long intervals. This proposition involves repositioning a station platform, the Arrival Side Platform (ASP).

RESEARCH METHODOLOGY

In answering a problem such as this, queuing theory (Breuer & Baum 2005) was initially explored, as this is a widely utilised theory that mathematically explores waiting lines, congestion or queues. In queuing theory, a model is constructed so that queue lengths and waiting times can be predicted. However, this theory does not apply to this research, as we do not need to predict either queue length or waiting times. Rather, computer simulation models are needed, not only to assess the benefits brought about by the proposed changes, but also to help in generating situations, optimising controls, and in predicting network behaviour at the operational level (Boxill and Yu, 2000).

Computer simulation is said to be one of the most powerful tools available for modelling and simulation activities in an interactive mode, as it allows and simplifies the methods used to study, analyse and evaluate conditions that could not be studied under normal circumstances (Ingalls 2008; Shannon 1998). Computer simulation aims at understanding and finding solutions to complex phenomena (Winsberg 1999).

Using computer simulation, both the current approach and the proposed approach are emulated to study the behaviour and activities of rail and road traffic at level crossings, gaining an understanding of the operations of level crossings and of road closures at level crossings, events that cause road motor vehicular traffic congestion.

A number of steps are required to build an accurate simulation model: (a) confirmation of the accuracy of the model, that it represents the actual phenomenon; (b) analysis of the full aspect of subject matter; and (c) analysis of model using both uncertainty and sensitivity methods to understand the models behaviour (Peck 2004). For the simulation to work and to produce reliable results, it requires a lengthy period of trial, error and comparisons of theory and actual results of physical experiments, allowing for approximations, idealisation, falsification, and additional information (Winsberg 2003).

Carson II (2005) suggested that an appropriate commercial simulation package model should be used to develop models using specialised purpose software packages available. Law (2007) recommended and emphasised the need to be cautious and prudent, and to give strong due consideration to the selection of the simulation package to use, so the appropriate software is selected. Law indicates that the selection of the software to use by the analyst, researcher, or modeller is one of the most, if not the most important decisions to be made during the project.

VISSIM was the software tool adopted for this study as it is a multi-modal microscopic traffic flow simulation software purposely developed by Planung Transport Verkehr AG (PTV AG) (Choa, Milam, & Stanek 2003). VISSIM was selected and deemed the most appropriate of the packages available, as it allows the following types of traffic entities to be simulated: (a) motor vehicles (cars, buses, and trucks); (b) public transport vehicles including heavy rail (trains), light rail (off road articulated trams), trams and buses; (c) emergency vehicles including fire, police, ambulance and emergency services in general; and (d) other road users including cyclists and pedestrians.

The research methodology was developed using Law's (2007) model and expanded to fit the requirements of this research, ensuring that the new design model incorporated into its design, the validity, reliability, and replicability features from Law's method. The methodology has been specifically constructed for the model design using data such as train timetables collected in 2008, 2011 and 2012 at one railway station and associated level crossing in the Melbourne train network as well as observed and recorded data during the same period as part of the data collection process, and using traffic computer simulation techniques to simulate the current operations of the level crossing. The simulation of the current operation was tested as many times as required ensuring: (a) operational validity; and (b) replicability of a simulation design model created. Once a valid and operational model of the current operations was achieved, a new model was created by the repositioning of the infrastructure of the station, modifying the station to the new platform specifications; the new model was a replica of the current model, ensuring the replicability of a simulation design of the new model.

PROPOSED APPROACH

Platforms at a station are classified as either Departure Side Platform (DSP) or Arrival Side Platform (ASP); this classification is dependent upon the relative position of the platform in relation to the adjunct railroad level crossing intersection. The current platform structure and operations DSP – ASP Station platform arrangement is simulated and depicted in Figure 1 (left). As an example, in the current system, the train travelling east to west arrives at the ASP platform before the level crossing, setting the trigger for the boom gates to lower, passenger's board and disembark, the train then proceeds through the level crossing; the road remains closed during this entire operation. An DSP platform indicates that a train travelling from west to east triggers the boom gates to lower, the train then passes through the level crossing to get to the platform, again passenger's board and disembark and the train continues; during boarding and disembarking, the road is open to traffic, as the train cleared the level crossing before stopping at the platform.

The proposed platform structure and operation of a DSP - DSP Station platform arrangement is simulated and depicted in Figure 1 (right). The simulation displays a train at the DSP platform and a train at the new DSP Platform; the "old" ASP platform becomes a decommissioned platform.



Figure 1: (left) The current DSP-ASP station platform configuration; and (right) the proposed DSP-DSP station platform configuration

VISSIM has the ability to output a variety of reports. Preliminary results indicate a saving across the different areas such as average queue length, maximum queue length and number of stops. Below is a summarised table outlining some the differences between the current and proposed operations.

Platform Environment (165 cycles) (Queues in metres)	North - South Traffic			South - North Traffic		
	Ave Queue	Max Queue	# of Stops	Ave Queue	Max Queue	# of Stops
Current DSP-ASP Station	98	224	68	120	277	76
Proposed DSP-DSP Station	28	128	36	39	159	42
DSP-ASPDSP-DSP differences	-70	-96	-32	-81	-118	-34
Differences in Percentage	71%	43%	47%	68%	43%	45%

Table 1: Summary of the results for the current and proposed systems Main Road North-South bound traffic (NS traffic) and South-North bound traffic (SN traffic)

An analysis of the preliminary results from both the current and proposed simulations indicates that both NS traffic and SN traffic average vehicle queue reduces by 71% and 68% respectively under the proposed system. The maximum vehicle queue is also reduced by a considerable amount under the proposed system, 43% for NS traffic and 43% SN traffic. The number of vehicles stopping at the intersection also reduces by 47% in NS traffic and 45% in SN traffic, under the proposed system.

CONCLUSION

Preliminary results from the computer simulation of the implementation of Departure Side Platforms (DSP) as a method to demonstrate the impact on road traffic congestion at railway station level crossings, indicates that a significant reduction on vehicles queue and numbers of vehicles stopping at the road queue, thus mitigating road traffic congestion at level crossing intersections next to or in close proximity of railway stations.

The primary contribution of this finding is that it addresses the causes of road traffic congestion problems at level crossings, that is, the positioning of platforms at railway stations adjacent to intersecting roads. Furthermore, this research provides an alternate solution that would minimise delays in urban areas caused by road traffic congestion. This also reduces delays in delivery of goods and services as part of logistic operations.

The research provides a contribution in the form of enhancing knowledge in simulation by building a computer simulation model of a real working problem and constructs a computer simulation model that recreates a solution to that problem. Furthermore, this research adapted Law's (2007) methodological approach to suit the current simulation, thus contributing to our understanding of appropriate methodologies for such research. This study also contributes to research by providing an alternative approach to the remediation of the level crossing problems.

However, this research is not without its limitations. The DSP concept is potentially an interim solution for railway station level crossings until implementation of the more permanent grade separated solution; although the DSP concept could be a permanent solution in its own rights. There may be other variables excluded from this simulation that cannot be controlled or measured easily by the VISSIM system. No official costing has been conducted in terms of the proposed system. Future research could look into the costing and other variables associated with the proposed system, building on the limitations highlighted above.

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ON-TRIP FREIGHT CONSOLIDATION IN LAST-MILE LOGISTICS

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ABSTRACT

Last-mile logistics delivery firms have always faced the problem of asset under-utilization in spite of the various mitigation initiatives proposed. A common initiative is to consolidate freight off-trip through a large consolidation center (CC), which is albeit not a robust improvement from the economic perspective. This paper, therefore, focuses on the alternative strategy of freight consolidation, i.e. on-trip freight consolidation. Specifically, we employ a vehicle routing optimization model, which aims to simultaneously capture the strengths of two previously proposed approaches – freight transshipment and freight deposit. The performance of the proposed on-trip freight consolidating strategies and the model formulation are evaluated on a numerical example.

INTRODUCTION

Last-mile logistics, which usually pertains to the delivery of merchandise to end-customers in cities, is identified as the most expensive, inefficient, and problem-generating element of the supply chain (Ehmke & Mattfeld 2012; Lindholm & Behrends 2012). Among the recent problems associated with last-mile logistics operations and which has received considerable industry attention, one of them is the issue of the under-utilization of a logistics firm's resources, e.g. trucks and drivers (Klundert & Otten 2011; Nair 2005). There are consequences to this under-utilization, namely, the economic woes of the logistics firms, and the environmental and social problems such as congestion, pollution, and excess energy consumption.

Several initiatives from policy, academia, and industry have been proposed to improve asset under-utilization. One common initiative is to utilize an aggregator or consolidation center (or CC) to perform freight consolidation (Goldman & Gorham 2006; Taniguchi, Thompson & Yamada 2012). In general, the CC might be represented by a distribution center, a service center, or a regional warehouse operated by either the public or private sector. The merchandise from different sources (i.e. shippers, distributors, and suppliers) are first sent to and collected at the CC. Then, the merchandise are sorted and consolidated such that the cargoes intended for the same or close-by destinations are distributed by the same vehicle (Song, Hsu & Cheung 2008; Verlinde, Macharis & Witlox 2012).

Indeed, the literature reports that off-trip freight consolidation via the CC improves utilization and operational efficiency for last-mile logistics. Despite this, such off-trip freight consolidation has limited success. For a start, the infrastructural cost of establishing (and operating) the CC is considerably higher, especially when operating in a high real estate location, even with the subsidies and grants provided by the city government. Business still needs to pay for the consolidation services. Due to the higher cost and smaller profit margin, the number of willing participating firms, especially the small and medium enterprises (SMEs), may be few and far between. In addition, only a limited number of CCs can be located within an area. Firms that cannot capitalize on the CC may have to travel longer on their inbound trips to the CC. These reasons could lead to fewer users using the CC (Duin, Quak & Munuzuri 2010; Thompson & Hassall, 2012). Furthermore, in today's competitive market, customers prefer to be served during

their desired time periods, i.e. time windows, which can significantly negate the advantages of the CC, especially when operating under highly restrictive time windows (Hernandez, Peeta & Kalafatas 2011; Verlinde *et al.* 2012).

As such, this paper focuses on on-trip freight consolidation, i.e. less the use of the CC. Put simply, on-trip freight consolidation seeks two or more vehicles to move and exchange their freight over their scheduled routes. Some on-trip freight consolidation strategies have already been introduced in the literature to improve the performance of last-mile logistics distribution. The first strategy found in the literature is freight transshipment (e.g. Rais, Alvelos & Carvalho 2014), whereby vehicles are allowed to move, swap, and exchange their freight directly with other vehicles at some designated transshipment depots. However, schedules of the vehicles visiting the transshipment points need careful coordination. Otherwise, a long waiting time may result, leading to late deliveries.

Another on-trip freight consolidation strategy is the freight deposit approach, which requires collaboration, not only among the freight carriers but also between the carriers and receivers (i.e. customers). In this approach, carriers can temporarily store their freight along their routes with customers, who are willing to keep these temporary freight deposits for a fee (Mirzapour Al-e-hashem & Rekik 2013). Other vehicles would then visit these customer locations to pick up the deposited freight for further delivery. While this freight deposit strategy has merit over the freight transshipment strategy in terms of flexible schedules, some difficulty may arise as the practice of doing so is new to customers and the carriers have to pay for the additional inventory holding cost.

As there is no clear domination between these two strategies, this paper therefore attempts to integrate these two strategies. To the best of our knowledge, there is no integration of these two strategies for any last-mile logistics operations so far. This paper is among the first to simultaneously incorporate these two strategies under last-mile logistics distribution, yielding a computationally expensive but more effective vehicle routing optimization model.

The rest of paper is organized as follows. In the next section, a novel vehicle route optimization model that simultaneously takes into account two on-trip freight consolidation strategies for last-mile logistics operations is presented. Then, an evaluation of the model through a numerical example is given, followed by the discussions, and conclusions of the paper.

VEHICLE ROUTING OPTIMIZATION MODEL

The route optimization model presented in this paper is deterministic. This novel model explicitly represents a class of delivery schemes of last-mile logistics involving multiple depots, multiple commodities, and two on-trip freight consolidation strategies. The model also aims to design the optimum configuration of a set of vehicle routes, visiting sequences on the routes, and the freight consolidation options so that the overall distribution costs are minimized.

The following assumptions apply to our model:

- 1) Each depot has sufficient quantity of its products to be supplied, that is, no shortage of product supply is allowed.
- 2) All customer locations are set to be potential locations for both freight consolidation strategies, i.e. transshipment and deposit.
- 3) Each customer location has unlimited capacity for freight consolidation i.e. there is no limit on the number of vehicles entering a customer location at the same time for freight transshipment as well as there is no limit on the amount of freight deposited.

- 4) The duration time of the service at each customer location is assumed to be zero.
- 5) Demand of each customer on each product type is not allowed to be split.
- 6) There is no limitation on the total number of vehicles used in the operation.
- 7) All data and information are known in advance of the planning.

Next, we present the notations used in the paper and the mathematical model, respectively.

Notations

Sets

K :	Set of homogeneous vehicles
B :	Set of depots (multi-depot)
C :	Set of customers
T :	Set of customers that are set to be potential transshipment points ($T \subseteq C$)
P_i :	Set of products supplied from depot $i \in B$ (multi-commodity)
V :	Set of all vertices ($V = B \cup C$)
A :	Set of all feasible arcs (i, j) , $i, j \in V$, $i \neq j$, and all feasible arcs are assumed to satisfy triangular inequalities.

Parameters

d_{jp} :	Demand of customer $j \in C$ requesting for product $p \in P_i$
$[a_j, b_j]$:	Time windows at customer $j \in C$, where $0 < a_j \leq b_j$
H_{jp} :	Inventory cost at customer $j \in C$ when holding the temporarily deposited product $p \in P_i$
Q :	Capacity of vehicle
FC :	Fixed cost of vehicle
V :	Variable cost of vehicle per unit distance travelled
c_{ij} :	Travel distance on arc $(i, j) \in A$
t_{ij} :	Travel time on arc $(i, j) \in A$
M :	Large value

Decision variables

x_{ijk} :	Binary vehicle flow variable equals one if vehicle $k \in K$ traverses arc $(i, j) \in A$ and zero otherwise
z_{ijk} :	Binary variable equals one if customer $i \in C$ precedes (not necessarily immediate) customer $j \in C$ on vehicle $k \in K$ and zero otherwise
I_{jpk}^h :	Binary variable equals one if demand of customer $h \in C$ on product $p \in P_i$ is temporarily deposited at customer $j \in C$ by vehicle $k \in K$ and zero otherwise
Y_{jpk}^h :	Binary variable equals one if demand of customer $h \in C$ on product $p \in P_i$ is picked up from customer $j \in C$ by vehicle $k \in K$ and zero otherwise
l_{hpk} :	Load of product $p \in P_i$ on vehicle $k \in K$ when traversing arc $(h, j) \in A$
r_{ghpk}^j :	Binary variable equals one if demand of customer $j \in C$ on product $p \in P_i$ is traversed on arc $(g, h) \in A$ by vehicle $k \in K$ and zero otherwise
s_{ik} :	Arrival time of vehicle $k \in K$ at vertex $i \in V$
e_{ik} :	Departure time of vehicle $k \in K$ at vertex $i \in V$
sv_{jk} :	Service start time of vehicle $k \in K$ at customer $j \in C$
ss_j^{km} :	Binary variable equals one if vehicle $k \in K$ and vehicle $m \in K$ ($k \neq m$) are the participants at transshipment point $j \in T$ and zero otherwise

Mathematical model

$$\begin{aligned}
\text{Min} \quad & \sum_{k \in K} \sum_{i \in B} \sum_{j \in C} x_{ijk} FC + \sum_{k \in K} \sum_{i \in V} \sum_{j \in V} c_{ij} x_{ijk} V + \sum_{j \in C} \sum_{k \in K} \sum_{h \in C} \sum_{p \in P_i, i \in B} H_{jp} I_{jpk}^h d_{hp} \quad (1) \\
\text{s.t.} \quad & \sum_{i \in B} \sum_{j \in C} x_{ijk} \leq 1 \quad \forall k \in K \quad (2) \\
& \sum_{j \in C} x_{ijk} = \sum_{j \in C} x_{jik} \quad \forall i \in B, \forall k \in K \quad (3) \\
& \sum_{i \in V} x_{ihk} = \sum_{j \in V} x_{hjk} \quad \forall h \in C, \forall k \in K \quad (4) \\
& z_{hjk} + z_{jkh} \leq 1 \quad \forall h, j \in C, \forall k \in K \quad (5) \\
& \sum_{p \in P_i, i \in B} l_{hjpk} \leq x_{hjk} Q \quad \forall (h, j) \in A, \forall k \in K \quad (6) \\
& \sum_{j \in C} \sum_{p \in P_j} l_{ijpk} = \sum_{j \in C} \sum_{h \in C} \sum_{p \in P_i} x_{ijk} r_{ijpk}^h d_{hp} \quad \forall i \in B, \forall k \in K \quad (7) \\
& \sum_{j \in C} \sum_{p \in P_j} l_{jipk} = 0 \quad \forall i \in B, \forall k \in K \quad (8) \\
& \sum_{h \in V} \sum_{k \in K} l_{hjpk} + \sum_{h \in V} \sum_{k \in K} x_{hjk} [\sum_{f \in C} Y_{jpk}^f d_{fp} - \sum_{g \in C} r_{hjpk}^g I_{jpk}^g d_{gp} - d_{jp} r_{hjpk}^j] = \sum_{h \in V} \sum_{k \in K} l_{jhpk} \\
& \quad \quad \quad \forall j \in C, \forall p \in P_i, \forall i \in B \quad (9) \\
& \sum_{k \in K} I_{jpk}^h = \sum_{k \in K} Y_{jpk}^h \leq 1 \quad \forall h, j \in C, \forall p \in P_i, \forall i \in B \quad (10) \\
& \sum_{h \in V} \sum_{k \in K} r_{hjpk}^j = 1 \quad \forall p \in P_i, \forall i \in B, \forall j \in C \quad (11) \\
& Y_{jpk}^h \leq \sum_{m \in K, m \neq k} I_{jpm}^h \leq 1 \quad \forall h, j \in C, \forall k \in K, \forall p \in P_i, \forall i \in B \quad (12) \\
& \max(s_{jm} - e_{jk}, s_{jk} - e_{jm}) \leq M(1 - ss_j^{km}) \quad \forall j \in T, \forall k, m \in K \quad (13) \\
& sv_{hk} + t_{hj} \leq M(1 - x_{hjk}) + sv_{jk} \quad \forall h, j \in C, \forall k \in K \quad (14) \\
& a_j \leq sv_{jk} \leq b_j \quad \forall j \in C, \forall k \in K \quad (15)
\end{aligned}$$

The objective function (1) of the model attempts to minimize the overall distribution costs comprising the total fixed vehicle costs (representing the total number of vehicles used), total travel costs, and total holding inventory costs. Constraints (2) state that each vehicle must start from the depot, and it can cover only one route; therefore the terms "route" and "vehicle" are used interchangeably. Constraints (3) impose that each vehicle needs to return to the depot that it started from. Constraints (4) are vehicle flow conservation constraints when entering a customer $h \in C$. Constraints (5) prohibit any cycling on the routes (i.e. route elementary constraints). Note that each customer could possibly be visited more than one time by different vehicles for different purposes. Constraints (6) are vehicle capacity constraints imposing on all feasible arcs. These constraints also illustrate the linking constraints between the vehicle flows and loading flows. Constraints (7) and (8) signify the total capacity of each vehicle when departing from and returning to the depot, respectively. Constraints (9) are the loading flows of each product at customer $j \in C$, where the vehicles might possibly consolidate their freight (i.e. transshipment and deposit) if necessary. Constraints (10) state that all products that have been deposited at customer $j \in C$ need to be picked up for further delivery. Also, all the demands of each customer on all product types need to be fulfilled as stated in Constraints (11). In Constraints (12), vehicle $k \in K$ can pick up the deposited products from customer $j \in C$ only when those products have already been deposited by the other vehicles. Constraints (13) are precedence constraints at the transshipment points, denoting that two participating vehicles have to complete their freight

transshipment before one vehicle leaves. Constraints (14) are scheduling constraints on two consecutive customers traversed by the same vehicle. Constraints (15) are time window constraints of the customers, where the service can start only within the time window. If a vehicle arrives at a customer earlier than the opening of the time windows, it needs to wait without penalty. Further, in our model, the flows of the vehicle and load are deemed impossible when one depot is traversed directly to another depot (i.e. an idle vehicle) and when one vertex is traversed to itself.

EXPERIMENTAL RESULTS AND DISCUSSION

Figure 1 shows a last-mile logistics network used to evaluate our model. The network comprises three depots and five customers. Each depot has its own products to be supplied to the customers. Each customer has a request on each product supplied from each depot and a time window for each request. Table 1 contains the details of the customers.

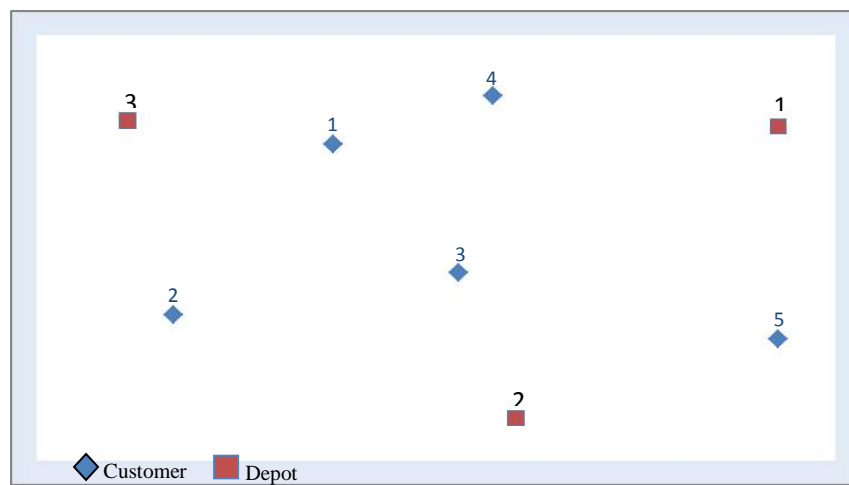


Figure 1: Example of last-mile logistics network
Source: Adapted from Solomon's benchmark R101 (Solomon 1987)

Customer	Requests on depot 1			Requests on depot 2			Requests on depot 3		
	a_j	b_j	demand	a_j	b_j	demand	a_j	b_j	demand
1	34	44	14	63	73	27	62	72	7
2	67	77	4	32	42	5	95	105	25
3	32	42	28	27	37	16	37	47	15
4	63	73	19	50	60	18	41	51	2
5	89	99	7	75	85	3	80	90	12

Table 1: Details of customers (randomly generated data)

For the numerical experiments, the travel distance on each arc $(i,j) \in A$ was computed based on Euclidean distance and was rounded down to the nearest integer. The travel time was set equal to the travel distance (i.e. one unit of travel distance = one unit of travel time). Each vehicle was assumed to have a fixed capacity of 70, a fixed cost of 5,000, and a variable cost per unit distance of 10. A unit inventory holding cost of each product at each customer was also set to 100.

In the experiments, the utility of our combined on-trip consolidation strategies and its model formulation are investigated. Further, our model is compared and evaluated with three other state-of-the-art cases, as described below:

Case 1 (no freight consolidation allowed): Therefore, the last-mile logistics network consists of three general vehicle routing models, each of which is served for each depot and its products. To solve each model individually, the exact-based column generation algorithm (Kohl *et al.* 1999; Qureshi, Taniguchi & Yamada 2009) was employed. Figure 2 displays the optimal solution of the logistics network of case 1.

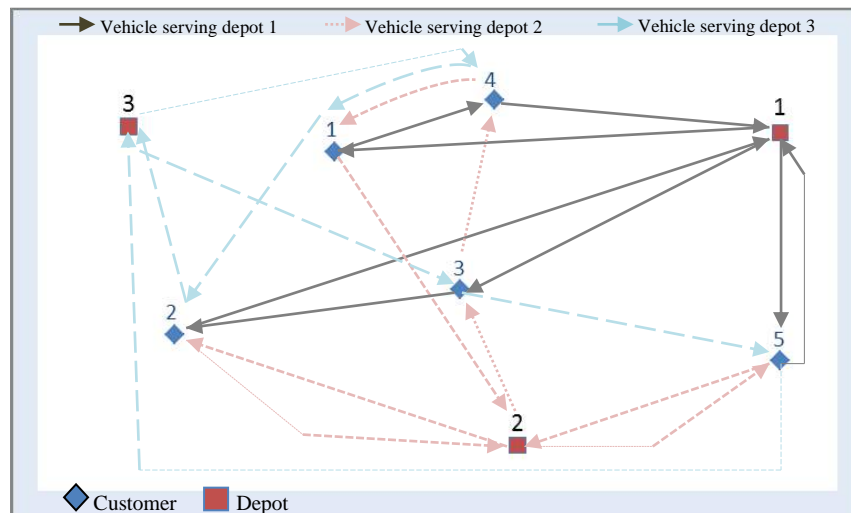


Figure 2: Optimal solution to case 1

Case 2 (only freight transshipment allowed): To solve the entire logistics network in this case, the optimal solution of case 1 was used as an initial solution. Then, the random removal and random insertion operators (Coelho, Cordeau & Laporte 2012) were iteratively performed on the solutions until no improvement on the solution could be found. Note that each time the removal or insertion operator was performed, route feasibility subject to all operational constraints needed to be checked concurrently. In the experiments, one transshipment was done at customer 4, where the vehicle departing from depot 2 transferred the demand of customer 1 to another vehicle serving depot 3.

Case 3 (only freight deposit allowed): In order to be realistic, as freight deposit is rare in practice, the maximum occurrence of freight deposit in the network is set to only one. Similar to case 2, the same solution processes, and the removal and insertion operators were also applied. From the obtained solution, the demand of customer 5 supplied by depot 2 was deposited at customer 3. The vehicle from depot 3 later picked up this deposited freight to serve customer 5.

Case 4 (two on-trip freight consolidation strategies integrated): This case combines cases 2 and 3, where now both freight transshipment and freight deposit are allowed. The solution to this case, which has also been solved by the same solution approaches, is illustrated in Figure 3.

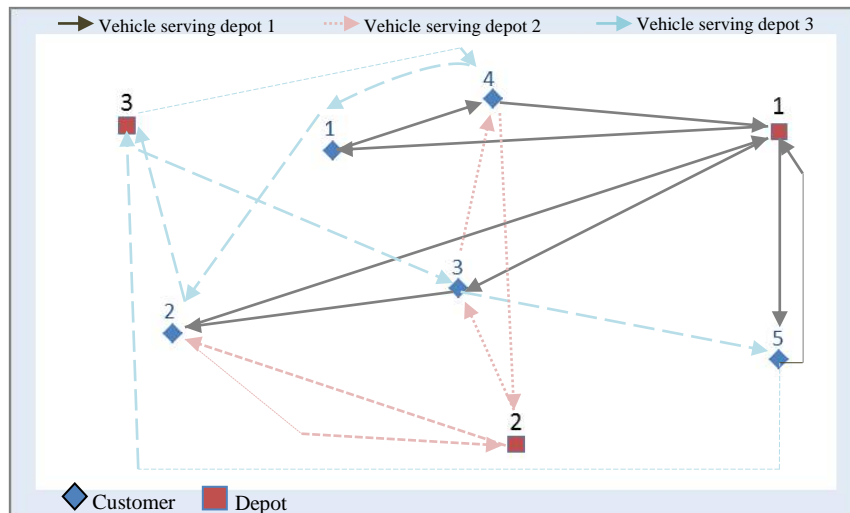


Figure 3: Solution to case 4

Table 2 also provides the overall numerical comparisons of these four cases. For the column heading, in particular, column “% residual capacity (mean)” specifies the average percentage of residual capacity of the vehicles in the network, which implicitly represents the average proportion of vehicles under-utilized. Clearly, using a freight transshipment strategy (Case 2), the total travel distance, overall cost, and the percentage of vehicle under-utilization can be decreased as compared with Case 1. However, due to the restrictive (hard) time windows and the resulting inflexible schedules, only a small reduction is found.

In Case 3, where a freight deposit strategy is employed, there is more flexibility in terms of the vehicle schedules. As such, there is a reduction of one vehicle as compared to the case of no consolidation, i.e. Case 1, and the case of freight transshipment, i.e. Case 2. This vehicle saving would also result in a lower overall cost (notably on the total fixed costs on assets), and the total travel distance. Even though the inventory holding cost must be paid for such freight deposits, they are however only a small fraction of the overall cost.

Combining the two on-trip freight consolidation strategies as in Case 4, the derived solution outperforms all the solutions from the other three cases, where the overall cost, the total number of vehicles used, the total travel distance, and the average percentage of vehicle under-utilized are all minimized.

Cases	Overall distribution cost	Total number of vehicles used	Total travel distance	% residual capacity (mean)
1	47540	8	754	0.72
2	47440	8	744	0.68
3	42320	7	702	0.68
4	42220	7	692	0.64

Table 2: Numerical comparisons of four state-of-the-art cases

CONCLUSION

With the increasing concern over asset under-utilization and environmentalism of the last-mile logistics distribution, several mitigating initiatives have extensively been conducted. One common response is to aggregate or consolidate the freight. In general, on-trip freight consolidation is less expensive than off-trip freight

consolidation through a CC. This paper combines two such on-trip freight consolidation strategies – freight transshipment and freight deposit for last mile logistics operations to develop a novel vehicle routing optimization model. We test the model using an instance adapted from Solomon’s benchmark and find that our model which combines the on-trip freight consolidation strategies is superior to the case of no consolidation, and the case of applying the on-trip freight consolidation strategies individually.

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AN INTEGRATED SHIPMENT PLANNING AND WAREHOUSE CAPACITY DECISION: A CASE STUDY OF BULK ITEM

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ABSTRACT

Purpose

In a transportation and distribution system, the shipment decisions, fleet capacity, and storage capacity are interrelated in a complex way, especially when we take into account uncertainty of the demand rate and shipment lead time. In this paper we investigate the effect of various factors on total costs and service level of a distribution system. The objective is to obtain a better policy related to a number of issues in transportation and distribution under uncertain situation.

Design / Methodology

We develop a simulation model that mimics transportation and distribution of bulk cement by the use of ships in a large cement company in Indonesia. The system consists of a storage at the port of origin, storage at two port of destinations. We develop scenarios related to storage capacity at port of origins as well as port of destinations, number of ships employed, operating hours of ports, and rules for ship dispatching. Each scenario is evaluated in terms of shipment costs and service level. A factorial experiment has been conducted and ANOVA has been used to analyze the results.

Findings

The results suggest that significant all factors have significant effects on both total costs and service level. However, the use of different number of ships appear to have the most substantial impacts on those two performance measures. We also observe a strong correlation between total costs and service level and able to show the efficient frontier of cost and service level.

Practical Implications

This paper brings an important recommendation to the company as well as insight for maritime logistics in general. Cost is a very important competitive factor for bulk items like cement, and thus the proposed scenarios could be implemented by the company for substantial transportation and distribution cost reduction. In addition, the efficient frontier graph resulted from this study can be used as an internal target or performance benchmark.

Keywords

Transportation and distribution, maritime transport, simulation

1. Introduction

Shipment planning and warehouse capacity are two important decisions in logistics activities. This importance has become more significant for low value and high volume products which are normally distributed in bulks using large-scale transporters and stored in large quantity (Christiansen et al., 2011; Pantuso, Fagerholt, & Hvattum, 2013). However, regardless of high costs, these activities are often overlooked which then lead to inefficient logistics operations (Christiansen, Fagerholt, Nygreen, & Ronen, 2006).

Most bulk products are distributed via maritime line operations (Al-Khayyal & Hwang, 2007; Christiansen, et al., 2011; Dauzère-Pérès et al., 2007; Siswanto, Essam, & Sarker, 2011). One of decisions to make regarding maritime logistics is when to

dispatch a ship considering the nature of maritime environment. There have been several characteristics identified by researchers why decision making in maritime distribution tends to be very hard. Low visibility, less structured problem, and more uncertainties are some factors characterizing maritime transportation (Christiansen, et al., 2006; Christiansen, Fagerholt, Nygreen, & Ronen, 2013; Panayides, 2006).

When dealing with bulk items, shipment decisions should take into account various factors such as demand rate, the shipment lead time, inventory level both in the storage and in transit, and the storage capacity itself. In many cases, the bulk items are stored in silo with a certain capacity level where items are directly unloaded from ship to silo. When a ship is dispatched too late, there will be out-of-stock situation at the destination. Conversely, if dispatched too early, the ship may arrive when the silo is still almost full which prevent unloading process to be started immediately after the ship arrives. This will force the ship to wait for unloading which means lower ship productivity and hence higher shipping costs. The problems is further complicated by the uncertain availability of docks, uncertain schedule of other ships coming to the same ports, and problems with weather and limited working hours at ports.

In such a situation, the important decision is not only to find the best schedule for ship departure from the port of origin, but also the capacity of the storage. Small storage is cheaper to build and to operate, but it may in turn lower ship productivity because ships often have to wait for unloading. Service level may also be lower as the ability to maintain buffer stock is also lower. Hence, it is of high importance to integrate between shipping decisions and storage capacity decisions. In this study we develop a simulation model that is capable of evaluating different scenario related to shipping decisions and storage capacity design. Shipping decision includes number of ships and their capacities as well as dispatching rules. The model is motivated by a problem encountered by a cement company in Indonesia.

2. System Description

We consider a storage and transportation system that mimics the situation of cement company. The company is producing cement in one location to serve the market in Indonesia. The products are distributed in the form of packaged or bulk. The bulk cement, the one that we model in this study, is transported by ships from port of origin which is located in the vicinity of the plant to two port of destinations, called Port A and Port B in this paper. The loading rate at port of origin is about 400 tons per hour and assumed to take place for 12 hours a day, that is between 7 am to 7 pm. In each port of destination ships will unload the bulk cement to a silo with a rate of 300 tons per hour. There is currently one silo in each port of destination with a capacity of eleven thousands tons each. Each silo will serve the demand from the market area that they cover. Daily demand is stochastic following a certain probability distribution. From the data, the demand in Port A is significantly higher than that of Port B. Figure 1 illustrates the system configuration.

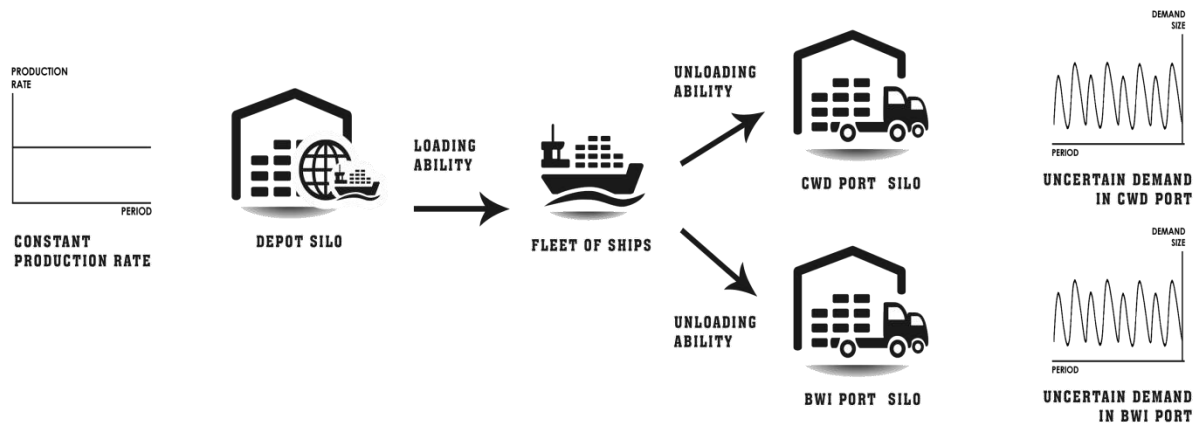


Figure 1. System configuration.

When a ship arrives at the port of destination, there are a number of possibilities that may occur. First, the ship may directly go for unloading if (i). the inventory level in the silo is below a certain quantity; (ii). there is a free unloading dock in the port; and (iii). no weather-related problems that prevents the unloading process to be done. If any of these conditions is not met, the ship has to wait until all constraints are relieved. From our field study, waiting time has been a major part of the time spent by the vessels. In this specific case, the percentage of waiting time is about 60% - 70% of the total vessel time.

To deliver the product, the company charters six heterogeneous ships under time-charter scheme, each with different chartering rate and capacity, namely Ship A (7,500 tons), Ship B (10,000 tons), Ship C (6,000 tons), Ship D (5,000 tons), Ship E (10,000 tons), and Ship F (6,000 tons). Because the company charters its ships based on time, scheduling is not a point of consideration in dispatching ships in its current situation. However, although waiting incurs almost the same demurrage cost to company wherever it happens, allowing it to happen in depot probably is better than in port of destinations.

Scheduling improves the flow of inventory and balance its placement throughout all distribution stages. To do a better ship scheduling, a reorder point is set in such a level that the shipment is only made when both on hand inventory and in transit inventory are not adequate to satisfy demand during the distribution lead time. We will refer to this point as *Reshipment Point* (RSP) which is obtained by finding the demand during lead time at the percentile of the desired service level. The shipment policy will then be "to assign a ship up to its full capacity to destination port where on hand and in transit inventory is less than or equal to its RSP". For Port A, demand at the percentile of 98% is 4,750 ton/day while in Port B it is 1,650 ton/day. Considering that it takes about 6 days to ship to Port A and 4,5 days to ship to Port B, RSP for Port A and Port B consecutively is 28,500 tons and 7,312 tons.

3. Experimental Design

In this study we attempt to find alternative ways to reduce the logistics costs while maintaining acceptable service level. The basic idea is that there is an interrelationships between the capacity of origin storage capacity, the number (and total capacity) of ships, and the capacity of the destination storage. We may treat those three stages as interconnected activities that should have balanced capacity in order to improve the throughput, that is, to serve the demand better at lower costs. It may be the case that reducing the number of ships is possible but larger storage capacity would be needed to maintain an acceptable service level. However, given the problem complexity, how those factors interact each other are not quite obvious and hence simulation experiments would be necessary. Some of the alternatives that we are trying to explore in this simulation are:

1. Reducing the number of ships, which will directly reduce the transportation costs, but it may also reduce the service level. We are interested to find whether or not working with fewer ships would still be acceptable from business perspective. As shown in table 1, we include 3 levels of number of ships, namely 6, 5, and 4.
2. Adding storage capacity in the port of origin and in one of the destination (in this case silo in Port A because of its high demand and large proportion of ship waiting time due to silo capacity constraint). This will obviously increase storage costs. For this purpose, we have estimated the annualized cost for silo investment and distribute this cost into the total distribution cost. The two alternatives of silo capacity are 11,000 tons which is the current capacity level and twice of the current capacity.
3. Dispatching ship only if the on hand inventory in the silo plus the in transit inventory fall below the reshipment points (RSP) that have been calculated based on 98 percentile of demand during lead time, which is in contrast to the current practice where any available ship is loaded and dispatched (i.e., the RSPs have unlimited values) . This is expected to bring better performance to the system as the ship waiting at the port of departure is creating more flexibility compared to a ship waiting at the port of destination.
4. Ports are operating with longer times for each day. Currently some ports are operating only 12 hours a day. We would like to test what would be the impact of extending the working time in each port to 24 hours a day. This is expected to reduce waiting time of ships in all ports and hence would have substantial impact on distribution cost per ton of product.

We design a full factorial simulation experiment. The simulation model is developed in ARENA simulation software. As mentioned above as well as shown in table 1, there are five factors included in the experiments, each with two or three levels, giving a total of 48 experimental cell. The number of replication in each experimental cell is five, leading to 240 individual experiments.

Table 1. Experimental Design

Factors	Levels	Number of Levels
RSP Port A and Port B (RS)	1 = Unlimited; 2 = at 98 percentile;	2
Silo capacity in port of origin (DE)	1 = 11,000; 2 = 22,000;	2
Operating hours of ports (OT)	1 = 12; 2 = 24;	2
Number of ships (NS)	1 = 6 ships; 2 = 5 ships; 3 = 4 ships	3
Silo capacity in Port A (PA)	1=11,000; 2= 22,000;	2
Total number of experimental cells		48
Replications		5
Number of experimental cells		240

4. Performance Measure

We use the two most important performance measure of logistics, i.e., total costs and service level. Total costs consists of investment costs of constructing additional silos and shipping costs, calculated as an annual cost, given by the following expressions:

$$\text{Total cost} = \text{investment cost (IC)} + \text{shipment cost (SC)}$$

$$\text{IC} = \text{number of additional silos} \times \text{Investment cost per silo} \times \left(\frac{A}{P}, i, n\right)$$

The last term is the conversion of investment cost to annual cost using the assumption of 12% annual interest rate and 20 years of economic life for the silo. On the other hand, shipping costs consist of two different rate apply for both off-road (moving) and on-road (non-moving) time of the vessels. During on-road time, the chartering rate is including the fuel cost (full chartering rate). When being off-road, the chartering rate only includes payment for ship owner (off-road chartering rate). The mathematical expression of the shipping costs is as follows:

$$SC = ORC \times ORT + FCR \times FCT$$

Where ORC is the off-road chartering rate, ORT is duration of off-road time, FCR is full chartering rate, and FCT is duration of on-road time.

Service level is the measure of stock availability in each destination. Given that we have two destinations with different demand rate then we aggregate service level of the two locations as follows:

$$SL = \left(\frac{DA}{TD}\right) \times SLA + \left(\frac{DB}{TD}\right) \times SLB$$

Where DA is demand in A, DB is demand in B, TD is total demand, SLA is service level in A, and SLB is service level in B. Service level is obtained by the ratio of number of days without stockout with total number of days in one year, expressed as follows:

$$SLA = 1 - \frac{\text{number of days with stockout in A}}{\text{number of days in one year}}$$

5. Results and Discussions

5.1 Significance Tests

The simulation results in terms of total cost and service level have been summarized. Table 2 presents the average total cost across five replications for each experimental cell. In table 3 we present the same format for the service level. Statistical test has also been conducted to evaluate which factors give significant impact on the two performance measures. Tables 4 and 5 present the results of ANOVA test for the main effect and two-way interactions. Here are some of the observations from the results:

- All factors have significant impact on both total costs and service level which is shown by the small values (less than 5%) of significance level. Some interactions are also significant. For example, as far as the total cost is concerned, all interactions involving number of ships (NS) is shown to be significant. This means that the effect of number of ships on the total costs is affected by all other factors.
- The most obvious observation is that both total costs and service level are significantly affected by the number of ships operating. Deploying more ships result in better service level but higher total costs. This is quite obvious as we apply time charter assumptions for all ships.
- Extending operations time from 12 hours to 24 hours has significant effect on both total costs and service level, i.e., results in lower total cost and higher service level. However, looking at the F values of the ANOVA tables, the effect of extending operations time is much more apparent on the total costs than on the service level.
- The use reshipment point (RSP) has significant effect on both total costs and service level. This is an interesting observation. This supports our premise that it is better to hold ships at the port of origin until the stock at the destination reaches reshipment point rather than dispatching the ships whenever they are available.

Table 2. Average of total costs for each treatment

RS	DE	PA	NS = 4		NS = 5		NS = 6	
			OT=12	OT=24	OT=12	OT=24	OT=12	OT=24
1	1	1	170,805	164,645	180,727	176,930	189,933	188,642
1	1	2	178,819	163,735	188,058	179,362	192,332	185,519
1	2	1	171,147	169,957	186,176	181,778	190,848	189,066
1	2	2	175,529	164,102	185,393	182,781	195,775	190,835
2	1	1	168,337	153,433	176,339	169,324	180,010	172,367
2	1	2	170,948	165,081	178,301	168,412	185,065	174,176
2	2	1	170,992	158,284	179,024	160,178	185,399	172,124
2	2	2	175,608	162,095	179,236	168,117	189,596	180,454

Table 3. Average of service level for each treatment

RS	DE	PA	NS = 4		NS = 5		NS = 6	
			OT=12	OT=24	OT=12	OT=24	OT=12	OT=24
1	1	1	0,830	0,841	0,897	0,870	0,957	0,935
1	1	2	0,848	0,891	0,890	0,890	0,969	0,977
1	2	1	0,870	0,848	0,888	0,872	0,981	0,958
1	2	2	0,893	0,931	0,931	0,928	0,998	0,996
2	1	1	0,828	0,888	0,868	0,838	0,973	0,962
2	1	2	0,887	0,876	0,914	0,919	0,997	0,998
2	2	1	0,863	0,883	0,886	0,925	0,983	0,982
2	2	2	0,884	0,943	0,931	0,947	0,992	0,997

From table 3, it is important to see that the use of four ships would be unable to deliver acceptable service level if ports are working for 12 hours. However, with 24 hours operating time and storage capacity extension to 22 thousands tons, it would be possible to achieve above 93% service level. When the number of ships operating is six, the impact of extending the working hour from 12 to 24 on service level is marginal. The ANOVA table also confirms this phenomena where there is a significant interaction effect between operating time and number of ships on service level.

5.2 Efficient Frontier Analysis

The trade off between cost and service level is well known in logistics. However such a relationships is mostly obvious when we vary the level of inventory. In this study we suspected that there is also a strong trade-off between costs and service level. The reasons is that, when we invest in higher storage capacity then there should be higher stock availability, but there is also a cost associated with this investment. On the other hand, the decision to reduce the number of ships would save costs but result in lower the stock availability. Given that there are many interrelated factors, the trade-off is not that obvious and some complex interactions present.

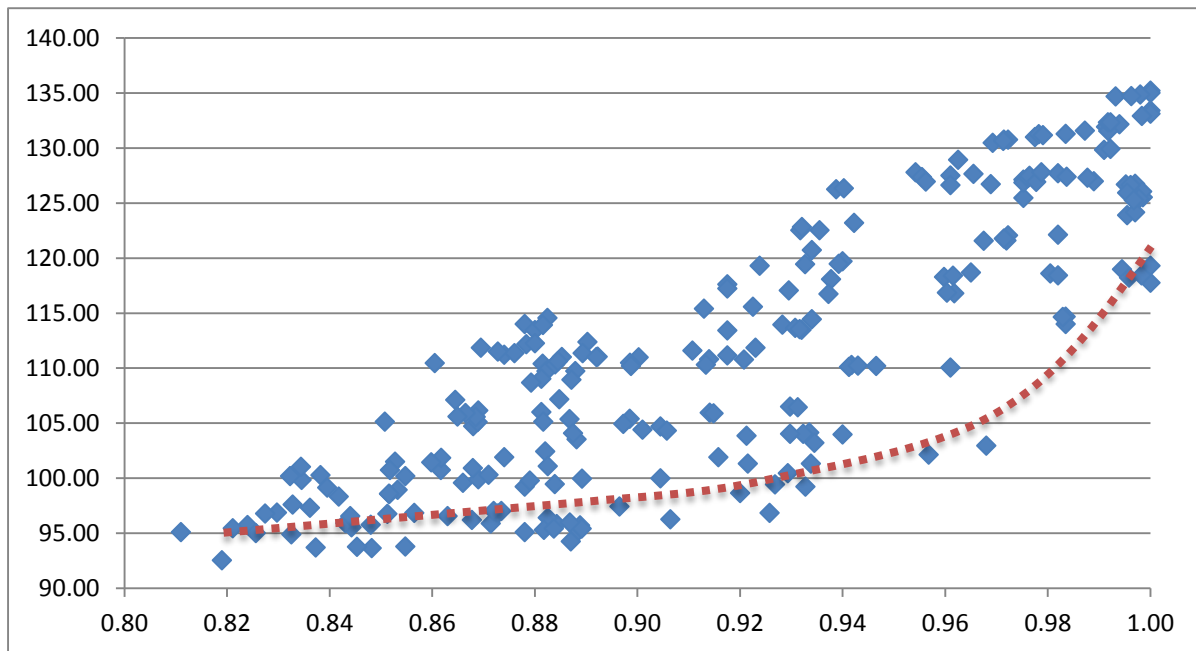
In figure 2 we plot the total cost (vertical) against the service level (horizontal) for each experiment. The general pattern show that there is a correlation between total cost and service level, i.e., higher service level is achieved with higher total costs. From this figure we can also identify the approximate frontier line that connects the most competitive options (which is shown by the dotted curve at the bottom part of the graph). The points which are far from the frontier curve are dominated options. The frontier curve can be used to guide the cost and service level targets for the company. It is interesting to see which combination of levels that lead to efficient frontiers and which ones are mostly dominated. It is important to note however, that there should be a lower limit of acceptable service level. Generally, for any comodities, a service level should not be below 90%.

Table 4. ANOVA table for total cost

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
RSP (RS)	4167.000	1	4167.000	1,965.0	.000
Capacity of silo at depot (DE)	194.292	1	194.292	91.6	.000
Operating hours of ports (OT)	4292.435	1	4292.435	2,024	.000
Silo capacity in port A (PA)	553.038	1	553.038	260.8	.000
Number of ships (NS)	12192.306	2	6096.153	2,875.0	.000
RS * DE	2.177	1	2.177	1.0	.312
RS * OT	462.315	1	462.315	218.0	.000
RS * PA	91.810	1	91.810	43.3	.000
RS * NS	501.617	2	250.808	118.3	.000
DE * OT	4.942	1	4.942	2.3	.129
DE * PA	1.482	1	1.482	0.7	.404
DE * NS	70.710	2	35.355	16.7	.000
OT * PA	29.977	1	29.977	14.1	.000
OT * NS	98.967	2	49.484	23.3	.000
PA * NS	13.543	2	6.771	3.2	.043

Table 5. ANOVA table for service level

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
RSP (RS)	.007	1	.007	63.4	.000
Capacity of silo at depot (DE)	.034	1	.034	297.4	.000
Operating hours of ports (OT)	.002	1	.002	16.8	.000
Silo capacity in port A (PA)	.067	1	.067	581.8	.000
Number of ships (NS)	.475	2	.238	2,074.0	.000
RS * DE	8.167E-5	1	8.167E-5	0.7	.400
RS * OT	.003	1	.003	23.3	.000
RS * PA	6.667E-6	1	6.667E-6	0.1	.810
RS * NS	.000	2	.000	1.9	.142
DE * TW	.001	1	.001	6.4	.012
DE * PA	.000	1	.000	3.3	.072
DE * NS	.002	2	.001	10.8	.000
OT * PA	.004	1	.004	33.5	.000
OT * NS	.011	2	.005	46.8	.000
PA * NS	.002	2	.001	9.6	.000



6. Concluding Remarks

This paper presents a simulation study of bulk cement distribution via sea transport from one port of origin to two ports of destinations. We investigate five factors that were suspected to have effect on total costs and service level. We have demonstrated that all factors have significant effect on total costs as well as service level. Further observation also shows that some interactions between factors also have significant impact on both performance measures. We also plot the trade-off between service level and costs. It is obvious that there is a strong correlation between cost and service level, but some combination of levels are obviously dominating others.

This study can be extended to include investigation of supply chain flexibility typology. Angkiriwang et al. (2014) suggest that there are various strategies of flexibility that could be applied to deal with uncertainties. In this study, we tested a number of scenarios which are related to creating better flexibility. For example, the use of RSP has an implication on system flexibility because ships available at the port of origin maybe hold until the stock level at the port of destination reached a certain level. Adding capacity to storage is also a strategy that could improve supply chain flexibility.

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IMPACT ANALYSIS OF TRANSPORTATION SYSTEMS ON CITY LOGISTICS

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Abstract

Decentralized development is believed to be the most viable solution for managing logistics related issues of the transportation system. With decentralized development, the traffic volume is diverted from central business district (CBD) with the intention of minimizing congestion, emission and safety. However, the policy of decentralized development needs critical analysis for intuition and counterintuition. System dynamics (SD) methodology is used to analyze the possible policy dichotomy appearing in the transportation system. Using SD, the policies of investment in the decentralization and emission control are investigated to attain minimum possible congestion. The outcome of this study will help the policy makers to develop the scenario for efficient transport planning in the city.

Introduction

Cities are embracing the decentralization concept in their effort to reduce the externalities in the urban transport network (Israel&Cohen-Blankshtain 2010) and better manage land use intensification. These externalities are related to congestion, emissions, and safety. However, the spatial development of urban areas will not eliminate the externalities. Instead, the same problem is manifest at the decentralized level in that the traffic volume, both passenger and freight is still converging to the central business district of the cities. Already, congestion pricing is a well used instrument to handle traffic congestion in many cities such as Singapore (Goh 2002), London (Santos *et al.* 2010b, Santos *et al.* 2010a), and Stockholm (Kottenhoff&Brundell Freij 2009). The variable pricing maintains the differentiation between the commercial and non-commercial vehicle movement in the congested areas (reader can see de Palma&Lindsey (2011) for more detailed pricing classification). The policy of congestion pricing is not well received in many cities like Edinburgh (Li&Hensher 2012).

Sustainability in the urban transportation system is the multi-faceted measure, which emerged to be a complex analysis based on quantitative and qualitative measures of the transportation system. The sustainability in transportation system is wide and vast area of research with economical, social, environmental factors. There are many actors related to commercial and non-commercial transportation that lead to achieve sustainable transportation system. The interactions between these actors make it more difficult to attain the sustainability due to induced non-linearity (Richardson 1994). It is important to model these interactions for minimizing adverse effects of non-linearities in the transportation system. According to the World Business Council for Sustainable Development report (WBCSD 2004), globally, the sustainable transportation is also constrained by expected growth of both commercial transport to around 45 Trillion ton-kilometers by 2050 in comparison with approximately 15 Trillion ton-kilometers in 2000. As the contribution of commercial vehicles toward the emission is more, it is worth mentioning that the negative impacts of such dramatic growth needs mitigation strategies or policies.

Decentralization promises to alleviate problems related to sustainable transportation. Already, research suggests that the urban city of the future could be based on decentralized rather than global production networks. Decentralization has been promoted as a means to better reflect citizen preferences and improve local services.

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However, the amount of investment and dedication requirements makes this an unfavorable option. Also, many developing countries decentralized and promoted neoliberal policies such as commercialization simultaneously, leaving administrators with the responsibility for improving public services through self-financing reforms (Herrera 2014). It is believed that combining decentralization with neoliberal commercialization has increased social and political conflict surrounding the urban service provision and that local institutional constraints further undermine the administrator's ability to adopt and govern for the politically contentious policies (Faguet 2014). Thus, along with three major facets of sustainability, policy making in the urban transportation system should consider additional political factors. This inclusion of additional factor makes it even more difficult to justify the decentralization efforts for development.

In this paper, we investigate the decentralization policy with all the important factors of sustainable transportation using a case example of Singapore's Jurong East Gateway (JEG) precinct development. This development is one such initiative taken to move the traffic volume from the central business district (CBD) to suburbia. In advocating such policies, it is important to identify any counterintuition and its impact on the development strategy and overall growth. The practical implications of such development were found associated with the traffic congestion due to the limited capacity, inadequate information, and unorganized facilities. Besides congestion, it is also required to investigate the growth in the economy, leading its intuitive and counterintuitive impacts on the population and the environment. Furthermore, the inverse impacts of emission on environment and to the economic growth. To solve this complex, policy dichotomy and non-linearity related issue, the system dynamics (SD) tool is used. Mind maps representing causal relationships between the factors of the urban transportation system are developed.

The rest of the paper is arranged as follows. Section 2 covers the work on decentralization in the transportation system to attain sustainability. Section 3 presents the system dynamics methodology used to investigate the policies in the decentralized transportation system. In Section 4, the results of the system dynamics model are discussed. The results are analyzed against two policies in the urban transportation system. Finally, Section 5 concludes with some future directions for research in the urban transportation system.

2 Literature review

Sustainability is defined by many possible definitions, which in general refers to the long-term availability of proper means that are necessary for long-term achievement of pre-specified goals (Kourtit *et al.* 2014). The sustainability is a major concern for the researchers in the transportation system. The sustainable transport is not only considered to curb emission, but also for social, ecological and economic development. To achieve sustainable development requires coordination (or at least harmonisation) of multiple of transport policies in different member states, which should be considered as equally accountable for creating the negative externalities (Nijkamp 1994). In view of Nijkamp (1994), sustainable transport needs time span of many years, leaving many flexible new opportunities at the decentralized level for local development. Zhao (2010) has analyzed that sustainability issues is more relevant in curbing the urban sprawl along the urban fringe that will increase the vehicle kilometer travelled (VKT) in the suburbs. The failure to respond to the urban sprawl in an efficient way reflects the government's failure to manage the growth in the current transformation process.

The decentralization or suburbanization is now practiced in many of the countries like US (Cidell 2010) and China (Cervero&Day 2008). The various ways to adopt suburbanization are Edge cities (Phelps 2009), Eco-cities (Caprotti 2014), which falls in the broader class of smart cities (Dierwechter 2013, Neirotti *et al.* 2014). Many of the researchers have realized potentials behind the decentralization or suburbanization for the sustainable transportation besides opening up the new opportunities for the people to find their job outside the central business district (Cho Yam Lau 2010, Caprotti 2014). In its effort for decentralization, there have been emerging of Special Economic Zones (SEZ), which are dedicated commercial zones for the manufacturers and foreign direct investors to set up

their production units with low liability for taxes, which serves as incentives for such initiatives (Wang 2013, Chaudhuri&Yabuuchi 2010). The major domains in suburbanization have been realized as natural resources and energy, transportation and mobility, building, living, government, as well as economy and people. The grown interest level can also be seen in intermodal transportation (Dierwechter 2013, Zhou *et al.* 2008), where the big trucks instead of travelling through the cities, they deliver the product to the consolidation center (Gonzalez-Feliu&Salanova 2012). The small trucks are used later on to move around the city for last mile delivery. Although these concepts of consolidation and warehousing outside the congestion prone areas are promising, there are some practical implications behind its use. The major hurdle in such initiative is with the amount of investment required and also societal reluctance. As observed by Neirotti *et al.* (2014), in their critical analysis on smart cities, policy makers and city planners need to consider vulnerability, resilience of panoptical environment created through smart cities.

SD is the methodology with which mind-maps are analyzed through causal loop diagrams that depict the cause and effect scenarios in the system. So far, SD is more focused on policy decision-making to reduce congestion in the city, increase commuter safety, and lower emissions (Armah *et al.* 2010, Feng *et al.* 2013, Wang *et al.* 2008). The SD methodology is also used in other applications of policy making like traffic incident information system (Hou *et al.* 2013, Chung 2012, Cooke&Rohleder 2006), spatial dynamics (Fang *et al.* 2005). The SD modeling become more efficient when used with cellular automata for traffic impact analysis required for policy makers (Fang *et al.* 2005, Long *et al.* 2009). Some of the applications can be found in commuter behavior analysis for the policy over variable pricing (Springael *et al.* 2002). In all these applications, the SD modeling is used to investigate the intuitive and counterintuitive impacts of policies in the urban transportation system. The SD methodology has all the potentials to be a best fit tool for managing investigating policy of decentralization in the urban transportation system.

The literature scan on sustainability through decentralization has revealed some research gaps. First, the decentralization policy has been considered in isolation of the counterintuition in the form of consequences of moving too much traffic volume towards the suburban areas. City planners need to address what make the balance between the traffic volume increment and suburban capacity. Second, city planners need to make economic decisions over suburban development, in which the investment decision has important implications for transportation sustainability. Third, the dichotomy over policy will appear when the policy contains multiple factors for the decentralization. The policy investigation is required in the such environment considering the induced dynamics in the system. Last, any decentralization decision based on policy investigation has a limited focus, where the policy is multi-faceted instead of a single parameter.

2.1 Field survey: Jurong east gateway (JEG)

The Jurong Lake District (JLD) has been designated as a strategic piece in the decentralization of Singapore's commercial and leisure activities (Malone-Lee *et al.* 2001). This is a bold move to better manage congestion, improve environmental sustainability, and optimize land use for a brighter urban future (Malone-Lee *et al.* 2001). The JLD is considered as a cluster of urban logistics in Singapore with Jurong east gateway (JEG) as a key precinct. JEG provides a rich mix of urban functions, with expansions planned for the near future. Malls such as JCube, Jem, Westgate and IMM already provide around 200,000 m² of retail footprint, housing over 800 shops. The upcoming Westgate Tower will supply a large increase in high-rise commercial space by the end of 2014, and the Ng Teng Fong General and Jurong Community Hospitals will collectively provide 1100 hospital beds, catering to over a million residents in JLD. Finally, JEG also houses some light business and warehouse facilities. However, the high density of urban functions in JEG is naturally prone and highly sensitive to traffic congestion, especially when both cargo and people are channelled into the area, causing negative externalities to all concerned. Put simply, the current approach creates operational and tactical challenges for routing and resource scheduling. The large amount of urban logistics activities

generated deserves better orchestration through resource and information sharing in collaborative and co-opetitive efforts between stakeholders in the precinct.

3 SD methodology for decentralized, sustainable transportation system

In the urban transportation system, the main objectives are to minimize congestion level on the road, minimizing carbon emission, and improving safety for the passengers. These objectives coincide with those of the sustainable transportation. Using system dynamics, these objectives are achieved through the changes in policy parameters, which defines the array of policy. The policy makers in the suburbanization or decentralization developers would want to decide the investment for the decentralization by opening new development or precinct for the diverted traffic volume from CBD. The need for the SD arises due to the anticipated counterintuitive effects of the policy, which is the result of intuition applied to the system. Our best efforts to solve the problem make it worse, causing delay, dilution, or defeat in the policies by the unforeseen reactions of the nature. Also the need for the system dynamics arises due to the policy resistance from the local and global factors of the system. As our concern is the behavior of complex systems, SD is grounded in of non-linear dynamics and control theory.

The assumptions used in the current SD model are as follows. First, the population growth of JEG is from people moving into the precinct, following business and work opportunities in the area. Next, economic growth along with a growing population necessitates greater travel demand using private vehicles. Third, an increasing population density increases the VKT of vehicles into the area. Fourth, the traffic volume and the VKT can be reduced by decentralizing the traffic flows. Thus, decentralization can be seen as the sustainable option of urban development. Fifth, any investment in decentralization is through new opportunities. Finally, the consequences through more vehicles in the precinct should be measured in terms of its impact on the economy and growth.

3.1 Causal loop diagram

Figure 1 shows the causal loop diagram (CLD) for the system dynamics modeling. The CLD has five causal loops, 3 negative (or balancing) loops and 2 positive (or reinforcing) loops. In first negative loop, "-1", it is shown that the increasing economy attracts the migrants, which increases the population, which increases the travel demand - increases traffic volume - increasing traffic congestion level, which impact economy in a negative way. Second negative loop, "-2", represents the environmental impact on the population by increasing the number of vehicles. In this loop, population growth increases the number of vehicles that will affect the environment in an adverse way, which reduces the population (by increased death rate). Third negative loop, "-3", shows the environmental impacts on the economy. In this loop, the economic growth booting the number of vehicles on the road, which affects the environment that indirectly affects the economy by lower gross domestic product (GDP) increase rate. The two reinforcing (or positive) loop depicts the advantage of decentralization on the economy and congestion level in

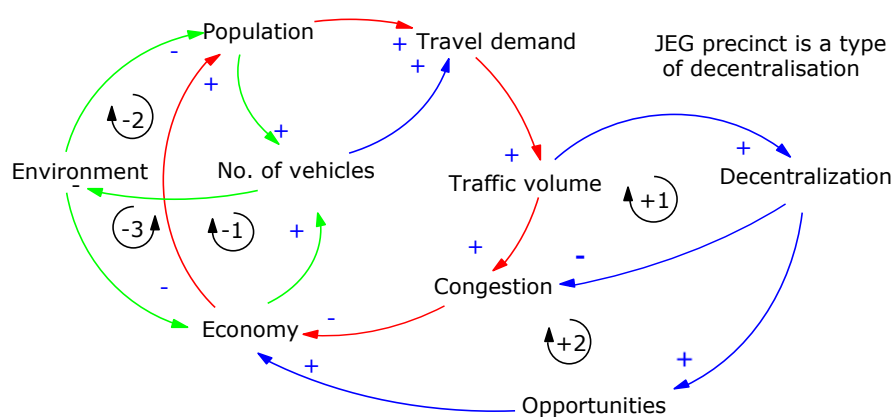


Figure 1 Causal loop diagram for Jurong east gateway precinct

the urban area. The first positive loop, "+1", continues from increased traffic volumes of '-1'-loop by moving the traffic volume by decentralization, which reduces the traffic congestion level that increase the economy because of the inverse relation between the 'economy' and 'traffic congestion'. The second positive loop, "+2", shows the opportunistic development in a decentralized way by opening new precinct for development. In this loop, decentralization raises the opportunities for the new developments that will help the economy to grow.

3.1.1 Intuition and counterintuition

In Figure 1, the intuition and counterintuition is reflected in the loop interactions. The intuition part of the SD model is 'when the traffic volume increases, move the traffic volume towards suburban areas'. However, the counterintuition for this is that 'economic growth would attract more people and hence increase traffic congestion and impact the environment negatively'. Thus, using SD modeling, these interactions are modeled in the decentralisation policy to decide how much traffic to move away from the CBD and how much to invest in precinct development. As precinct development investment grows, a more concentrated traffic volume leads to more traffic congestion. In the JEG case, the investment is opening a new facility (hotel, office tower, hospital) in the precinct.

3.2 Stock and Flow diagram

Next, we construct the stock and flow diagram. We first identify the variables which are related to the causal relationship depicted in Figure 1. Table 1 summarizes the variables used to describe the causal relationship modeled with mindmaps. Figure 2 shows the stock and flow diagram.

Table 1 Variables used in SD model

Description	Variable	Description	Variable
Total population	POP	Percentage of trips made by trucks	TBVP
Net increase in population	NIP	Total vehicle kilometers travelled	VKT
GDP per capita	GDPPC	Traffic congestion level	TCL
Net migration rate	NMR	Precinct increment (capacity increment for diverting traffic volume)	PI
Number of vehicles per capita	NOVPC	Precinct decentralization (fraction proportional to the investment in precinct development)	PDC
Total number of vehicles	TNOV	VKT per facility (VKT required for each facility in a precinct)	VKTPF
Increment in GDP	IGDP	Traffic congestion level factor (decentralization rate of precinct development)	TCLF
GDP increasing rate	GDPIR	Decentralization investment to GDP ratio	DCR
Decentralization/Precinct development investment	DCIV	Investment per facility	IPF
Average Trip distance	ATD	Stock of emission	STE
Total trips	TP	Increase in emission	IE
Avg. Trip rate (number of trips made in a day)	ATR	Vehicle contribution to emission	VCE
Total trips made by vehicle	TBV	Emission per vehicle	EPV
Decrease in emission	DIE	Environment factor	EF
Emission capacity	EC		

The relationship between these factors is based on following axioms, which have been drawn from the SD literature on congestion.

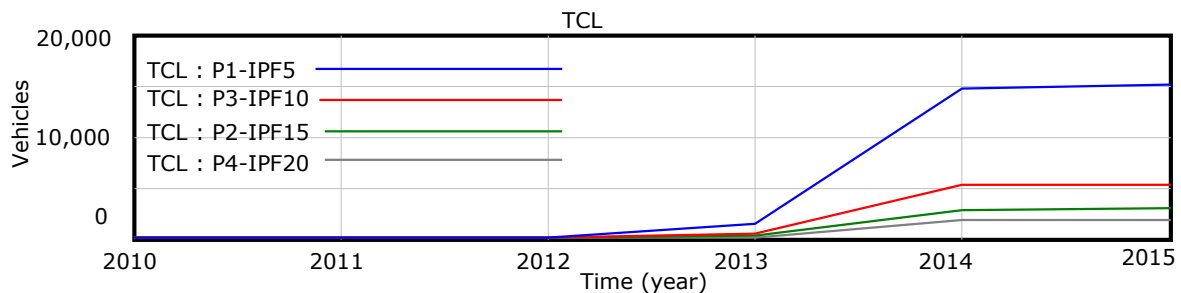
From Test II, congestion in JEG can be controlled by limiting vehicular emissions through the emissions per vehicle (EPV) and by reducing the contribution of emissions from the vehicles (VCE). Test II investigates the policy on vehicular emission. The inputs from Table 3 are considered in the SD model for investigating the policy of controlling for vehicular emissions. The results of TCL are shown in Figure 4, which depict the phenomenon of more the capacity more the population crisis. These results are used as base for keeping the emission capacity control in the city. Such an analysis is required to know how much we can invest in decentralization along with controlling the emissions from the vehicular growth in JEG.

Table 2: Input variables for SD model

Input variable	Base run	P1 (IPF=5%)	P2 (IPF=10%)	P3 (IPF=15%)	P4 (IPF=20%)
BTR	0.004	0.015	0.015	0.015	0.015
DTR	0.006	0.006	0.006	0.006	0.006
ATR	2.1	6	6	6	6
ATD	50	70	70	70	70
VKTPF	40	40	40	40	40
GDPIR	0.09	0.15	0.15	0.15	0.15
VCE	0.5	0.6	0.6	0.6	0.6
EPV	20	50	50	50	50
DIER	0.2	0.2	0.2	0.2	0.2
CIE	75.6	40	40	40	40

Figure 3: Results of Test I [$P(run_index)IPF(percentage\ investment)$]

Table 3: Input variables for Test II



Input variable	Base run	C1 (CIE=90)	C2 (CIE=100)	C3 (CIE=120)
BTR	0.004	0.004	0.004	0.004
DTR	0.006	0.006	0.006	0.006
ATR	2.1	2.1	2.1	2.1
ATD	50	50	50	50
VKTPF	40	40	40	40
GDPIR	0.09	0.2	0.2	0.2
VCE	0.5	0.7	0.7	0.7
EPV	20	82	82	82
DIER	0.2	0.2	0.2	0.2
CIE	75.6	90	100	120

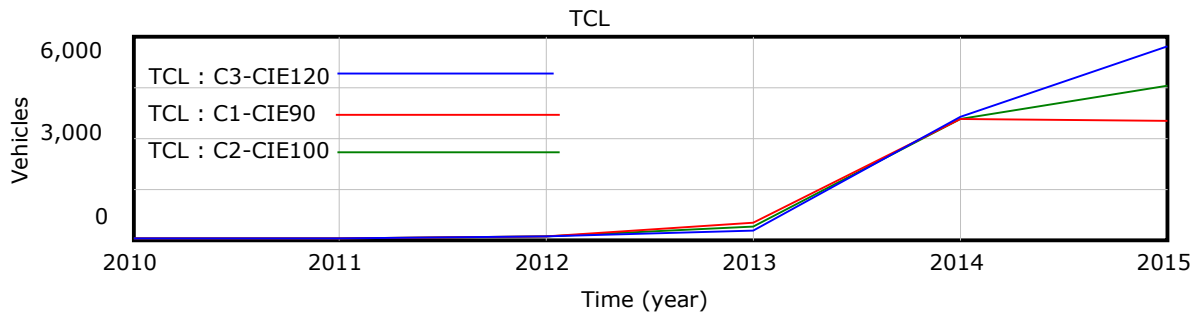


Figure 4: Results of TCL for Test II [$C(\text{run_index})\text{CIE}(\text{emission capacity})$]

4.1 Policy investigation

There are two ways to control the congestion level; investment decision on precinct development, and emission policies. First, the added investment on precinct development will open up new facilities with more VKT's, which is intended to reduce the traffic volume at the CBD. Second, the control over the emission capacity of the city and emission per vehicles will reduce the congestion level in the city. Third, the combining the change in policy parameters of the above two parameters would derive more appropriate results required for reducing congestion level in the city.

4.2 Validation

For any SD methodology, it is important to validate the model based on data (see Barlas (1994)) for the steps for full validation. The first step in SD model validation is structural validation, where the causal relationships between the variables are validated. For this paper, the structural validation is completed with several interviews with government agencies such as the Land and Transport Authority and the Urban Redevelopment Authority of Singapore. For the full validation of the model, it is required to analyze the actual data on traffic volumes and data related to other important factors in the urban transportation system. We also seek input from industry through a seminar to ascertain the accuracy and behavior of the SD modeling.

5 Conclusion

The urban logistics system increases in complexity as the nodal density of the transport network increases. As such, city planners and policy makers are under constant pressure to better manage congestion, liveability for its citizens, economic growth without compromising on the social balance. Using SD, we analyse the impact of traffic congestion through a challenging urban decentralization project on one of Singapore's new precincts - the Jurong east gateway precinct. The policies over emission control and investment on decentralization are analyzed through different scenarios of traffic congestion. In this paper, emissions control is achieved through emission capacity of the city, however the study lack in analyzing the problem through restricting number of vehicles in the city. In future, SD analysis can be combined with other traffic impact analysis tools such as cellular automata to better predict urban congestion levels. The demand consolidation concept of the managing the traffic congestion level and impact analysis for commercial as well as non-commercial vehicles can also be analyzed using the system dynamics modeling. One more extension of this work would be to design an incentive structure for the congestion affected areas of the city. Finally, we intend to provide the full validation of the system dynamics model presented in this paper using more realistic estimates of traffic volume data.

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Due to page restrictions, the references are available from the authors.

THE EFFECTIVENESS OF NATIONAL SINGLE WINDOW: AN EVALUATION OF FREIGHT FORWARDERS PERSPECTIVE

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ABSTRACT

This paper discusses the importance of *the single window concept* recommended by United Nation European Economic Commission (UNECE) to support trade facilitation initiative to overcome impediments in international cross border. Malaysia has developed its National Single Window (NSW) as national agenda, but issues about the effectiveness of its delivery to facilitate international trade remains highly debated among freight forwarders as the main users of national single window facility. This study adopts a qualitative research approach. In depth face to face semi-structured interviewed has been conducted with 12 freight forwarders who were in the single window user group. Every respondent has to answer a standard set of control questions. All interviews were properly recorded, coded and analysed using thematic analysis. The findings resulted in a set of eight categories that influence the effectiveness of the implementation of single window in Malaysia. They are (1) government policy, (2) institutional cooperation, (3) stakeholder awareness, (4) electronic system reliability, (5) training, (6) ICT supporting facility and (7) simplified procedure under these seven factors. This research fills in the gap through the identification on the important role plays by government policy in trade facilitation environment, particularly in the national single window process, which was previously very lacking. However, this research was conducted from the users' perspective. The findings in this research provide an insight to the policy maker and authorized stakeholders on the factors leading to an establishment of a highly reliable system for the benefit of the trading community and the nation as a whole. This research discovered that the government policy has become the most important factor that influence the effectiveness of the implementation of single window. The result demonstrated that the push and pull factors need to be streamline in the form of policy setting was lacking resulting to the problematic implementation of single window in Malaysia. It was also found that it was the users who will determine the effectiveness of the development of national single window as a trade facilitation measures for cross border administration.

INTRODUCTION

International trade is generally an exchange of goods from one country to one another to fulfill the supply and demand between nations which evolved with broader supply chain activities. It is normally involves three things that moves together with cross border movement which are cargo, people and modes of transport either land transport, air transport, or sea vessel (Choon, 2011). Beyond the physical movement of the goods, there are detail information that entwined with the cargo being moves which carries the status of the cargo (ADB, 2009a). Cargo information management plays an important roles to measure the supply

chain process efficiency, public administrators efficiency and legislative impact on market efficiency. Therefore, management of information at international border is very important because it will determine information traffic during clearance of goods at the border (Djankov, Freund, & Pham, 2006).

BACKGROUND OF THE STUDY

Trade Facilitation

During 1998, trade facilitation was introduced by United Nation as a potential solution to the world trade with the objectives of simplifying trade process and minimizing transaction costs in international trade while maintaining effective levels of government control. Trade facilitation defined as "*systematic rationalization of customs procedures and documents. In a broader sense, it covers all the measures that affect the movement of goods between buyers and sellers, along the entire international supply chain*" (ADB, 2009a). Even more important, from a trade facilitation action agenda is the establishment of a single window will force authorities to collaborate and streamline their processes, to collaborate and consult with the business community and in the best of cases also lead to coordinated border management, cutting lead time not only in the administrative procedures but also in the actual border-crossing (Pontén, 2011).

Single Window

Single window concept was created as part of an initiative for a solution to impediments to trade from trade procedures and documentation factors. Trade procedures are divided into commercial, transport, regulatory and financial categories. According to a study conducted by UNESCAP in 2001 and 2002 on a few trade friendly country in Asia, for an export procedures, trade will interface with 15 parties, 24 documents and approximately 700 data elements for a total transit time of more than 22 days (ADB, 2009b). This phenomena in trade are becoming an unnecessary burden towards buyer and seller due to the existence of additional cost from trade procedures through the requirement of exchange of information and documents between parties.

Therefore, Single Window recommendation was developed as part of trade facilitation agenda to eliminate or minimizing the procedures by enhancing efficient information exchange. Single Window is defined by UNECE in their Recommendation No. 33 as "*A facility that allows parties involved in trade and transport to lodge standardized information and documents with a single entry point to fulfill all import, export, and transit-related regulatory requirements. If information is electronic, then individual data elements should only be submitted once*" (UNCEFACT, 2005). In another word, Single Window is an adoption of 'standardization' element from trade facilitation concept that derive by UNCTAD in 2002 which emphasize on international standard through agreed format, procedures and information practice for all members countries (ADB, 2009a). Benefits from Single Window can be disclosed by the government and traders as generally the implementation of Single Window will assist government to have a better risk management handling and improve security management gain from traders' compliance while traders in return will gain a transparent rules and productive public. (ADB, 2009b).

The development of Single Window in logistics industry is associated with paperless trading; an adoption of information system management whereby a comprehensive framework of information flows has been developed in order to trigger the movement of goods (Graiger, 2010). Single Window are closely related with ICT (Information Communication Technology) as the key enabler of the speed of information transfer. However, the provision of hardcopy documents transaction in the operation is still allowed (UN/CEFACT, 2005).

Component in Single Window Delivery

The emergence of National Single Window in Malaysia was initiated from the adaption of trade facilitation measures developed by UNCEFACT purposely to facilitate trade through effective management of information (UN/CEFACT, 2005). Thus, a committee has been set up by the Ministry of International Trade and Industry that brought to the appointment of Dagang Net Technologies Sdn Bhd to serve as national IT service providers to develop a reliable framework for the operation of Single Window in Malaysia since mid 90's. Since then, Dagang Net has become the sole assessment service providers to design, develop, manage and operate NSW system in Malaysia until 2014; after another contract renewal in 2009 (Choon, 2011). Single Window in Malaysia is designed to operate in electronics means in order to assist the clearance process between trade community and custom office at the border. This trade community consists of port operators, shipping agencies, forwarding agents and traders. Existing structure, National Single Window is consisting of five core services namely Electronic Declarations (e-Declare), Electronic Manifest (e-Manifest), Electronic Duty Payment (e-Payment) and Electronic Preferential Certificate of Origin (e-PCO) to covers basic cross boarding activities (UNNExT, 2010). Figure 1 shows simple diagram on information transaction process in national single window from the users to the respective authority. The submission process will be assisted by system moderator currently host by DagangNet Technologies Sdn Bhd that will act based on specific request on main five core services.

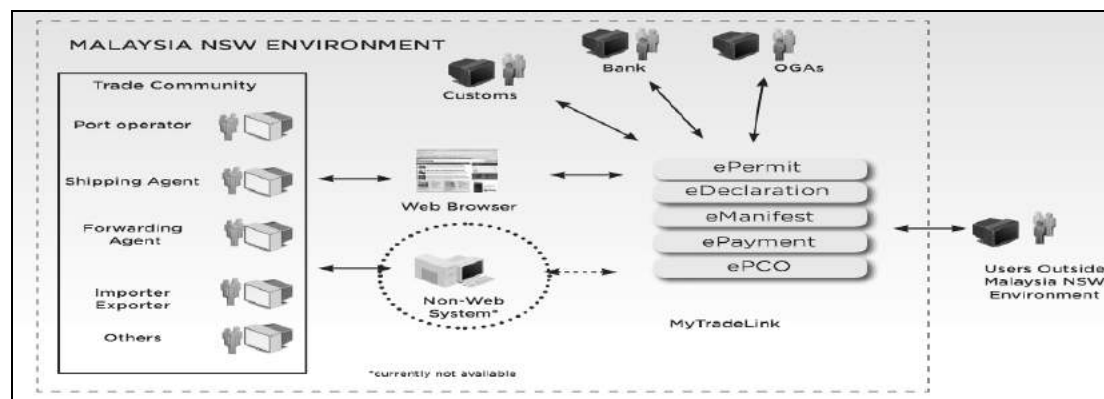


Figure 1: Malaysia single window environment system operational map.

Source: UNNExT. (2010). Case of Malaysia's National Single Window. *Towards Single Window Trading Environment*, (Brief No. 04), 1-8. Retrieved from <http://www.unescap.org/unnext>

METHODOLOGY

Qualitative method

Case study is used to describe an intervention or phenomenon in real-life context, in which it occurred (Yin, 2009). The core strategy for this research is the individual experience of the subjects interviewed, represented through narrative analysis and interpretation to determine if a pattern or trend exists for further research efforts. The target audience was specific and focused to the group of users from private and public sectors unique to the national single window service in Malaysia particularly freight forwarders in the operational fields.

Units Analysis

Within the qualitative paradigm, research sampling size is not judgmental referring to the nature of this research which adopts phenomenologist point of research. The sample selection may be small to be more focused and maintained the closeness to the situation and transform the pattern (Hussey & Hussey, 1997). This research adopts freight forwarders as the of unit analysis. Each participant

was coming from different organization that contributes to a unique perspective of single window process with various background of experience in freight forwarding business. The percentage of respondents were selected according to purposive sampling. Purposive sampling allows researcher to examine a selected group of subject that hopes to be investigated (Singh, et al., 2006). As shown in Table 1, there were 12 participants selected from users in Klang Valley area with various length of experience in freight forwarding and shipping business. Majority of them who were still active came from Port Klang and Kuala Lumpur International Airport.

Table 1: List of interview participants

No	Organization status	Code	Designation	Years of Experience	Date of interview
1	Freight Forwarder	P4	Operation	2 years	January 2011
2	Freight Forwarder	P5	Operation	9 years	January 2011
3	Freight Forwarder	P6	Operation	6 years	January 2011
4	Freight Forwarder	P7	Documentation and customer service officer	6.5 years	January 2011
5	Freight Forwarder	P8	Operation	4 years	January 2011
6	Freight Forwarder & shipping agencies	P9	Operation	3 years	January 2011
7	Freight Forwarder	P10	Operation	7 years	January 2011
8	Freight Forwarder & shipping agencies Freight forwarder	P11	Operation	3 years	January 2011
9	Freight Forwarder & shipping agencies	P12	Operation	19 years	January 2011
10	Freight forwarder	P13	Operation	8 years	January 2011
11	Freight Forwarder	P15	Operation	8 years	May 2011
12	Freight Forwarder & shipping agencies	P16	Head of documentation and declaration	13 years	May 2011

Data Collection

Main data collection method was in-depth and open-ended interviews, in which they were used to prepare interview guideline. Key informants provided supplementary data. The use of the interview guide indicated that there was some structure of the interviews, were treated as conversations during which the interviewer drew out detailed information and comments from the respondents. Average interview length is one hour for each participant.

Data Analysis

According to Glesne & Peshkin (1992), the data analysis in qualitative research deals with managing, filtering as well as selecting data using detail judgment and interpretation. It is spelled out using an entails process consist of sensing themes, constant comparison, recursiveness, inductive and/or deductive

thinking and interpretation to generate meaning (Ruona, 2005). In this research, interview session voice data was properly recorded before the data were translated and filed according participants' unique code for easy references where pseudonyms were used to maintain its confidentiality. Hence, those data were those transcribing scripts were analyzed one by one to extract out the sensing themes that being discussed or mentioned by the participants.

DISCUSSION

Single window is among trade facilitation measures which assist economic development and promotes logistics operational efficiency. Throughout the investigation, it showed that policy establishment, institutional cooperation, stakeholder awareness, electronic system reliability, training, ICT supporting facility, simplified procedure are the most significance factors of the effectiveness of national single window in Malaysia. As shown in Table 2, there are 30 elements categorised under the seven factors that contributes to the effectiveness of national single window in Malaysia.

Table 2: Factors identified by freight forwarders

No	Elements	Factors
1	<ul style="list-style-type: none"> • System ownership • Security • Internet Communication Technology (ICT) • Institutional Collaboration • Financial Facility • Data Harmonization • Investment Incentive 	Policy establishment
2	<ul style="list-style-type: none"> • Authority Collaboration • Data sharing • Trust 	Institutional Cooperation
3	<ul style="list-style-type: none"> • Publicity • Resistance to change • User knowledge • Information channel 	Stakeholder Awareness
4	<ul style="list-style-type: none"> • System ownership • Data security • Value added service • Administrative custom evaluation 	Electronic System Reliability
5	<ul style="list-style-type: none"> • Training availability • Training schedule • Training module • Electronic system literacy 	Training
6	<ul style="list-style-type: none"> • Mobilized equipment • System investment • Telecommunication infrastructure • Financial facility 	ICT Supporting facility
7	<ul style="list-style-type: none"> • Process re-engineering • Timeliness • Trust accountability • Data sharing 	Simplified Procedure

Policy establishment

The government policies were highlighted as one of the important factors to determine the direction of effective single window. The importance of policy towards the implementation of single window was also highlighted by Grainger (2008), where he argued that though a policy is highly required to support trade

facilitation development but less effort is made on its execution considering the trade environment's complexity, many different, often conflicting, interests are at work. Luddy (2011) emphasizes that upon the initiation of a single window system, a few important elements are to be considered as a national principle for the generalization of system for the domestic and international connectivity. Those elements were highlighted as a pertinent aspect of comprehensive fundamental to effective single window which includes understanding the key legal issues, enabling laws and regulations, information sharing, data protection, privacy, organizational issues, liability, competition, electronic documents, intellectual property rights, data retention, electronic signature, cross-border authentication, and e-documents of title. This study revealed that the government policy on single window were developed from a few elements that require government attention, mostly in realigning the strategy for single window delivery to be practically acceptable by the community at large. First, the system ownership highlighted the important warrant about the governance of single window that leads to perceived contribution to the diffusion, followed by security coverage, ICT, collaboration among stakeholders, financial facility, data harmonization, and investment incentives.

Institutional cooperation

Institutions in single window consists of government agencies or appointed agencies to hold authorized power to be carried to control cross-border activities. There were three important elements that have been highlighted by the users to determine effective institutional support, namely authority collaboration, data sharing, and trust. Collaboration between authorities is important to ensure the smooth border governance is in place. Findings showed that the users were facing with redundant information requirement by the related authorities for clearance arrangement. Therefore, the related institutions should support this collaboration by having mutual collaboration to support the single window initiatives. However, referring to the current situation, the participation stage is minimal to ensure the effectiveness of a single window.

Stakeholder awareness

Every stakeholder in the single window community was driven by the objective of their authorized responsibility or business commitment to be achieved. Four main cross-border agencies such as the customs were concerned about all cross-border trading undergoing possible screening and evaluation for duty and sales tax collection as well as their responsibilities were probably related to security and control purpose. For other government agencies, their responsibilities were in the border area to ensure the customs are given the best advice about particular products under their custody with respect of national or international law. In simple words, other government agencies were responsible for providing knowledge and expertise towards the extensive security compliance for a particular product to protect the national resources. Business people in a different set of agenda are concerned about their productivity to improve their operation and making more profits. Within the single window, multiperspective mindset was being united to produce a single window. Therefore, the very beginning of a single window formation involves multi-interests from every stakeholder. The 'individuality' assessment is no longer acceptable in the single window community to ensure the single window mission is effectively achieved.

Electronic system reliability

Another factor identified as a pertinent factor that contributes to effective single window is electronic system reliability. Reliability in the context of single window is the status of each information pledge to its recipient, where the single window will become the first to receive information that will establish system acknowledgement by the users. This factor is closely associated with another four

elements highlighted by participants, namely system ownership, data security, technical assistance, and administrative custom valuation that influence the effectiveness of single window implementation

Training

Training availability is an important element of training. It must be available first as an option for participation from the respective targeted participants. Availability here means expert training sessions are continuously offered to the interested groups whenever it is required. Training provision should be one of the obligatory missions in the single window governance to expose knowledge to the industry. The availability needs to be open to the public. According to the research data, training availability showed that the government was serious to encourage migration to total electronic single window community. It was a part of soft facility that should be provided to every single layer within the community. Once training is available, it will increase the users' confidence to get involved with the electronic community. It was found that reluctance to involve with a single window system that encourage users to 'do it yourself' option was due to the perception of the complexity of the system and the anxiety of making mistakes to a system that would create more complications. Findings from the interviews showed that there were two reasons why the training availability was very limited. First, a logistics officer from a small medium enterprise excuses himself to participate in the electronic system as the system is too difficult to understand and tedious. Due to his position as a documentation officer cum agent to the customs, he has limited time to undergo training. He is at the point of not knowing where to start in training since it is not published anywhere. A slight mistake would lead to a delay due to declaration problem. Hence, he would prefer to choose an alternative service using 'Kedai EDI' located at Port Klang. For that reason, he has not proposed to his top management about the system to avoid impediment towards his daily work. Second, in the context of freight forwarders, they also faced training difficulties as in the event of their effort to recruit more staff who were involved with the operational unit. They have to spend their time to conduct training to their new subordinates apart from their official duties. It was due to difficulty to get training from the system expert. Training availability was shown as an important element when the new industry comes who possess limited knowledge of cross-border information transfer require single window intermediary. Single window users were from various industries and different academic backgrounds, from the laymen to the highest level of management. Therefore, it would be possible to have public training available for users, so they will plan accordingly to attend the training.

ICT Supporting facility

Single window in Malaysia was an attempt for a fully electronic supporting environment. In a country with a wide geographical position like Malaysia, the decision of an electronic option was considered as the best solution since it will be able to support a faster information transfer between the users and public agencies. Since 1993, SMK-DagangNet is known as a backbone of the NSW for customs declaration transaction even though has been there but more room for improvement. There were four important elements highlighting the ICT supporting facility as a factor that encourages the effectiveness of single window. The ICT supporting facility should be supported by the government for the respective community and also an initiative by the business community to seriously support an electronic environment.

Simplified Procedure

Scholars researching trade facilitation highlighted the importance of simplistic procedures that are able to be developed through the mutual understanding and cooperation between the stakeholders by putting business

actors in a safer position (Grainger, 2007). Transformation of physical documents into the electronic set must associate with change of procedures at times (UNNExT, 2012). It was discovered that four elements to support the importance of simplified procedures in order to support the effective implementation of single window in Malaysia, particularly in the Klang Valley. The elements were process re-engineering, timeliness, trust accountability, and data sharing.

CONCLUSION

Obviously, single window effective delivery was driven by government policy and streamlines procedures by various agencies. Government policy should focus into data security, specific single window policy, agencies authority and promotion towards system usage that must be clearly setup to build up users trust towards single window. Single Window procedures on multiple window issues, redundant working approach, unnecessary procedures and paperless and paper-less create powerful influence towards the implementation that must be used carefully and systematically managed.

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PORT CENTRIC LOGISTICS: AN OPERATIONS STRATEGY FOR UK PORTS IN THE ERA OF SERVITISATION

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ABSTRACT

This paper aims to present the initial interconnection between two literature streams in order to provide a conceptual framework that investigates the effects of Port Centric Logistics (PCL) on the operations strategy of UK ports. The view that PCL represent an example of servitisation strategy for UK ports is taken and the findings of a two stage literature review are analysed in order to support this view. Initially four groups of servitisation drivers have been identified. These drivers are then used as a lens to analyse the emerging PCL literature and create the suggested framework.

INTRODUCTION

During the past decades organisations tried to find ways to increase revenue, face the challenging business environment, sustain relationships with their increasingly sophisticated customers (Gebauer et al. 2008) and overcome the barrier of saturation in their core product markets (Sawhney et al. 2004). An increase in the provision of services in order to enhance the offerings of companies has been noticed as a response to this need (Gebauer et al. 2006). Vandermerwe and Rada (1988) introduced the term servitisation in order to describe this phenomenon. According to their definition servitisation is perceived as the practice of adding value to the core offerings of the firm by providing services. Baines et al. (2009) developed this definition further in order to add the characteristics of the Product Service Systems (PSS) (discussed in detail by Mont (2002) and Tukker (2004)). According to Baines et al. (2009, p.555), servitisation is defined as "*the innovation of organisations capabilities and processes to better create mutual value through a shift from selling products to selling PSS*". From this definition it is apparent that the offering of a company (i.e. goods, services, information, and/or possible combination of these that can be offered to the customers (Brax 2005)) is a PSS. From a literature review on servitisation four groups of drivers relevant with the transition of manufacturers to service providers were identified. These drivers are involved with financial, strategic, marketing and environmental implications.

Additionally, various authors argue that the adoption of a servitisation strategy will affect the organisations in multiple ways. Particularly, the successful implementation of servitisation requires, among others, change of strategy, operations, value chains, technologies, people for supporting cultural shifts in the organisational blueprint, and system integration capabilities (Oliva and Kallenberg 2003, Gebauer et al. 2006, Zahir et al. 2013). Particularly, Neely et al. (2011) argue that firms, willing to proceed with the transition towards service provision, need to build the appropriate organisational capabilities and culture, crucial for the successful implementation of a servitisation strategy. According to the same authors failure to comply with these changes will eventually lead the firm to realise the so called "*servitisation paradox*" (i.e. less revenue than expected earned from the provision of services)(Brax 2005). It should be mentioned that the literature on servitisation focuses solely on manufacturers. Thus, a research gap on services providers which enhanced their offerings with the provision of Value Added Services (VAS) exists. An example of such organisations is the port sector.

The maritime literature has accepted that the current business environment of ports is determined by the increasing economic globalisation, result of containerisation, intermodalism and liberalisation of trade during the 1980s, and by the reshaped market, caused by the increased horizontal and vertical integration in the shipping sector, the increased vessel size, and various logistics innovations (Notteboom 2007). As a response ports changed their traditional role, which is the accommodation of cargo between sea and land transportation, by the provision of VAS and a focus on supply chain integration (Demirbas et al. 2014). As a consequence to these changes the contemporary understanding of ports as business networks (van der Lugt et al. 2013) or clusters (De Langen 2004) of interdependent organisations which cooperate for the holistic development of the system, emerged.

However, in the UK, due to various reasons, ports did not develop at the same “pace” with ports in the rest of the world. According to Pettit and Beresford (2009), UK ports focused only on the provision of cargo and ship handling services. As a result UK ports lost their competitiveness to European mainland ports which were promoted as logistics platforms. However, during the early 2000s UK ports started to realise that increased benefits could be derived by the on-site provision of warehousing and VAS, in addition to their core offerings. Mangan et al. (2008) define this strategic shift of ports as Port Centric Logistics (PCL). Several academics criticised the concept as an extension of practices applied at mainland Europe and North America (e.g. see Pettit and Beresford (2009), Monios and Wilmsmeier (2012), and Demirbas et al. (2014)). Despite critique many authors refer to the concept as a current strategy for ports. However, the majority of the authors only use the term abstractly and do not support their arguments on empirical data (Valantasis-Kanellos et al. 2013). Exceptions are the work of Demirbas et al. (2014) who identified several advantages and disadvantages related with the application of PCL on UK ports by a case study approach, and McKinnon (2014) who used modelling to demonstrate potential reduced environmental footprint of shippers.

On the other hand, the UK retailers and port sectors appear to have embraced the concept. Indicative are the cases of ASDA and TESCO which relocated their warehousing facilities for imported goods by the proximity of ports (Monios and Wilmsmeier 2012). PCL has been introduced as a way for regional ports to compete with the major ports in the South of UK. However, latter developments at major container ports at the South prove that PCL is a dominant port development strategy for UK ports (Wilmsmeier and Monios 2013).

In this paper PCL is viewed as a lagged strategic response of UK ports to practices already applied at other parts of the world. Additionally, this paper aims to relate the concept of PCL with the concept of servitisation by an analysis of the PLC literature through the lens of the servitisation drivers identified in the relevant literature. Furthermore, this paper intends to view PCL as a strategic decision that can enable UK ports to reform their operations strategy, which according to Slack and Lewis (2008) can enable an organisation to gain competitive advantage (CA) and superiority in their environment.

METHODOLOGY

For the purpose of this paper a two stage literature review has been conducted in order to develop the proposed conceptual framework. The first stage of literature review aims to classify the servitisation drivers for organisations. Baines et al. (2009) conducted a clinical review of the literature involved with the transition of organisation towards servitisation and identified three sets of drivers that can justify this move. These drivers are: financial, strategic and marketing. Moreover, Zahir et al. (2013) provide an additional driver which is related with the environmental pressures faced by organisations. PSS literature has routes in the debate about sustainability and shrinkage of the carbon footprint (Tukker 2004). Additionally, the definition of servitisation followed here encompasses PSS as the offering of “servitised” organisations. Thus, the environmental outcome of servitisation is considered as the fourth driver. Several

authors¹ have presented propositions that fit these drivers. The classification below presents these propositions.

- 1. Financial:** a. Higher profit margin of services compared to products, b. Services as stable source of revenue
- 2. Strategic:** a. Competitive advantage by adding value capabilities, b. Sustainable competitive advantage based on the inimitability of resources, c. Servitisation as differentiation strategy
- 3. Marketing:** a. Response to the increased demand for services, b. Enhanced offerings as tailored solutions, c. From transaction to long term relationship based on customer loyalty and supplier dependency
- 4. Environmental:** Environmental benefits from the use of asset instead of ownership of the asset

Furthermore, the above classification is used as the basis of a systematic review and analysis of the existing academic literature on PCL, which represent the example case of this research. For the purpose of this review the four step methodology proposed by Seuring and Müller (2008) has been followed. Due to space constraints this paper does not describe the process of the systematic literature view, only the results.

LITERATURE SEARCH

The search for relevant papers (unit of analysis) has been conducted by the use of major business management databases such as Elsevier, Emerald, Business Source Premier, and library services as EBSCO. The keyword search on "Port Centric Logistics" resulted in 77 publications during the period 2006-2014. Particularly, 34 peer reviewed academic papers, 6 government reports, 6 conference papers, 28 periodical publications and 3 white papers have been identified. As the scope of this paper is limited to peer reviewed academic papers, written in English, only 34 papers² published in 18 peer-reviewed academic journals were included in further analysis.

In order to evaluate the content of the papers the servitisation drivers have been used as a guideline. Papers that could not be attributed to any of the drivers were excluded from further analysis. After the content of the papers had been analysed in detail 18 papers were excluded. The reasons why those papers have been excluded were that either they were not relevant with PCL or they could not be attributed to any of the servitisation drivers. Additionally, some papers were excluded as they did use PCL only as a term without any further discussion on the concept. The remaining 16 papers were analysed according to their content and are discussed below.

FINANCIAL DRIVERS

Mangan et al. (2008) argue that the provision of non-core services can result into higher profit margins for ports. By its definition PCL strategy enables a port to experience increased revenue derived from warehousing and VAS provision. This argument is aligned with the first servitisation financial driver proposition that higher profit margin are expected by the provision of services compared to the provision of goods. VAS are considered as non-core services of the ports, thus although ports are service providers, the provision of VAS is considered as an enhanced service offering for the ports. Additionally, Coronado Mondragon et al. (2012) argue that PCL is perceived as a mean to offer supply chain (SC) rationalisation and decreased cost per unit, fact that can alter the assumption that ports add cost in SC. Thus, it could be argued that the logistics and VAS services by PCL operations will trigger increased profit margins to PCL users due to

¹ Due to space restrictions the complete list of the academic papers used for the identification of the various propositions is not provided. For a full list of references please contact the corresponding author of this paper.

² The complete reference list of the publications identified by the systematic literature search on PCL can be provided by the corresponding author upon request.

reduced costs. Additionally, Monios and Wilmsmeier (2012) support the arguments of Mangan et al. (2008). However, they highlight the need for land availability and hinterland connectivity in order for the port to be able to facilitate PCL. Furthermore, Demirbas et al. (2014) argue that PCL enables ports to utilise their land bank in ways that will result in increased revenue for the ports. Based on the discussion above the first hypothesis of the conceptual framework can be developed. **H1a:** *PCL enables a port to experience higher profit margins and increased revenue due to the provision of VAS.*

The analysis of the papers identified by the systematic keyword search did not result any arguments that could support the proposition that services can be perceived as a stable source of revenue. However, services can be perceived as intangible resources for a firm (see the discussion of H2b). According to Molloy (2011) intangible resource are not weakened by use. On the contrary they can be improved by repetition and yield benefits for longer period. Additionally according to H1a, it is argued that the provision of VAS will result in increased revenue and higher profit margins. Thus, the hypothesis that VAS are a stable source of revenue can be created. **H1b:** *The provision of VAS by a port can be perceived as a stable source of revenue.*

STRATEGIC DRIVERS

Servitisation strategy enables the manufacturers to achieve competitive advantage (CA) by the addition of value capabilities. Feng et al (2012) suggest that if the port of Humber invested in PCL, in terms of providing warehousing and distribution facilities, retailers would be incentivised to relocate their import operations from southern UK ports to the port of Humber. The same authors argue that the provision of warehousing and other logistics VAS can increase the ports' competitiveness in the region and can also enable the port to achieve CA. According to Grant (1991) and Hoopes et al. (2003), as capabilities are perceived the bundle of resources that work together and determine what the firm can achieve. Additionally the same authors argue that capabilities can confer CA to the firm and create value on their own or add value to a certain resource. Thus, the provision of warehousing and VAS by the port will enhance the level of its capabilities. Consequently, the following hypothesis can be created. **H2a:** *PCL can enable a port to achieve competitive advantage by the addition of value capabilities.*

Furthermore, as the second proposition of strategic drivers implies, servitisation can offer sustainable competitive advantage (SCA) based on the inimitability of resources. The provision of VAS is argued to enable ports to enhance their offering's portfolio in order to meet the complexity of customers demand and can be regarded as the base towards the generation of SCA (Mangan et al. 2008, Woo et al. 2013, Nam and Song 2011).

Slack and Lewis (2008) argue that the provision of services could be characterised as one of the intangible resources of the firm which are a combination of formal and informal procedures that take place within the firm. Herrman (2005) argues that intangible resources, due to the fact that are not easily measurable can create CA for the firm. Furthermore, according to Molloy (2011) intangible resources are untradeable fact that rises the level of heterogeneity of those resources even among the same industry. According to Barney (1991) inimitability of resources is one of the factors that can create the basis for SCA. Thus, from the discussion above the following hypothesis can be developed. **H2b:** *PCL can enable the creation of SCA by the provision of VAS.*

Servitisation can act as a differentiation strategy for manufacturers according to the third proposition of the strategic drivers identified in the servitisation literature. Mangan et al. (2008) argue that the strategies of the various SCs (i.e. lean, agile, leagile) that pass through a certain port will require a different level of logistics services to be provided by a port. Thus, the strategies of the SCs that pass through a port determine the role that the port is required to develop in order to accommodate the specific needs of these SCs. The authors argue that PCL could be considered a strategic choice for ports that want to utilise their space in order to accommodate the differentiated warehousing

needs of SCs that follow one of the three strategies suggested by Christopher (2011) and enhance their basic service offering by VAS. According to Porter (1980) differentiation strategy requires a firm to provide a unique product which will not be attractive because of its low price, but will be valuable to the customers. In this notion PCL can be regarded as a differentiation strategy for ports. Woo et al. (2013) and van Asperen and Dekker (2013), also encompass the argument supported by Mangan et al. (2008).

Additionally, Pettit and Beresford (2009), build on the taxonomy provided by Mangan et al. (2008) regarding the port related warehousing needs of various SC strategies. They distinguish between Distriparks, Districentres, Traditional port warehousing and Inland Container Depot. Furthermore, Monios and Wilmsmeier (2012, 2013) argue that PCL is a strategy implemented by medium sized UK ports as a way to compete with larger ports in the South. In this sense PCL could be perceived as a differentiation strategy of medium sized ports. However, larger ports in the UK such as Tilbury and London Gateway implement PCL as well. Thus, PCL is no longer a differentiation strategy for medium sized ports in the UK but can still be perceived as a differentiation strategy as it is valuable for customers.

Demirbas et al. (2014) argue that PCL enable ports to utilise their land in a way that will result in increased revenue streams for the port. In this sense PCL can be viewed as a strategy that enables port to differentiate their assets in ways that will create value for their customers. Indicative is the response of one of their case ports, which purchased land and leased it out for different use instead of using the purchased land for the provision of warehousing facilities. Thus, it can be argued that PCL is a differentiation strategy for ports as it enables them to deliver value through resource utilisation. Based on the discussion above Hypothesis 2c can be developed. **H2c:** *PCL can act as differentiation strategy for ports.*

MARKETING DRIVERS

The first marketing driver proposition of servitisation is that servitisation of manufacturing can be perceived as response to the increased demand for services. According to Chhetri et al. (2014, p.226) various regions are engaged with the development of a logistics hub in the proximity of a port in order to "*consolidate and distribute the influx of increasing quantities of products into and out of specific regions from and to various global positions*". The same authors argue that as the volume of global trade will increase those hubs will be expected to offer increased "*volume of activity, scope of work and capabilities required*" (p.235), and that the agglomeration of various logistics activities at those points will enhance the regional and national economy. The argument of Chhetri et al. (2014) that logistics services are increasingly required due to the nature of the global trade is in alignment with the importance of PCL development in the UK, as it is highlighted above, while imports from Far East countries rise. Thus, it could be argued that at the import points an increased demand for logistics VAS is required. PCL by their definition offer those services, hence PCL can be regarded as a response to the increased demand for logistics services at the points of entrance. The same argument is also supported by Mangan et al. (2008), De Langen et al. (2012) and Coronado Mondragon et al. (2012). Thus, Hypothesis 3a could be developed accordingly. **H3a:** *PCL can be perceived as a response to the increased demand for warehousing and other logistics VAS at the points of import.*

Moreover, the provision of enhanced service offerings is perceived as the provision of tailored solutions to the customers. As it already discussed PCL enables ports to enhance the portfolio of services they offer to their customers. Particularly the VAS offered by the implementation of PCL strategy can be regarded as response of ports in order to meet the increased complexity of customer demand and as tool to diversify their offerings to the needs dictated by the strategies of the SCs that pass through the ports (Mangan et al. 2008, Woo et al. 2013). Additionally, Pallis et al. (2011) argue that the new operating environment of ports, which is highly influenced by developments in logistics, has

triggered the notion that ports should be viewed as elements in value driven SCs. Thus, Pallis et al. (2011) argue that ports should adjust their offering in order to provide value to shippers and third party service providers. They encompass the view of Mangan et al (2008) that PCL is one response of ports in the need highlighted above. According to the discussion above the Hypothesis 3b can be developed accordingly. **H3b: Provision of VAS as tailored solutions.**

The third proposition of the marketing drivers of servitisation is that transactions will be developed to long term relationships based on customer loyalty and supplier dependency. Wilmsmeier and Monios (2013) argue that the proposed developments of regional ports as northern gateways in the UK are involved with PCL developments. In their view PCL is a way to anchor container traffic at a specific port. That means that port customers will be tight up to use this port. Customer loyalty and supplier dependency are hindered within these practices. Additionally, Monios and Wilmsmeier (2013) argue also that PCL ties a company to a specific port. In their view this attribute of PCL is a disadvantage because the company located at the proximity of the port is not only dependent on the port itself but also to the shipping lines using this port. They argue that if the shipping line will raise its prices, the shipper will be restrained from the option to use another shipping line. However, their argument is focused on PCL at regional ports. As it was already discussed PCL operations have been implemented by large ports in the UK as well, where more shipping lines include these ports in their network. Thus, it could be argued that PCL do trigger customer loyalty and supplier dependency which on a regional port might be considered as a risk for the shipper, but does not have the same effect on PCL operations at large ports. Based on the discussion above Hypothesis 3c can be developed accordingly. **H3c: PCL create customer loyalty and supplier dependency that will develop transactions to long term relationships.**

ENVIRONMENTAL DRIVERS

The discussion regarding the environmental benefits associated with increase of services is derived from the notion that services are considered less environmental harmful in comparison with business models. Additionally, a total PSS offering implies that the customer will purchase the use of the product instead of the product itself. This practice will offer increased efficiency and utilisation of the product and a reduction to the total cost and environmental output (Wang et al. 2011). The proposition based on the servitisation literature regarding the environmental drivers is that environmental benefits can be derived from the use of an asset instead of the ownership of the asset.

McKinnon (2014) argues that the implementation of a PCL model can trigger CO₂ emissions reduction due to the fact that containers can be loaded up to their actual capacity instead of the capacity implied by the UK road transport weight restrictions. This argument gives an environmental dimension to the financially and operationally beneficial practice of loading containers up to their actual capacity that is supported by Mangan et al. (2008). Additionally, Piecyk and McKinnon (2010) argue that the extensive use of the hub and spoke system, which add links in the SCs, increases road miles. Thus, an increase of tonne-kilometres is expected. However, the elimination of entire SCs parts after the implementation of PCL is expected to balance out the increase of road kilometres and consequently the assorted tonne-kilometres. Furthermore, Monios and Wilmsmeier (2012) also suggest environmental benefits derived by the implementation of PCL. They argue that ports can leverage these anticipated environmental benefits in order to seek government support for the development of their infrastructures to accommodate PCL activities. The CO₂ emissions reductions suggested by the discussion above are not in alignment with the environmental benefits supported by the servitisation literature. However, sufficient arguments are presented to support the development of Hypothesis 4. **H4: PCL strategy enables the creation of environmental benefits based on increased container load utilisation and reduction in road kilometres.**

CONCLUSION

The discussion above shows that PCL can be perceived as a form of servitisation in some extent as many of the servitisation drivers are supported in the PCL literature. However, it should be mentioned that many papers rely their arguments on the paper of Mangan et al. (2008). This fact shows that empirical research on PCL is limited. This observation is in line with Monios and Wilmsmeier (2012) who argue that PCL is a term used rather abstractly over the last decade without sufficient grounding. In alignment with this fact is the observation that many of the papers that are identified by the keyword search of PCL do not contribute to the discussion on PCL. The authors use the term but do not discuss it further or do not provide empirical research relevant to the term, exceptions include Demirbas et al. (2014) and McKinnon (2014).

The present paper attempted to provide an initial link between PCL and servitisation in order to create a conceptual framework that will enable the investigation of the effects of PCL on the operations strategy of ports. Nine hypotheses were formed from the analysis of these literature streams. Primary data collection is needed in order to validate the Hypotheses formed on the proposed conceptual framework.

Particularly, the validation of the framework will be executed by the following methods. Initially, interviews with academics experts in port research will be conducted in order to validate the suggested hypotheses. Additionally interviews with port managers in UK ports that have implemented a PCL strategy will be executed in order to offer the practitioners insights needed and test the of the hypotheses. Moreover, annual port reports, and contractual changes will also be consulted. Additionally, data from port statistics of Department for Transport on the empty container runs will be used in order to support H4a. The validation of the framework will enable the realisation of the intention of this paper to support that PCL positively affects the operations strategy of a port in order to gain CA and superiority in its environment. Particularly, Slack and Lewis (2008) argue that operations strategy is determined by the decisions that frame the long term capabilities of all the operations and its contribution to the organisational strategy, through the merge of the market requirements with operations resources.

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A STUDY ON THE BUSINESS EXECUTIVES COMPETENCY REQUIREMENTS IN THE PORT INDUSTRY

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Abstract

As the port industry is facing the constant challenge from the ever changing world business and trading environment, thus an investigation on the importance of port executives' competency requirement is deemed necessary before a port can recruit capable executives and perform well. This study aims to survey port executives' competency and skills requirements perceived by executives from the port holding company, tanker terminal operator, ocean container terminal operator, bulk terminal operator, and stevedoring company in Taiwan. Research findings indicate 65 items of competency are grouped into three dimensions, and management skills and knowledge dimension is perceived by all groups of respondents to be the most important executives' competency requirement for these port operators. In addition, the importance of all the three dimensions of competency requirements will be greatly decreased in a decade from now. This implies new competency requirements not included in our survey will become more important in the future.

1. Introduction

Port industry is facing ever-change challenges due to its customers' new demands. Climate change and sustainability management makes ocean carriers seriously considers the deployment of LNG powered vessel and the enlargement of their vessel size to achieve the goal of the economies of scale. World trade pattern changes have made emerging economics become one of the most important new markets for port operators. Under this uncertain and ever-changing business environment, the core competency requirements will be changed over time as well.

2. Organizationally-specific competence & personal-specific competence

Employees' competency is one of the key successful factors for the growth of an enterprise (Tippins & Sohi, 2003). There are two types of competency, generic standard of competence and organizationally-specific competencies (Sparrow & Bognanno, 1993). The former one is widely discussed in previous literatures and the latter one is rarely discussed in terms of the port managers' core capabilities. Lee & Blaszczyński (1999) surveyed the "Fortune 500" executives to determine their perceptions of the competencies necessary for entry-level accounting graduates. They investigated these executives' perception on the importance of various skills for accounting graduates in 1999 and contrasted with those in 1992 and those for 5 years into the future. Their research indicates there are six areas of skills that the entry-level accounting graduates must have: (1) Accounting knowledge, (2) Communication skills, (3) Group work/interpersonal skills, (4) Problem-solving skills, (5) PC and Internet skills, and (6) Other knowledge and skills. There are four types of communications skills: oral communications, written communications, informational reading, and listening. Accounting knowledge is ranked the most important competency, and communications skills and PC/internet skills are ranked as the second and third important competency. Alldredge & Nilan (2000) investigate the degree of importance of 3M's leadership competency and found three groups of leadership competency: (1) Fundamental competency: Ethics & integrity, intellectual capacity, and Maturity & judgment. (2) Essential competency: customer orientation, developing people, inspiring others, and business health & results. (3) Visionary competency: global perspective, vision & strategy, nurturing innovation, building alliances, and organizational agility.

Stokes (2004) studies the core competency for the information technology leaders and executives, and concludes knowledge, understanding, skills, attitudes,

and values are the five groups of must-have competency for the high performance IT managers. Nwokah & Ahiauzu (2008) use a 27-item survey questionnaire to investigate 84 corporate organizations listed in the Nigerian stock exchange gazette. They identify the managerial competence includes consummate competencies and threshold competencies. Six scale items are used to measure the consummate competencies and the other six scale items are used to measure the threshold competencies. Emphasis on increased staff productivity and members apply specialized knowledge in handling complex work situations are the most important scale items for these two types of competencies respectively.

Ding, Kam, and Chandra (2012) investigate operational routines and supply chain competencies of Chinese logistics service providers and indicate three types Chinese LSP competencies: positioning competency, distribution support competency, and agility competency. Positioning competency implies the LSP's ability to perform an extensive range of logistics activities in innovative ways. Widespread distribution coverage is the major factor used to measure the LSP's distribution support competency. The ability to respond to market changes, expedited delivery services, rapid response to customer needs, or flexible delivery schedule are the major items used to measure the agility competency. Naquin & Holton (2006) indicate LMSS (Louisiana Managerial/Supervisory Survey) competencies related to process management, improvement, redesign, and psychiatric aides are required for the first-line supervisor in the public sector organization.

From the company's viewpoint, competency is a multi-functional integration and harmonization of capabilities. For a corporation involved in diversified businesses, competencies are a cluster of know-hows and skills owned by a strategic business unit (Javidan, 1998). While core competencies are situated in the highest level in a competencies hierarchy and are result from the interaction between all strategic business units' competencies. Javidan(1998) identified four core competencies for a natural gas pipelines company: (1)operate safe, sound, cost-effective facilities, (2) manage regulatory processes, (3) develop and manage projects, and (4) avoid risk. From the individual employee's viewpoint, competency is defined as a person-related concept referring to a cluster of dimensions of behaviour enable ones for perform well at work (Selmer & Chiu, 2004).

3. Port Employees' Competencies

To design the questionnaire, 65 items of questions found from previous literatures are grouped into three dimensions: Business-related skills/knowledge dimension (27 questions), Port and logistics affairs-related skills/knowledge dimension (24 questions), and Management-related skills/knowledge dimension (14 questions). Details of questions in each dimension are listed in the table 1.

Table 1 Skills required by port executives

Business-related skills/knowledge dimension		
Accounting & financial management	Analysis statistical data	Managing client relationships
General business administration	Human resource management	Impact of globalization & climate change
International business	Risk management, including emergency management	Quality and customer service management
Strategic planning & management	Economic principles	Information system management
Industrial relations	Occupational health & safety	Corporate social responsibility
Roles and functions of ports	Customs procedures	Port revenue, costs and charges
Port tariff	Pricing of port services	Port marketing mix
Port market segmentation	Port marketing information systems	Port marketing communication tools
Principles of fire fighting	Dangerous cargo regulations	Port safety & security, including ISPS Code, 24-hour rule, CSI
Port and Logistics Affairs-related skills/knowledge dimension		
Navigation and traffic control	Transit shed and warehouse operations	Planning and operations for conventional cargo terminals*
Freight station operations	Container ship & yard operations	Berth planning
Ship stowage planning	Quay transfer operations	Dangerous cargo operations
Reefer cargo operations	Project cargo operations	Equipment safety measures
Equipment operating procedures	Solving technical problems	Introduction to equipment maintenance & repair
Contract management	Purchasing	Materials handling
Transportation management	Packaging	Inventory management
Warehousing	Salvage and scrap disposal	Reverse logistics
Management-related skills/knowledge dimension		
Ability to plan, organize, lead & control	Effective oral & written communication	Effective supervision of staff
Effective time management	Ability to negotiate	Problem-solving ability
Ability to delegate, train & motivate staff	Ability to adapt to organizational change	Personal enthusiasm & integrity
Knowing two or more languages	Team building and communication	Port strategic planning, master planning and operations planning
Management Information System, including terminal planning systems	Time in port and port productivity management, including KPI measurement	

*. Conventional cargo terminals include dry bulk, liquid bulk & general cargo terminals.

Source: compiled from various literatures and interviews

4. Design/methodology/approach

This is an empirical research by a series of post questionnaire survey. Sixty five items of competency requirement are grouped into business related, port and logistics affairs related, and management related dimensions. With responses from the five groups of surveyees mentioned in the research purpose section, a comparison study on their perception differences on the importance of the above mentioned 65 items currently and in a decade is calculated. A comparison on the importance of these 65 items of competency requirements for port executives between now and in the next decade is also analyzed.

5. Profiles of the Surveyed Companies

Four groups of executives from the following port industry are surveyed in this study: executives from the headquarter of the Taiwan International Ports Corporation in Kaohsiung, Kaohsiung oil tanker terminals of the China Petroleum Corp., Kaohsiung container terminal of the American President Lines(APL), and the Taichung and Kaohsiung Grain Silo Terminals of the Far Eastern Silo & Shipping Corp.

Taiwan International Ports Corporation (TIPC) is founded in the early 2013 to enable the four major international ports in Taiwan compete efficiently in the global shipping market. TIPC has a total number of 2900 employees. Executives from

various departments of the TIPC should own their department-specific competencies. However, some of the competencies should be mutually owned in all departments which are called 'general competencies'. Business department is the most important unit in the TIPC to generate revenue and to communicate with their key account customers (i.e. mainly large ocean carriers).

CPC has over 60 years of oil terminal operation experience with a total number of 14,908 employees and is the largest petroleum refinery in Taiwan. China Petroleum Corp., Taiwan (CPC Corp.) leases and operates four berths with the total quay length of 881.13 meters in the port of Kaohsiung. Two of the four berths have the quay water depth 6.5 meters and the other two quays' depth is 10.5 meters.

American President Lines (APL) is a wholly owned subsidiary of Singapore-based Neptune Orient Lines (NOL). APL in Taiwan operates two berths in Kaohsiung with a total quay length of 640 meters and a container storage area of 7796 square meters. APL is also one of the largest international ocean transportation service providers in Taiwan since 1976. Its terminal employees both operate the container terminals and also maintain a container and equipment repair shop in the dockside.

Far Eastern Silo & Shipping Corp.(FEFSC) is founded in 1979 and is the largest grain silo operators in Taiwan. FEFSC changed its names to Eastern Media International (EMI) when it diversified its business scope. Each year it handles more than 6 million tones of imported grain cargo. EMI has more than two hundred full time and part time employees in its four grain silo berths in the port of Taichung and the port of Kaohsiung.

6. Research Findings

A comparison on the perception of importance on the three dimensions of port executives' competency requirements from the executives in the five different port operators is listed in the table 2. Not surprisingly, all respondents perceived the management skills and knowledge is the most important dimension in terms of competency requirement for a port executive which implies port executive position is a management-oriented job. Port and logistics skills and knowledge is perceived to be the lowest important dimension in terms of competency requirement for a port executive except the respondents from the China Petroleum (CPC) Corp. As respondents from CPC Corp. are involved in handling a highly dangerous cargo, the petroleum, thus the importance of port and logistics skills and knowledge is higher than its business skills.

Table 2 Perception on the importance of competency requirements by different port operators currently and in a decade

Port Operators	Taiwan International Ports Corp.	China Petroleum Corp.	APL Kaohsiung	Far Eastern Silo & Shipping	Stevedoring company (GJ Corp.)
Dimensions					
Business skills / knowledge	3.76/2.84 (-24.46%)	3.49/2.71 (-22.35%)	3.48/2.75 (-20.98%)	3.84/2.82 (-26.56%)	3.81/2.75 (-27.82)
Port and logistics skills / knowledge	3.17/2.55 (-19.56%)	3.63/2.75 (-32%)	3.17/2.84 (-10.41%)	3.69/2.8 (-24.12%)	3.79/2.73 (-27.97%)
Management skills/ knowledge	4.17/2.96 (-29.02%)	3.96/3.04 (-23.23%)	3.79/2.76 (-27.18%)	4.20/2.88 (-31.43%)	4.17/2.80 (-32.85%)

Note: % in the parenthesis indicates the percentage of decrease of its importance in the next ten years.

Source: this research

7. Conclusions and Implications

The value, research limitations, and practical implications are discussed as follows.

Value:

According to the authors' knowledge, this is the first research that has identified the core competency required by executives in different types of port terminal. Training institutions operated by port authorities and port companies can use the findings in this research to design their training curricula for the next generation port/terminal executives in the future.

Research Limitations

This research only makes one empirical survey to port executives in a single nation. In the long run, cross national comparison across the western world and eastern world on port executives' competency requirements should be carried out to generate more fruitful research results.

Practical implications

Ports are used to be perceived as a nodal point for physical movements of cargoes and exchange of transport modes. When the demands of cargo shippers and ocean carriers changed, the port operators have to change their services to meet requirements made by their customers. Current known knowledge will be replaced by the future unknown knowledge quickly. Thus the importance of current competency requirements are found greatly decreased in the next coming decade. How to monitor the development of modern competency requirements and have their executives receive the updated competency training is a necessity for the survival of port operators. Shipping training institutions should bear this finding in their mind before an appropriate port management curricula and training programme is designed.

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Section 12: Supply Chain Skills, Capability and Education

ACADEMIC-INDUSTRY COLLABORATION: SCM RESEARCH AND KNOWLEDGE BUILDING

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Abstract

Operating in a global, complex and rapidly changing environment, there is a need for greater collaboration to foster theory building and knowledge transfer. Collaborative academic-industry research within the context of Supply Chain Management (SCM) has yet to be examined. This empirical study represents the first attempt to explore how academics and practitioners engage each other in the SCM discipline, and provides a better understanding of collaborative SCM research between academia and industry. A two-pronged approach, involving a content analysis and an e-mail survey, is employed to explore a series of issues on collaborative SCM research. We examine 122 articles co-authored by both scholars and practitioners of six relevant SCM journals from 2003 to 2012. We specifically analyse the motivations, expectations, and communications involved in the process of collaborative research. Our findings suggest that academics and practitioners can function as co-investigators in research collaboration to better explore an array of SCM phenomena embedded in SCM practice. Further, building collaborative SCM knowledge relationships expedites collaboration and benefits SCM knowledge learning, transfer, and co-production. The development of practice-based scientific SCM knowledge is useful for SCM theory building and serves to bridge the gap between rigor and relevance.

Keywords: Collaboration, Supply chain management, Collaborative SCM research, Survey

1 Introduction

Supply Chain Management (SCM) is a function which links major business functions and processes within and across companies into a cohesive and high-performing business model. It includes all of the logistics management activities, as well as manufacturing operations, and it drives coordination of processes and activities with and across marketing, sales, product design, finance and information technology (CSCMP, 2010). As such, SCM is as much an applied science as it is a complicated practice.

Flynn (2008) rightly points out that without problems in actual supply chains to study, there would be no need for SCM research. Put simply, the worlds of academia and practice are closely interwoven, with each informing the other. Primarily as a result of its practical nature, the outcome of the debate on the rigor-relevance gap of SCM research is considered most important (Fawcett & Waller, 2011), though the rigor versus the relevance issue has long been discussed in academic research (Carter, 2008; Mentzer, 2008).

However, academics and practitioners belong to different communities. Academics generally value scholarly work whereas practitioners are concerned

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about business practice. When the two groups interact, they may or may not complement each other for the research fulfillment based on their own domains of expertise. Some scholars claim that such interactions are an effective way to bridge the rigor-relevance gap for SCM research (Carter, 2008; Fawcett & Waller, 2011, 2013; Flynn, 2008; Mentzer, 2008).

Our study takes the rigor-relevance gap one step further and aims to explore the phenomenon of involving practitioners in conducting SCM research. Here academics and practitioners function as co-investigators, forging an actual collaboration between theory and practice to facilitate SCM knowledge building. Academic-practitioner collaboration is not new in the other disciplines. However, there is a dearth of research into the ways in which academics and practitioners actually engage each other in the SCM discipline. This study fills this void. Specifically, the research objectives of our study are threefold:

- (1) What is the state of academic-practitioner collaborative SCM research?
- (2) What are the aims of academics and practitioners who initiate such collaboration?
- (3) How is the collaboration fulfilled in the form of SCM knowledge building?

The rest of the paper is organized as follows. We first discuss the literature on academic-practitioner collaboration, and then review the debate on rigor versus relevance in SCM research. Next, we describe the research method used, namely, a two-pronged approach involving a literature search and an e-mail survey. We then present the findings, followed by a discussion. We conclude with a proposition for the working definition of collaborative SCM research, and state the limitations of this study as well as future research directions.

2 Literature review

Carter (2008: 78) has provided a definition of rigor and relevance specific to SCM: 'rigor' refers to "sound, coherent, logically developed theory, and the various dimensions of methodological and analytical validity that are necessary to test theory", while 'relevance' is concerned with "creating knowledge that managers can use to better understand the phenomena relating to that which they manage - supply chains in the case of our field".

SCM scholars differ in their perspectives on the value of rigorous versus relevant SCM research. To avoid research with no practical relevance, Davis-Sramek and Fugate (2007) propose that the relevance of SCM research be given priority. In contrast, from the perspective of the scientific attributes of the SCM discipline, Flynn (2008) stresses the rigor of SCM research. From the perspective of advancing the body of valuable and scholarly SCM knowledge, Mentzer (2008: 72) attaches equal importance to both rigor and relevance, echoing "Why would we choose only one?".

Despite the on-going debate on this conundrum, it is clear that SCM research should be relevant to practice and that a bridge to overcome the rigor-relevance gap must be constructed. Carter (2008) suggests that research and practice need to co-involve. Involving practitioners in the research can address the closed loop dilemma as it can mitigate the knowledge production problem as well as, potentially, the knowledge transfer problem. Mentzer (2008) insists that rigor and relevance are equally important for good research; choosing only one of them does not make sense. To bridge this "gap" between scholarly research and practice, Mentzer recommends that researchers and practitioners should dedicate themselves to interacting regularly to understand the issues facing the SCM discipline. Hutt (2008), and Dess and Markoczy (2008) suggest that engaging corporate partners in the research is useful for bridging the rigor-relevance gap. This innovative research approach, as noted by them, not only enables

researchers to identify and modify research topics based on practitioner engagement, but also helps academics to gain access to company sites and industry funding. In sum, the literature suggests that interacting with practitioners is conducive to narrowing the rigor-relevance gap in SCM research. Moreover, involving practitioners in the research can fast-track knowledge production useful for a community of practice.

3. Research method

A two-pronged approach, i.e., a literature-search and an e-mail survey, is employed to achieve the research objective. The literature search examines the articles that were co-authored by academics and practitioners, since such joint works represent actual collaborative behavior between the two parties. The e-mail survey explores the author's perspectives on their collaborative research.

The literature search was performed as follows: literature selection, first article screening, and second article screening. Our study focuses on primary journal outlets in SCM from 2003 to 2012. In the literature selection step, six journals were thus identified: the International Journal of Logistics Management (IJLM), International Journal of Logistics Research and Applications (IJLRA), International Journal of Physical Distribution & Logistics Management (IJPDL), Journal of Business Logistics (JBL), Journal of Supply Chain Management (JSCM), and Supply Chain Management: An International Journal (SCMIJ). These six journals are listed in the Web of Science database, and are appraised as being significant to the maturation of the field's literature (Ellinger & Chapman, 2011). Given their reputation with and influence on academics working in SCM, the journals were therefore considered as the literature sample for this study.

In the first stage of article screening, the author bibliographies of 1,647 articles from the six journals were reviewed. Of these, 127 articles met the selection criteria of being co-authored by both academics and practitioners.

Next, an open ended e-mail survey was conducted, covering items that address the motivations, expectations, processes and outcomes of the collaborations. Based on the first article screening, e-mails were sent to all authors of the 127 articles. Six respondents indicated that they are purely scientific papers since the practitioner contributors were still researchers at the time of submission. After excluding these six articles, 122 articles were subsequently used in the analysis. Only 65 authors from 22 articles answered all six e-mail questions, yielding a return rate of 18.03%.

Two techniques were used in the analysis: content analysis and qualitative interpretation. Content analysis was used to examine the 122 articles, so as to uncover the knowledge content of such collaborations. The use of content analysis in the study followed two steps: categorizing and evaluating. Categorizing defined the analytical units such as research subjects and research methods, while evaluating them, led to an examination of the analytical units. Aside from the content analysis, a qualitative interpretation was performed on the results of the e-mail survey. This serves to explore the experience and attitudes of the authors on the collaboration.

Table 1 presents the descriptive statistics from the six journals; the 122 articles are listed in the Appendix. Of these articles, 34.4% were published in SCM, followed by 26.2% in IJPDL, and 16.4% in IJLRA respectively. Table 1 also shows only a small portion of articles with collaborative research initiatives in the six journals from 2003 to 2012. In all, 1647 publications were released in the ten years, with only 7.4% completed through academic-industry collaboration.

Table 1 Articles statistics from data set

Journal	Articles	First screen	Fulfill criterion
IJLM	179	11	9
IJLRA	237	21	20
IJPDLM	422	31	32
JBL	203	12	10
JSCM	185	9	9
SCM	421	43	42
Total	1647	127	122

4. Findings

4.1 Literature search

Table 2 presents the research topics that were addressed by the collaboration, and shows that the subject areas are generally well distributed and traditional in focus. This reflects the breadth of SCM and the on-going attention paid to the core areas of interest, in particular, inventory and inventory management, and outsourcing/LSPs. Some relatively new subject areas were studied in the collaborative SCM research examined, such as supply chain security, risk management, global issues, the environment, and sustainability. This again reflects that inputs from industry have been brought to bear on SCM research, to jointly seeking solutions to urgent concerns of the day.

Table 2 Subject category for articles surveyed

Subject category	Number of articles
Inventory/inventory management (including forecasting)	11
Outsourcing/LSPs	10
Collaboration/integration	7
Purchasing/sourcing	7
SC relationship	7
Social responsibility (including CSR, humanitarian logistics, and sustainability)	7
International/global issues	6
SC operation/management/performance	6
Transportation and related issues	6
SC mapping/design/reconfiguration/	5
Cost/price	5
Customer service and demand management	4
SCM implementation	4
SC risk management	4
Technology and IT (including ERP, RFID)	4
Green logistics/SCM (including reverse logistics)	3
E-business	3
Logistics operations/services/strategy	3
SC quality management	3
Lean thinking	3
Logistics facilities	2
SC segmentation	2
SC process maturity	2
Lead time	2
Knowledge management	2
HRM	1
Logistics innovation	1
Networking	1
SC security	1
PhD dissertation	1

Note: Some articles are allocated to more than one category due to their multifaceted foci.

Figure 1 shows the research methods applied in collaborative SCM research, with case studies being the most frequent (55; 43%), followed by empirical studies (21.1%). The case study is an effective method for exploring research problems such as “how” and “why” (Yin, 2014). It is a research strategy which focuses on understanding the dynamics present within single settings. The finding points to the suitability of case studies in examining collaborative SCM research to jointly explore and understand the SCM phenomena embedded in the real world.

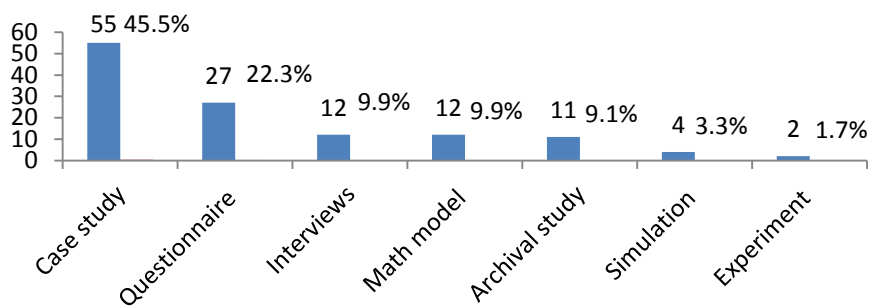


Figure 1 Classification by research method

Moreover, of the 55 articles, 12 articles used multiple case studies. For instance, based on the results of 12 case studies in three multinational corporations, Trantmann *et al.* (2009) have explained how and why firms integrate under different circumstances. The multi-case study approach permits the generalization of the research findings (Yin, 2014). Our finding suggests that the authors have attempted SCM knowledge building and theory development.

In general, field-based research (i.e. ethnography, case study, and in-depth interview) was popularly employed in the articles surveyed. In all, 67 articles (55.4%) are built on the field-based approach, using either case studies or interviews (12 articles). Many scholars (Carter, 2008; Dess & Markoczy, 2008; Fawcett & Waller, 2011; Mentzer, 2008) advocate field-based research as being useful for narrowing the gap between theory and practice. The evidence is consistent with this suggestion.

To determine the contribution to research and management provided by the articles surveyed, we examine the discussion/implication/conclusion section of the articles. We find that a number of articles explicitly discussed the implications for research, management and theory, as exhibited in Table 3. Under the heading of “research implications” or “implications for researchers”, seven articles indicated the need for further research and provide suggestions for potential opportunities. For example, Sila *et al.* (2006) analyze the state of supply chain quality management in manufacturing firms by testing several hypotheses. In the research implications section, they summarize the research findings and provide guidelines for future research to tackle the issues raised by the findings.

Another 32 articles (26.4%) discuss the managerial / practical implications. The discussions summarize the study, reinforced the awareness of the phenomenon researched, and provide specific recommendations for managers. For instance, De Leeuw *et al.* (2011: 451) have made the following remark: “The managerial implication of this is that decision making at the dealer level must be explicitly incorporated in supply chain design. It is essential to co-operate with the dealers to change the supply chain”.

Table 3 Research/Managerial/Theoretical implications

Journal	Number of Articles (count)	Implications (count)		
		Research	Theory	Management
IJLM	9	-	2	4
IJLRA	20	-	-	-
IJPDLM	32	-	2	9
JBL	10	2	-	6
JSCM	9	2	-	6
SCM	42	3	-	7
Total	122	7 (5.7%)	4 (3.3%)	32(26.2%)

Carter (2008) and Mentzer (2008) suggest that a better elaboration on managerial/practical implications of the research in scholarly papers is helpful for bridging the research-practice chasm. Their explanation is that this can allow academics to better translate the findings to students and practitioners with whom they consult. In addition, to advance high-quality conceptual theory development, Carter (2011) reinforces the demonstration of the relevance of the research effort to SCM practice by meaningfully discussing the managerial implications of the work. Our finding provides evidence for their view.

4.2 Open-ended e-mail survey

An e-mail survey was designed to investigate the collaborative behavior from the responses of the 22 articles for the 6 questions surveyed: primary initiator, original expectation, communication, problems encountered, roles and responsibilities, and final performance.

The responses reveal three main types of collaboration initiators: academic initiated, practitioner initiated, or both. The findings reveal that the motivation for the collaboration between academics and practitioners is varied.

- 1) *Academic initiated: 11 responses (50%):* Academics initiated collaboration with the motivations of producing a paper, research project fulfillment, documenting a company's experience and current work and then connecting it to theory, and completing a relationship dynamics study.
- 2) *Practitioner initiated: 4 responses (18.2%):* Practitioners initiated collaboration with the motivation of exploring more in their own specialized area.
- 3) *Both initiated: 3 responses (13.6%):* Academics and practitioners both acted to initiate collaboration with the motivation of sharing the research output through engaged projects, and/ or delivery of a study course.

On the original expectation for collaboration, exploring practical SCM issues was the most important expectation, followed by journal paper publication, as shown below.

1) Explore SCM issues: (11 responses, 50%)

Respondent#11, #47: Original expectation was the research hypotheses listed in the article. Basically it was to formalize different supply chain options the industry had at the time. We did continue at a much more detailed level.

2) Publish a journal paper: (6 responses, 27.3%)

Respondent#36: Expectation was to make a good case study article, and it seems like we managed. It is one of the most downloaded article in the journal, and is very much quoted.

Almost all the respondents claimed that they did not encounter problems, in that "working was smooth as there was a genuine complementarity in approach", and "It was very straightforward, no problems whatsoever". Some respondents

indicated that time management was a major issue. This could be that researchers and practitioners differ in their work styles.

The roles played by academics and practitioners were also examined. The results suggest that both sides had various roles during the collaboration. Academics were generally responsible for 1) initiating the research (9 responses), 2) writing the article (20 responses), proof-reading (7 responses), and data analysis (5 responses). As for the practitioners, they characterized their roles as 1) initiator (5 responses), 2) writer/part writer (4 responses), 4) proof-reader (5 responses), and 5) devil's advocate (2 responses). Practitioners also cited themselves as providing access to the materials and data, giving experience, fixing access to additional interview respondents, and participating in discussion/analysis sessions.

5. Conclusion

Empirical SCM research is still in a relatively early stage (Carter, 2011). As such, SCM has no theory of its own, tending instead to borrow theories from the other disciplines to facilitate understanding of the various SCM issues (Carter, 2011; Stock, 2009). More forms of SCM research, well founded on the actual SCM practice, are needed. In this study, we provide an in-depth investigation of academic-practitioner collaborative SCM research. The two-pronged approach employed, i.e., a review of 122 articles from six SCM specific journals during 2003-2012 followed by an e-mail survey based on the authors of the articles reviewed, provides us with valuable information on collaborative SCM research.

First, collaborative SCM research is emerging as a viable approach to bridge the gap between rigor and relevance. In the form of engaged scholarship, both academics and practitioners function as co-investigators, exploring an array of SCM phenomena. The motivation of initiating such research collaboration is primarily driven by the need to solve SCM issues hidden in the real world. By means of diverse research methods, in particular, a field-based approach, a body of SCM knowledge has been applied and developed. The endeavor for SCM development has also been attempted.

Second, we note that collaborative SCM knowledge-building relationships fulfill the collaboration. The relationship, by nature, is mutual understanding, trust and respect for scholars and practitioners which reside in the collaborative process, evidenced by collaboration in respect of their common interests, roles and responsibilities, and communication.

Third, collaborative SCM research yields significant benefits for both academics and practitioners. Practitioners obtain scientific knowledge input which is beyond their own experience while academics are allowed to access the real world, fueled with a practical test for their scientific inquiry. The effect of the collaboration has not only created a co-learning environment for both sides, but also has improved the productivity and quality of collaborative SCM research, as Van de Ven (2007: 27) has noted: "By exploiting differences in the kinds of knowledge that scholars and practitioners from diverse backgrounds can bring forth on a problem, engaged scholarship produces knowledge that is more penetrating and insightful than when scholars or practitioners work on the problem alone".

Like any research, our study has limitations. As a piece of exploratory research, the sample size obtained could be larger; e.g., although we consulted the six top-tier journals, we may have missed information from the other journals. In addition, we conducted an e-mail survey rather than face-to-face interviews. Moreover, the response rate was not very high. To some extent, this conduct may influence the explanatory power of the survey data. Future research could, however, pursue a larger sample for further inquiry.

Collaborative SCM research is certainly not the only way to generate knowledge in SCM science, but it has many advantages as a complement to the other forms of research in the field, as evidenced by the study. Therefore, it has a special value and significance for the development and advancement of the SCM discipline. As a discipline that is maturing, the development of practice-based scientific SCM knowledge should represent a distinctive role for SCM research. We hope the study can provide a starting point for academics and practitioners interested in SCM to further collaborate and accelerate growth of the discipline.

ACKNOWLEDGEMENT

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COOPERATIVE MODES AMONG PORT CORPORATION, CARRIERS, AND TERMINAL OPERATORS- THE CASE OF TAIWAN

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Abstract

Purpose of this paper

As the theories of supply chain management thrived, more and more business entities have moved to creating competitive advantages via collaborative partnering relationships with their suppliers and customers. Through integrated with sea-end container carriers and land-end terminal operators, Seaport Corporation could provide more complete and efficient logistics services to customers. This paper aims to determine and to examine critical services attributes of seaports to container carriers and terminal operators. Meanwhile used identified attributes to select appropriate cooperative modes to implement the integration strategy.

Design/methodology/approach

Based on extant literature review and expert interviews, this paper built an evaluation system comprising 3 dimensions and 12 criteria respectively. Next combined DEMATEL and ANP to construct the causality of the dimensions and criteria and transferred from the interdependence to the degree of importance. Finally, the VIKOR evaluates the total gap of cooperative modes performance of a case study – TIPC (Taiwan International Port Corporation).

Findings

The results suggest that the best cooperative mode among seaport, container carriers and terminal operators is the majority shareholder, and then minority shareholders. The seaport wants to develop solid relationships should consider the controlling powers shipping industrial chain in order to improve the success rate of cooperative strategy.

What is original/of value in paper?

The whole approach developed by this study can serve as a reference to construct an evaluation framework to evaluate cooperative strategic choices in the shipping-related industry. DEMATEL not only can convert the relations between cause and effect of criteria into a visual structural model, but also can be used as a way to handle the inner dependences within a set of criteria.

Research limitations/implications

The unit of analysis is corporation, and there is only one port corporation exist in Taiwan to be surveyed. However, we conducted expert interviews from container carriers, terminal operators and the academic that consist of more than ten experts.

Practical implications

The findings are expected to provide Taiwan Port Corporation with reference frame for competing globally. The casual relationships among critical services attributes can be effective in helping TIPC managers

allocate and configure their limited resources in time and space.

Keywords

Port Corporation, Cooperative Mode, DEMATEL, VIKOR

Introduction

The global marketplace with more and more extensive and complex logistics networks have impacted the *raison d'être* of seaports and left seaport managers with the questions of how to respond competitively to market dynamics (NOTTEBOOM, 2007). Port authorities and port management teams, whose main objectives are financial, are forced to reevaluate their role and reform their competitive strategies. Within the Seaport supply chain, the liner industry are undergoing a sweeping structural changes, the three largest liner carriers in the world (Maersk Line, Mediterranean Shipping Co., and CMA CGM) are going to operate their services jointly on the world's three major east-west trades: the transpacific, Asia-Europe, and transatlantic, we called P3 network. Meanwhile, another major alliance, G6 is clearly trying to trump its main rival, P3 network by cooperating in the Asia-Europe and Mediterranean trade lines and extending into the transpacific. If that wasn't enough, there is one other alliance, the CKYH alliance re-groups with Evergreen to CKYHE alliance to fight with P3 and G6. The games for international shipping supremacy play out, it seems unlikely that all the carriers on the arena of the oceans will survive.

The third relevant members in the port community is terminal operating companies (TOCs), there have been a number of papers acknowledging the important role of ports and TOCs in the context of supply chain management (Bichou and Gray, 2004; Carbone and De Martino, 2003; Heaver, 2002; Paixao and Marlow, 2003; Panayides, 2006; Robinson, 2002; 2006; Wang and Cullinane, 2006). Heaver (1995) indicated that "the increased competition faced by ports is more focused than previously on the performance of logistics systems of which the individual terminals in ports are critical hubs". Like De Souza (2003) stated that port and terminal operators need to achieve a higher degree of integration to be successful in port supply chain. It is shown that integrated and complex network has transformed the fragmented key players within port supply chain into the cohesive seaport-container liner-terminal operator community. To cope with this changing business environment, a certain form of strategic cooperative modes among port operator, container liners and terminal operators is necessary so as to bring value to the final consumers. Despite the importance of port supply chain integration for ports as well as for port users and other members of the supply chain, there have been limited empirical investigations in the area. This paper aims to determine and to examine critical services attributes of seaports to container liners and terminal operators. Meanwhile used identified attributes to select appropriate cooperative modes to implement the integration strategy.

Literature Review

Port choice has become an essential issue to be investigated to ensure the effective integration of port supply chains and sustain development of regional competitiveness. Thus, there exist lots of extant papers that dealt with the port choice issues (Peter, 1990; Bergantino & Coppejans, 2000; Itoh & Doi, 2003; Nir, 2003; Bichou & Gray, 2004; Chang, 2008; Wiegmans et al., 2008; Sanchez et al. 2011). Port selection criteria or factors affecting port choice have evolved due to changing business environment and

technological advancement in provision of port services.

Peters (1990) identified two group of factors that influence port selection, that is internal (service level, available facility capacity, status of the facility, port operation policy) and external (international political environment, change of social environment, trade market, economic factors, features of competitive ports, functional changes of transportation and materials handling). Wiegmans et al., (2008) argued that the availability of hinterland connections, tariffs and the immediacy of consumers as the most important port services attributes, while Yeo, Roe, and Dinwoodie (2011) and Yeo et al. (2009) have identified port service, hinterland condition, availability, convenience, logistics costs, regional centre and connectivities, which influence the port attractiveness in the NEA region. Ng (2006) highlighted the importance of 'qualitative factors' in affecting port choice, while at the same time argued that different port choice factors were interrelated to each other, that is the same idea as this study, casual relationships. His findings addressed an important phenomenon in port choice nowadays, of which there was often no single factor which could dominate the port choice behaviors of users. The works by Sanchez, Ng, and Garcia-Alonso (2011) further pointed out that the perception of the importance of port choice factors between different stakeholders (notably, service users and suppliers) could diverse significantly. This study reviewed the extant literature and interviewed senior managers served in liners and terminal operators to identify the three groups of key factors, internal, external and liners'/terminal operators' strategies that will affect the attractiveness of ports. Internal factors, under this group, we identify six factors, 1. Port capacity, 2. Operation efficiency, 3. Service quality, 4. Berth facility, 5.relevant costs, and 6. Water depth (Fleming & Baird, 1999; Heaver et al., 2001;Notteboom & Winkelmans ,2001; Zeng and Yang, 2002; Song & Tongzon ,2003). External factors, under this group, there are four factors, hinterland condition, geography location, connectivity to inland transport network, and customs efficiency. Corporate strategy of liner/terminal operator, under this group, there we retrieved from practical experts, route planning, owner preference, agent capabilities, and political conditions.

As to cooperative mode, there are various theories used by researchers to analyze different aspects of cooperative arrangement. Representatives such as transaction cost theory (TCT), resource- based theory (RBT), contingency theory (CT), and social exchange theory (SET) For example Parkhe (1993) has used TCT to study the factors that strengthens the ties among cooperative partners; Narasimhan etal.(2009) have used SET to analyze buyer–supplier relationships under lock-in situations in supply chains. This study modified three determinants of successful cooperative relationship management, degree of control, resource commitment and potential financial risk to describe three options of cooperative modes among port, liner and terminal operator (Hill et al. 1990). The detail is shown in Table 2-1.

Table 2-1 degree of control, resource commitment and potential financial risk

Determinants Modes	degree of control	resource commitment	potential financial risk
Alliance	Low	Low	High
Joint Venture	Middle	Middle	Middle
Vertical Integration	High	High	Low

Source : Hill et al. (1990)

Methodology

DEMATEL(Decision Making Trial and Evaluation Laboratory) is a methodology which is proposed in

1971 by Institute of Bottelle in order to solve complex and difficult problems in the real world. It is a method that use graph theory and matrix tools for system analysis. By analyzing the logical relationships between the system elements, researchers can determine whether there are relationships existing among the elements. The DEMATEL not only can convert the relations between cause and effect of elements into a visual structural model (Fontela & Gabus, 1976), but also can be used as a wise way to handle the interactions among a set of elements. DEMATEL is used to construct the interrelations between factors and factor weights can then be obtained via processing individual or group subjective perception by the AHP method. Then, the final tool this study used is VIKOR, it is advantageous in the context of multi-criteria-based decision making, particularly in situations where the decision maker is not able, or does not know how he/she expresses his/her preference at the early stage of system design. Because VIKOR provides a maximum "group utility of majority" represented by $\min S$, and a minimum "individual regret of opponent" represented by $\min R$, decision makers can determine compromise solutions based on their negotiated preferences. Thus, where unsatisfactory attributes can remarkably affect the selection of an entire service, VIKOR, compared with other MCDM methods, is useful for achieving the purpose of this study, because the decision maker can set the weights of maximum group utility and individual regret differently according to various situations.

Research Findings

● Data Analysis

Cooperative arrangement among Port, terminal operators and liner cooperation is critical strategic issues and it featured with professionalism, domain-specific, thus the selected expert process need to be discretion. The first consideration is if he/she got professional knowledge of shipping and ports, and then if extensive practical experience. And to improve the effectiveness and availability of the questionnaire, during the questionnaires distributed or returned also discussed with experts face to face to make sure he/she fully understand the problems identified in the questionnaire, and to answer the questions correctly. The study distributed eight questionnaires and got eight valid questionnaires from liners set offices in Taiwan.

● Dimension correlations and interrelationships

According to above literature review and experts interview, this study identified three major dimensions and twelve indicators. Three major dimensions identified including (S1) Internal factors, (S2) Internal factors and (S3) Corporate strategies. The corresponding indicators were (S11) Port capacity, (S12) Operation efficiency, (S13) Service quality, (S14) relevant costs, (S21) hinterland condition , (S22) geography location , (S23) connectivity to inland transport network , (S24) customs efficiency, (S31) route planning , (S32) owner preference , (S33) agent capabilities , (S34) political conditions. Therefore, the computation of using DEMATEL method is based upon these 8 experts' opinions. To follow the procedure of DEMATEL method, we confirmed system structure of key service attributes when liner select port and terminal, and the results can be found in Total influence matrix T as shown in Table 5-1. Table 5-1 revealed the direct and indirect effects of three dimensions. The digraph of these three dimensions is depicted in Fig. 5-1. Table 5-1 shown that, there are three key service attributes influence liner select port/terminal operators, S1 "internal factors", S2 "external factors" and S3 "corporate strategies". The prominence ($r+d$) showed the influence range of factors, including influencing and influenced. In addition, the score of relation ($r-d$) was more, and the factor influenced others more. Prominence ($r + d$) shown

more are S1 "internal factors" and S3 "corporate strategies", so these two dimensions owned more influence than others; relation (r-d) The S3 "corporate strategies" (-1.2822)" was more influenced by other dimensions.

Table 5-1: The sum of influences given and received among these three dimensions.

Dimension	r	d	r+d	r-d
S1: internal factors	2.5693	2.3267	4.8960*	0.2426
S2: external factors	2.4653	1.4257	3.8911	1.0396
S3: corporate strategies	1.5297	2.8119	4.3416*	-1.2822

Source: this study

Table 5-2 discovered the direct and indirect effects of 12 indicators. The digraphs of these 12 indicators are depicted in Fig. 5-2~5--5. Prominence (r + d) shown more are S21 "demand conditions" , S31 "route planning" and S32"owner preference", so these two dimensions owned more influence than others; relation (r-d) S21 " demand conditions " and S21 "Customs efficiency" was more influenced by other dimensions.

Table 5-2 The sum of influences given and received among 12 indicators

Indicators	r	d	r+d	r-d
S11: Port capacity	1.6398	1.2575	2.8973	0.3822
S12: Operation efficiency	1.5810	2.1141	3.6952	-0.5331
S13: Service quality	1.6330	2.3179	3.9509	-0.6848
S14: relevant costs	1.6049	2.2533	3.8582	-0.6483
S21: Demand Conditions	1.8582	2.6471	4.5054*	<u>-0.7888</u>
S22: connectivity to inland transport	1.6353	1.2793	2.9147	0.3559
S23: Customs efficiency	1.4602	1.5218	2.9820	-0.0615
S24: geography location	2.0585	0.4204	2.4789	1.6380
S31: route planning	1.8144	2.6059	4.4203*	<u>-0.7914</u>
S32: owner preference	1.8898	2.4327	4.3225*	-0.5429
S33: agent capabilities	1.3356	1.26214	2.5978	0.0735
S34: Political conditions	2.0504	0.4489	2.4994	1.6014

Source: this study

From the Table 5-1, the prominences (r+d), and relations (r-d) were viewed as the origin of coordinates. The x-axis was (r+d), and the y-axis was (r-d). The three dimensions score put on the Fig. 5-1, and show the causal diagram of the direct relation. Based on the Figure5-1, the complex interrelationship of three dimensions was found. The two dimensions, "S1 "internal factors" and S3 "corporate strategies"owned huger influenced than S2, because their prominences (r+d) were higher. An S1 "internal condition" its relations (r-d) over 0 were showed that it owned more control to influence S3. It showed it plays significant roles for attracting liners to call at. S2 " External conditions " had lower relations (r-d), less than 0, so that it is viewed as influenced factors and was influenced mainly by S1 "internal condition" and S3"corporate strategies".

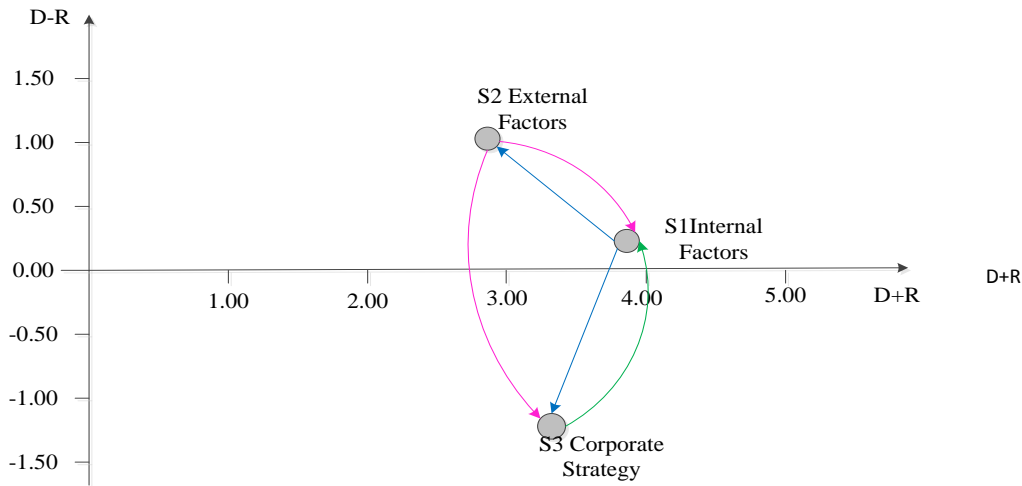


Fig.5-1 the causal diagram of dimensions

By similar analysis methods to investigate the influential and interrelationship among 12 indicators, and based on the results to find which indicators are influencing and which are influenced. Observed from fig. 5-2, the internal conditions, indicator S13 "service quality" and S14 "cost" affect each other, and S13 "Service Quality" influenced by S11 "port capacity", S12 "operational efficiency" and S14 "costs". therefore it would be infer that to improve service quality should start from S11 "Port capacity" , S12 "operation efficiency" and S14 "relevant cost". As to external conditions, S24 "demand conditions" influenced by S21 "geography location", S22 "connectivity to inland transport" and S23 "customs efficiency, if want to increase demand conditions, S22 "connectivity to inland transport" and S23 "customs efficiency" are workable improvement strategies. In corporate strategies, S31 "route planning" and S32 "owner preference" affect each other, and influenced by S34 "political conditions" simultaneously, mean S34 play a key factor in determining liners' corporate strategies.

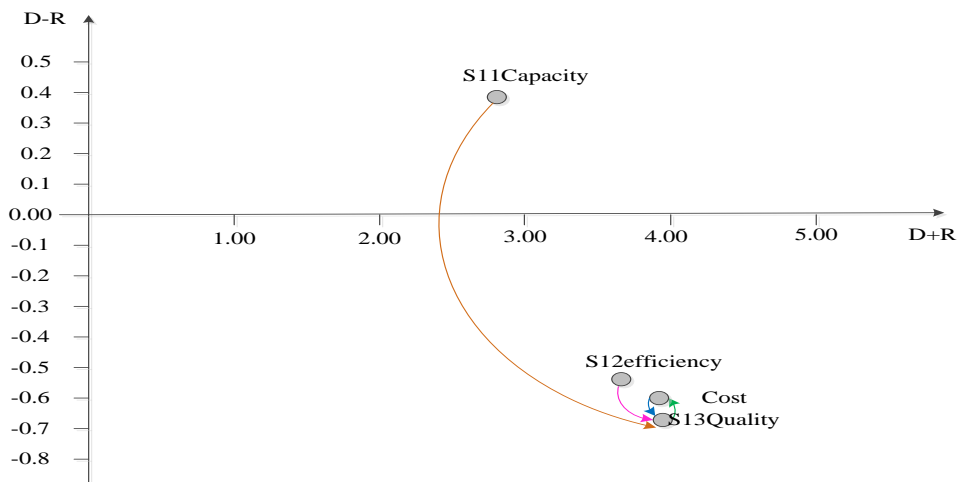


Fig.5-2 the causal diagram of internal conditions

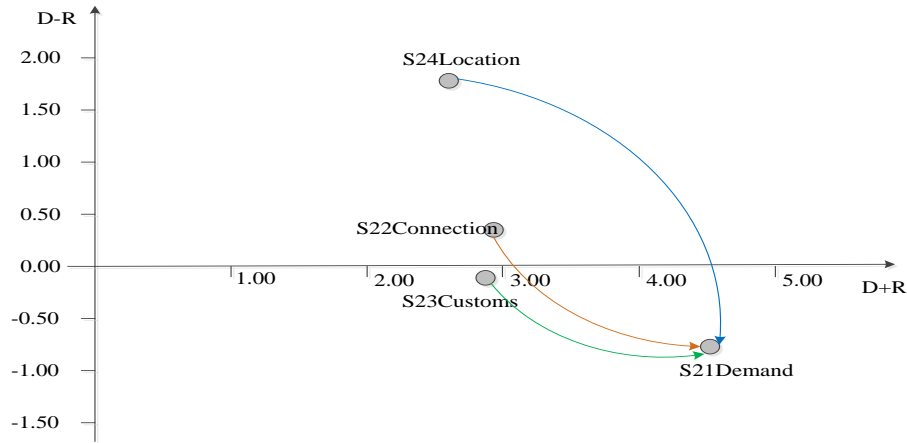


Fig.5-3 the causal diagram of external conditions

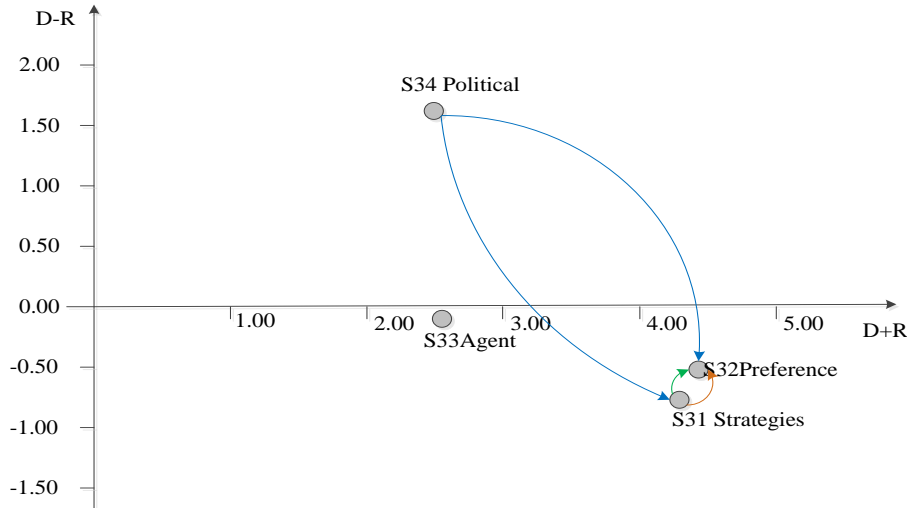


Fig.5-4 the causal diagram of corporate strategies

● AHP and weights

A further goal for Questionnaire was to use a pair-comparing method to find the factor weights by AHP methods. After collected AHP questionnaire that were combined with previous DEMATEL results and got the weighted score shown in Table 5-3 As table 5-3, the most important dimension is S2 "external conditions", S3 "corporate strategy "rank second. With regard to indicators, S21 "demand conditions" and "operation efficiency" is no.1 and 2.

Table 5-3: weights and priority of dimensions and

Dimension	weight	priority	indicators	weight	priority
S1: internal factors S2: external factors Dimension	0.163	3	S11: Port capacity	0.121	4
			S12: Operation efficiency	0.340	2
			S13: Service quality	0.230	3
			S14: relevant costs	0.309	1
S1: internal factors S2: external factors Dimension	0.540	1	S21: Demand Conditions	0.471	1
			S22: connectivity to inland transport	0.123	4
			S23: Customs efficiency	0.145	3
			S24: geography location	0.261	2
S1: internal factors	0.297	2	S31: route planning	0.301	1
			S32: owner preference	0.281	2
			S33: agent capabilities	0.201	4
			S34: Political conditions	0.216	3

Source: this study

- Adopt VIKOR to evaluate performance of alternative Cooperative modes

System model established in this study will be evaluated by VIKOR. The current dimensions and indicators of overall performance gap between the industry and the ideal value (GAP), smaller gap means performance closer to ideal performance. In this study, we asked senior manager worked in liners, terminal operators to conduct a performance evaluation for three different modes of cooperation which characterized with different control, commitment and risk, the gathered original data in the following table 5-4.

Table5-4: Performance of Cooperative modes

Indicators	Vertical Integration	Joint Venture	Alliance
S11: Port capacity	8	6	5
S12: Operation efficiency	9	7	6
S13: Service quality	8	7	6
S14: relevant costs	9	7	5
S21: Demand Conditions	6	6	6
S22: connectivity to inland transport	7	5	3
S23: Customs efficiency	6	6	6
S24: geography location	0	0	0
S31: route planning	7	5	4
S32: owner preference	7	5	4
S33: agent capabilities	6	5	3
S34: Political conditions	6	3	0

Note: 10 mean highest performance , 0 means lowest performance

Next we establish Positive-ideal solution and Negative-ideal solution , use all indicators and Positive-ideal solution as Table 5-5 . Meanwhile we can also find the worst indicators which need to be improved first. .

Table5-5 Positive-ideal Negative-ideal solution of Cooperative modes

Indicators	Vertical Integration	Joint Venture	Alliance
Positive-ideal solution	0.340	0.475	0.581
Negative-ideal solution	0.087	0.087	0.087
S11: Port capacity	0.008	0.016	0.020
S12: Operation efficiency	0.011	0.034	0.045
S13: Service quality	0.015	0.023	0.031
S14: relevant costs	0.010	0.031	0.052
S21: Demand Conditions	0.063	0.063	0.063
S22: connectivity to inland transport	0.012	0.021	0.029
S23: Customs efficiency	0.019	0.019	0.019
S24: geography location	0.087	0.087	0.087
S31: route planning	0.030	0.050	0.060
S32: owner preference	0.028	0.047	0.056
S33: agent capabilities	0.027	0.034	0.047
S34: Political conditions	0.029	0.050	0.072

Source: this study

Calculate the Positive-ideal and Negative-ideal solutions and found benefit ratios of three different modes of cooperative as Table 5-6 . The results of the assessment can be made of the following: the ideal cooperative modes among liner, port, and terminal operators is vertical integration, and second in Joint venture, the last choice is t (no equity investment) alliance. The results of this study may provide reference to Taiwan Ports Corporation to develop cooperative strategy with key members of port supply chain. .

Table 5-6 Performance and ranking of modes of cooperative

	Vertical Integration	Joint Venture	Alliance
VIKOR (v=0.5)	0.214(1)	0.281(2)	0.334(3)

Conclusions and Discussions

Select the right port supply chain cooperative partners (shipping companies and terminal operators) and employed appropriate cooperative mode will enhance the international competitiveness of whole port-centric supply chain. However, various cooperative modes have its advantages and disadvantages, and contributed diversely to competitiveness, make Ports Corporation encountered difficulties in selecting suitable cooperative mode among port, liner and terminal operators. To work closely with supply chain partners is the key to enhance port competition, and how to choose the right mode of cooperation that can create value-added logistics services to final customers has become an urgent issue that faced by Ports Corporation.

This paper presents assessment model to evaluate different cooperative modes among port corporations, liners and terminal operators. This study has identified three dimensions and 12 criteria for decisions making. The research methods used in this study included DEMATEL and AHP to develop a causal relationships and priority of importance of dimensions and indicators. Then adopted VIKOR to measure the overall performance of diverse cooperative mode, and help port corporations to make right choice regarding selection of mode of cooperation. The analysis results shown:

- "Internal conditions" of Port Corporation is the most influential factor in making cooperative mode choice. The rooted influential factors are internal and external conditions, once these two factors have been improved, that will cause a chain effect on the other factors and finally lead to increase the competitiveness. Dig deeper, operation efficiency and relevant costs are key elements of "internal conditions".

- To perform better, when consider cooperating with other partners of port supply chain, the assessment model developed by this study recommend the best mode of cooperation is vertical integration.

- Model established in this study is formed on experts' opinions and feedback, its validity is no doubt. However, the unit of analysis is corporation, and there is only one port corporation exist in Taiwan to be surveyed, for generality purpose, this study need to be done in different area to make it more reliable.

Acknowledgement

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Please refer to author

A PROPOSED MODEL OF VISIONARY LEADERSHIP FOR SUPPLY CHAIN MANAGEMENT IN THE MANUFACTURE INDUSTRIAL OF THAILAND

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Abstract

The Eleventh National Economic & Social Development plan 2012 – 2016 policy of Thailand has been designed to promote competition in both the domestic and overseas markets by setting logistics cost reduction target 1% per year. The main source of logistics and supply chain potential development is leaders. Therefore, this research aims to propose the conceptual framework of visionary leadership of supply chain management in the manufacturing industrial of Thailand in order to develop the logistics and supply chain human potential. The benefit of this model is used for planning and designing strategies for supply chain leadership potential development in the context of management in Thailand. As such, this paper draws upon the literature to illustrate aspects of the proposed model. Moreover, visionary leadership behavior, expression level, and factors affecting the visionary leadership for supply chain management are explained. Then the proposed model is confirmed via interview 5 key experts of supply chain management in the production industry in Thailand.

Keywords: Leadership, Visionary leadership, Transformation leadership.

1. Introduction

Globalization has forced every country to change their thoughts to more creative and to develop their major strategies in order to strengthen national economy so that it can sustain and grow continuously. This can be done by determining clear strategic visions at the global stage. They also have to change their strategies and working styles from what they are used to doing in their countries to what other people are doing globally. By doing this, they will be able to step from only exporting to other countries but also exporting globally. Wongkiatkhajorn (2010). This idea is in accordance with the ideas of Kangpen (2011) who mentioned about the success of the management in the workplaces, no matter how big they are, they can have a success only if they have the factors leading to a successes it is not far. The most important factor is "the leader."

Leadership originated in the periods of 1970 - 1979. Many scholars like Jacobs (1970), Stogdill (1974), and Boles and Davenport (1975), defined the word "leadership" as an interaction between people: one gives messages to the other to confirm that if he believes and follows the messages, he will succeed in his goal. Later, during the years 1980 - 1989, scholars gave a more complex meaning of the word "leadership" which was the process of an interaction and an influence towards other people's behaviors. The American Association of School Administrators (1986) defined the word "leadership" as it covers the ability of the leader who changes visions into facts including the ability to make other people believe in and have a steady faith with those visions. Or it is said that the leader of changes must be able to transfer his visions to other people to motivate them in working which will make the visions into facts. Besides these, Podsakoff et al (1990 cited in Bass and Riggio 2006) gave a summary of the main behaviors of leadership as follows: 1) Identifying and articulating a vision which refers to the leader's behaviors aiming at identifying the new opportunities of the organization together with articulating a vision and inspiring those who follow to relate to their future visions. 2)

Providing an appropriate model which refers to the leader's behaviors providing a good model as an example for other people to follow in accordance with the vision and principles of the leader. 3) Fostering the acceptance of the group goal which refers to the leader's behaviors having goals to enhance cooperation among members to work together until accomplishing the goal. Steer and Porter (1991) and White and Bednar (1999) gave an explanation of the word "leadership" as the clearness of vision that it is a type of a leader who is able to give precise words about good visions to predict the future.

2. Literature Review

From literature review on visionary leadership, it can be concluded that there are 5 factors influencing visionary leadership: communication, creativity, emotional intelligence, organization climate, and traits. A summary of each factor brought about determining the factors and structure of cause - effect relationships to create a hypothesized model of the factors that have an influence on visionary leadership. The researchers refer the word to the principles of cause - effect relationships, sequences of factors, direct or indirect results of theoretical ideas and related researches as follows:

Visionary leadership refers to the behavior of administrators that show their abilities in formulating their visions by data collection, analyzing both an internal and external condition of the organization, the ability to determine directions and goals to create the future through the visions of manufacturing industry. The leaders are capable of considering the problems occurring in the organization as a challenge. They also encourage the workers to have creativity and to think out of the framework. Articulating of visions by motivating colleagues to get together and cooperate the same dream of the organization is another task. The leaders are able to clearly communicate their visions. There is implementing by enhancing people to take part and implement the visions. Encouraging teamwork to make people show their absolute potential is another thing to share and empower their people. The following explanation will help the scholars and academics to understand visionary leadership more precisely:

1) Synthesizing the factors of visionary leadership. According to the literature survey (Zanning and Robertson,2002; Bennis and Nanus,1985; Williams, 2005; Kantabutra and Every,2004; Zaccaro and Banks,2004; Russell,2001, Armandi, Oppedlsano and Sherman,2003; and Pannitamai,2001), it is revealed that visionary leadership is comprised of 3 factors: 1) formulating means to create the image you want for future by collecting information, analysis data for both within and outside the organization, 2) articulating means the ability to make stakeholders understand the vision and the willingness to accept and follow,3) implementing means the ability to bring vision performs the actual by links and transforms vision into policy, goals and target of the organization.

2) Factors influencing on visionary leadership: The researchers has studied these factors from various scholars' ideas to determine related factors as a cause -effect relationship which helps us to see the relationships between groups of factors influencing on visionary leadership. This has led to the determination of a clear and logical framework. From synthesizing the factors influencing on visionary leadership, in this study, we used the principles considered from the frequency of factors which most researchers have chosen the factors influencing on visionary leadership. There are 5 factors: communication, emotional intelligence, organization climate, creativity, and traits, which are in accordance with the ideas of Howell and Frost (1989), Manasse (1986), Nanus (1992), Manning and Robertson (2002), Kantabutra and Avery (2004), Groves (2005), Thomas (2005), Jing and Avery (2008), and Andrew (2010).

From 5 factors influencing on visionary leadership, the researchers have studied various scholars' ideas to find out a linear structural relationship of the factors and to formulate a hypothesized model of the factors influencing on visionary leadership. In this study, communication, creativity, organization climate, emotional intelligence, and traits were found influencing on visionary leadership, whereas emotional intelligence and organization climate were found influencing communication and creativity. According to the ideas of Andrew (2010), Kantabutra and Every (2004), Rogers (1959), Smith and Hildreth (1971), Osborn (1973), Litwin and Stringer (1968), Steer and Porter (1979), Holbrook and Lee (1997), William (1994), Hay and McBer (2000), Thomas (2005), Choochom, Sukharom, and Surewallee (1999), Hormbuppha (2005), Pannitamai (1999), Wanasri (2007), Sarattana, and Panpreuk (2002), Palasak (2005), and Tanyatorn (2010), each factor has an influence on visionary leadership as follows:

Communication is the behavior of an administrator of a supply chain in a manufacturing industry in Thailand which indicates the process of communication receiving and sending messages between the administrator of a supply chain in a production industry and other relevant people to bring good understanding and working cooperation. This is a vital basic skill since the administrator must be able to use communication to empower himself in working for the organization. There are 3 factors which have frequency of those most researchers have chosen for advanced communication to determine conceptual framework: 1) communication skill, the ability of skill to send and receive information to others achieves the objectives by the skills of speaking, listening, writing and using gestures, 2) communication channel, the different ways that executives can use to achieve the purpose of communication, including speaking, writing or expression with action, 3) communication form, the nature of the communications related to the executive to achieve understanding and better coordination which are in accordance with the ideas of Schramm and Osgood (1954), Lunenberg & Omstein (1991), Charoenngam & Jablin (1999), Jarajit (2007), Wannasri (2007), and Pichitpornchai (2007).

Creativity is the behavior of an administrator of a supply chain in a manufacturing industry in Thailand, which indicates an original creativity to solve the problems by using an integrated knowledge and previous experiences which are made up of creativity, fluency, flexibility, and elaboration of creativity. There are 4 factors which have frequency of those most researchers have chosen for advanced communication to determine conceptual framework: 1) originality, the ability to think of something new by knowledge experience accumulated extensive applied usage thinking something new, That can be used to solve the problem properly, 2) fluency, the ability of create ideas that are a lot of options. There are the differences of fast and versatile, 3) flexibility, thinking for answers in several categories and multi-directional to think outside the scope, do not fall under the rules. It is independent in thinking leads to creative thinking, 4) elaboration of creativity, The expression to see the details of what are other peoples do not see. It also includes links to related things significantly which are in accordance with the ideas of Torrance (1962), Guilford (1967), Guilford and Hopefner (1971), Jellen and Urban (1986), Isarapreeda (1989), Hormbuppha (2005), and Waasri (2007).

Organization climate is the behavior of an administrator of a supply chain in a manufacturing industry in Thailand which indicates the acceptance of the administrator to the working environment of the organization where he is working for, including the administrative system of the organization influencing the attitudes and working

behaviors of the workers working in the organization with individual features. This will motivate and reflect the efficiency and effectiveness of the work in the organization. There are 4 factors which have frequency of those most researchers have chosen for advanced communication to determine conceptual framework: 1) structure, the formal system of task reporting relationships that controls, coordinates, and motivates employees so that they cooperate to achieve the organization's goals. 2) rewards system, the system determining compensation reward to employees who work by achieving organizational goals. On the contrary, it imposes the punishment to employees who do not follow the rules of the company. 3) warmth and support, the practice encouraging the employees in the organization to do the right thing as an overall benefit to the organization and themselves. 4) risk and risk taking of work, the managing about the event or any actions which might be faced to uncertainty situation including the responsibilities of the organization for those events which are in accordance with the ideas of Halpin and Croft (1966), Litwin and Stringer (1968), Alipour (2011), Dubrin (1984), Boongrut (2001), and Kangpeng (2008).

Emotional intelligence is the behavior of an administrator of a supply chain in a manufacturing industry in Thailand which indicates emotional self-awareness, emotional self-control, and self-motivation, including internal motivation, being able to respond to his own needs showing logical thinking optimistically, being able to interact and live with other people creatively and happily. There are 4 factors which have frequency of those most researchers have chosen for advanced communication to determine conceptual framework which are in accordance with the ideas of Salovey & Mayer (1997), Goleman (1995), Bar-On (1997), Skulhoo (2000), Kobkultanchai (2003), and Santipreut (2003). These are: 1) emotional self-awareness, the reorganization and understanding their feelings and thoughts, emotions and their needs why they cause different moods. 2) emotional self-control, the ability to deal with his inappropriate emotions and the ability to accept them with flexible changes. 3) self-motivation, the ability of self-improvement to build his own morale at each condition, also to improve the point of view for creating ideas and constructive actions. 4) interpersonal relationship management, the management building relationships with the attention and sharing feelings with each other and having relationships with others.

Traits are the behaviors of searching for features which separate leadership from followers of an administrator of a supply chain in a manufacturing industry in Thailand. The leader must have a clear different feature from that of the followers. He must have some drive to accomplish the tasks. He must need to lead other people and show his desire to other people, and also have responsibilities, honesty and integrity. The leader must create respectfulness and trust between himself and his followers with honesty, doing what he has promised with self-confidence and leading the followers towards the objectives and making the right decision intelligently. The leader must be informed of sufficient information, so he must be able to formulate the visions, solve the problems, and make the right decisions. There are 3 factors which have frequency of those most researchers have chosen for advanced communication to determine conceptual framework (Fleenor, 2006; Shelly and Edwin, 1991; Dov Dvir et al and Aron, 2009), Yukl, 1989 and Andrew, 2010). These include 1) self-confidence, the person to do something to finish it as he had intended, despite the setbacks without this discouragement. They still do that with even the confidence that they can do it to complete with accuracy. 2) ambition, an earnest or eager desire for some type of

achievement or distinction, such as power, honor, fame, or wealth, and the willingness to strive for its attainment.

3) motivation, a condition or behavior of the person being urged to act at the direction and continuity.

3. Research Methodology

This study is a quantitative exploratory in nature. In order to investigate the visionary leadership for supply chain management in the manufacturing industry in Thailand, this research has brought out various factors that affect the visionary leadership from the literature review. Furthermore, those factors and their causal relationships are confirmed via interview 5 key experts in the supply chain management directors. Which type of variables i.e. endogenous, manifest and exogenous variables are also investigated. After that a hypothesis and framework model from the synthesizing of factors influencing visionary leadership are constructed. According to the goal of this research, the questionnaire will be then carefully designed and distributed to the supply chain administrators in the manufacturing industry in Thailand. Then the research framework model will be statistically tested by using AMOS program based on path and factor analysis concept. The step of research methodology is shown in the Figure 1.

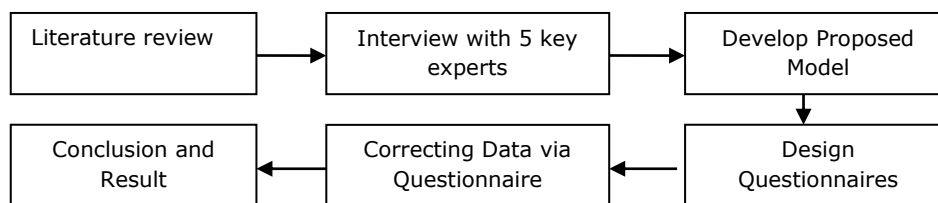


Figure 1. Step of Research Methodology

4. Purposed Research Model

From the literature and interviews with 5 key experts in the supply chain management director, the factors influencing on visionary leadership, the relationship of linear structure of the factors, and the components of of equation structure of visionary leadership as follows: each factor following theoretical framework and related research results, the researcher formulated a hypothesized model

1) Exogenous variables which are causative factors for result factors. There is only one variable: traits.

2) Manifest exogenous variables which refer to sub-variables of exogenous variables. There are 3 of them: self-confidence, ambition, and motivation.

3) Endogenous variables which are the results of causative variables. There are 5 of them: visionary leadership, communication, creativity, organization climate, and emotional intelligence.

4) Manifest endogenous variables which refer to sub-variables of endogenous variables. There are 18 of them: 1) visionary leadership which is made up of formulating, articulating and implementing of visions he organization. 2) communication within the organization which is made up of communication skill, communication channel and communication form. 3) creativity which made up of originality, fluency, flexibility and elaboration. 4) organization climate which is made up of structure, warmth and support, rewards system punishment, rise and risk taking of the work, and 5) emotional intelligence which is made up of emotional self-awareness, self motivation, emotional self-control and interpersonal relationship management. As such, a proposed framework

of structural equation model of visionary leadership of an administrator of a supply chain in a production industry in Thailand is demonstrated in Figure 2.

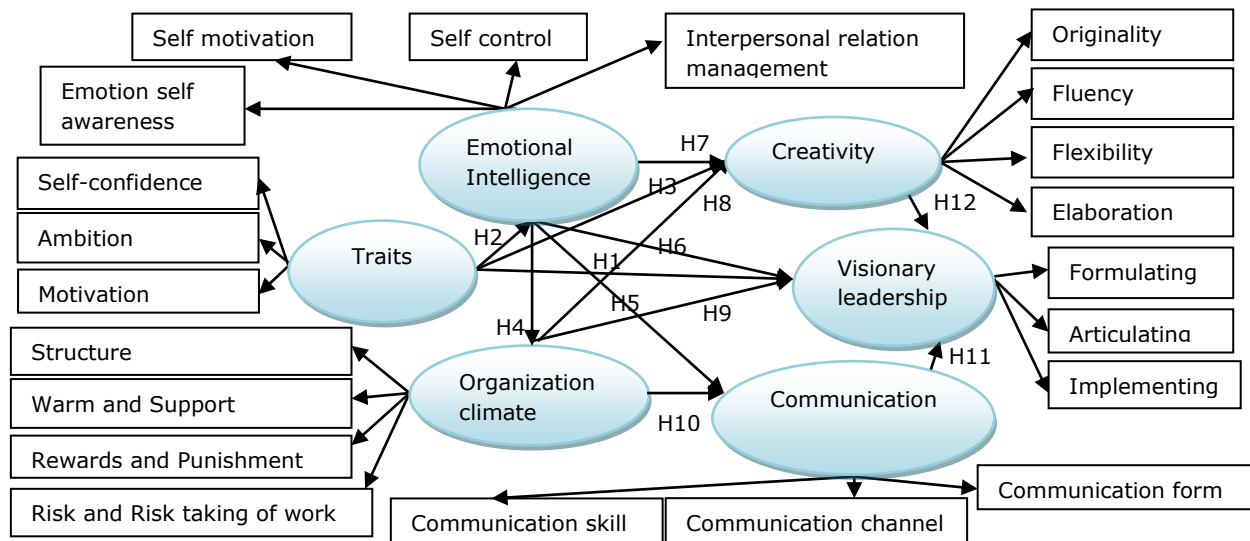


Figure 2. A conceptual framework

5. Population and Sample size

The research methodology was based on a survey of the supply chain administrators in the manufacturing industries. The industrials are located in various locations in Thailand, whit 2,681 factories. A survey questionnaire was designed with five main factors affecting the visionary leadership. Cronbach's alpha method was also used to assess the reliability of data supplied by the questionnaire. The respondents of the questionnaire are the managers or administrators of supply chain management in each firm. This research will be employed Structural Equation Model (SEM) to test hypothesizes. It needs to define sample in accordance with the statistical principles. In order to use structural equation model to analyze data, it requires a large number of sample size. The sample size is about 20 people per 1 variable, Sinjaru (2011) Therefore, a sample of 560 manufacturing industries will be selected for this study via using multi stage random sampling.

6. Hypothesizes

A review of the recent literature and interview with key person, as above, indicates positive linkages between visionary leadership of supply chain management and endogenous variables and leads us to propose the following hypothesizes:

H₁: The traits of leader are directly affected to the visionary leadership.

H₂: The traits of leader are directly affected to the emotional intelligence and indirectly affected to the visionary leadership.

H₃: The traits of leader are directly affected to the creativity and indirectly affected to the visionary leadership.

H₄: The emotional intelligence is directly affected to the organization climate and indirectly affected to the visionary leadership.

H₅: The emotional intelligence is directly affected to the communication and indirectly affected to the visionary leadership.

H₆: The emotional intelligence is directly affected to the visionary leadership.

H₇: The emotional intelligence is directly affected to the creativity and indirectly affected to the visionary leadership.

H₈: The organization climate is directly affected to the creativity and indirectly affected to the visionary leadership.

H₉: The organization climate is directly affected to the visionary leadership.

H₁₀: The organization climate is directly affected to the communication and indirectly affected to the visionary leadership.

- H₁₁: The communication is directly affected to the visionary leadership.
H₁₂: The creativity is directly affected to the visionary leadership.

The framework model will be tested using AMOS program based on path and factor analysis concept.

7. Future Research Directions

In future work, the determined hypotheses will be tested. The questionnaire will be distributed to 560 administrators of management of supply chains in 2,681 manufacturing industries throughout Thailand totally. The Structural Equation Model or SEM will be then employed via using AMOS Program to investigate associations among factors affecting the visionary leadership for supply chain management. As a result, the proposed model will be extracted.

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RESOURCES, DYNAMIC CAPABILITY, AND FIRM PERFORMANCE: EVIDENCE FROM LOGISTICS SERVICE PROVIDERS IN VIETNAM

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Abstract

Purpose of this paper:

One of the most significant changes in the paradigm of business management is the fact that individual businesses no longer compete as single entities, but rather as supply chains. Logistics performance has been elevated to a strategy level to create competitive advantage for large enterprises.

Researches on organisations' specific resources and dynamic capabilities has received much attention in logistics industries in the past decade, but studies on Vietnam' logistics service providers (LSPs) have rarely focused on these aspects. Vietnam has experienced rapid economic growth and widespread poverty reduction over the past 20 years. This impressive economic performance placed Vietnam among the world's five fastest-growing economies between 1990 and 2010.

Logistics remains a very new sector in Vietnam and logistics companies themselves are still lack of professional management knowledge. For example, according to statistics, Vietnam's total logistics cost currently accounts for 25 percent of GDP, while the rate in China is around 18 percent, and the rate in developed countries like the United States is only about 8 percent. If Vietnamese LSPs can improve their resource allocations to enhance dynamic capability and reduce this rate even by just 1-2 percent, it will greatly strengthen their competitive advantage.

The primary objective of this study is to examine the relationship between the resource, dynamic capability approach and firm performance for the logistics service providers in Vietnam. The other research objectives includes (1) an investigation on the relationship between resource attributes, dynamic capabilities, and financial performance. (2) A review on the crucial resources and dynamic capabilities of the Vietnamese LSPs.

Design/methodology/approach:

This study, based on a survey of LSPs in Vietnam, uses structural equation modeling to examine the relationships among resources, dynamic capability, and firm performance. The design of our postal questionnaire was firstly based on a comprehensive literature review and then pilot tested by interviewing both academic and practical experts.

Findings:

One of the research results demonstrates that top managers must enforce and improve the resource and dynamic capability to acquire and maintain these Vietnamese LSPs' competitive advantage.

Value:

Logistics service providers are mostly protected by Vietnamese law. But Vietnam government has committed to gradually open up its logistics services market to international competition by 2014. Thus it is the best timing to explore the development of Vietnamese logistics industry and the relationship between its LSPs' resources, dynamic capabilities, and performances. Hopefully the local LSPs can use the findings from this research to well prepare themselves to meet the future strong competition from abroad.

Keywords

Resource, dynamic capability, performance, logistics, logistics service providers

1. Introduction

Logistics is a critical part of supply chain management and it is an important element in business operation. Historically, logistics service providers (LSPs) provided traditional logistics

service, such as transportation and warehouse management. But nowadays, their business scopes and roles are increased to include the strategic coordination of their customers' supply chain activities.

Compared to the time before joining WTO in 2007, Vietnamese forwarding and logistics sector has made a significant progress in terms of their businesses revenues and the number of logistics professionals engage in this industry (Vietnam Logistics Information Gate, 2013). Vietnamese logistics performance index is ranked 53 out of 155 economics and 48 out of the 160 economics in the World Bank Logistics Performance Index (LPI) Report in 2012 and 2014. Vietnam's LPI is ranked the 4th and the 1st among all lower middle-income economics in 2012 and 2014 (World Bank, 2012, 2014). However most of local LSPs in Vietnam are still considered small, non-professional, and inexperienced. Vietnamese LSPs mostly supply shippers' basic and low value-added logistics services (Union logistics, 2013).

The objective of this study is to explore the relationship between resource, dynamic capability and performance for LSPs in Vietnam and to understand constructs and variables that have impacts on LSPs' performances by applying resource-based view and dynamic capability theory. Resource-based view lies on concentrating on resources as the basis of competitive advantages (Barney, 1991; Grant, 1991) and dynamic capability highlights the firm's processes that use resource such as to integrate, reconfigure, gain and release resource to gain market change (Teece et al., 1997; Eisenhardt and Martin, 2000)

According to the resource-based view (RBV) theory, a firm can be viewed as a bundle of resources that are heterogeneously distributed across the firm, give it a competitive advantage (Barney, 1991; Eisenhardt and Martin, 2000). Under RBV, logistics management and supply chain management have become important sources of sustainable competitive advantage (Ellinger et al., 2000). Resources are at the heart of RBV theory. Resources are heterogeneously distributed across competing firms and are imperfectly mobile (Barley, 1991). The resource can be viewed as a bundle of tangible and intangible assets, including a firm's management skills, its organizational processes and routines, and the information and knowledge it controls (Barley, 2001; Collis, 1991).

Dynamic capabilities theory is an extension of the RBV theory. Dynamic capability is defined by Teece et al. (1997) as "*the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environment*". If there is a changing environment, just accumulating resources without dynamic capabilities is insufficient for maintaining competitive advantage (Chien et al., 2012; Cavusgil et al., 2007). The dynamic capabilities play an important role in theoretical framework for understanding how a firm's resources transfer to generate the sustainable competitive advantages (Nieves et al., 2014). To build long-term competitive advantage, firms should use dynamic capabilities sooner, more cleverly, more frequently than their competitors. Summarizing the types of dynamic capabilities defined by extant researches, dynamic capability can be divided into the following three types: (1) sensing and seizing capability, (2) integration capability and (3) learning capability (Ambrosini and Bowman, 2009; Augier and Teece, 2009; Danneels, 2010; Eisenhardt & Martin, 2000). Sensing and seizing capability is the capability to scan, search, explore, and pursue opportunities and to evaluate and position oneself favorably in a changing environment; Integration capability is the capability relates with the ability to combine and operate resources; Learning capability is the ability that allows the firm to adopt, acquire and create new capabilities (Pavlou & El Sawy, 2011; Makkonen et al., 2014; Nieves & Haller, 2014).

Performance refers to the nature and quality of an action that an organization carries out to accomplish its principal missions and functions to generate profit (Sink et al., 1991). The performance is a process of quantifying the efficiency and effectiveness of actions (Neely et al 1996). Generally, performance can be measured in 2 classifications: financial performance and non-financial performance (Asthana et al., 2013; Venkatraman and Ramanujam; 1986). Non-financial performance measures tend to focus directly on actual production activities (investment turnover, defect ratio, lead time) whereas financial performance measures tend to focus on the resultant impact in financial symbols of production activities (logistics activities) (Asthana et al., 2013).

Previous researches have examined and suggested that there is a positive association between resources, dynamic capabilities and performance (Wu, 2006; Chien, 2012; Kim et al., 2011). The RBV hypothesizes that the exploration of value, rare resources and capabilities are the sources of differential firm performance and are crucial in determining the start-up success of a firm (Newbert, 2008; Wu, 2007). According to the concept of RBV, firms can generate and sustain competitive advantages in terms of achieving better performance by appropriately deploying

valuable resources (Barney, 1986; Barney 1991; Grant, 1991).

The relationship between resource and dynamic capability are also confirmed in the other industries. Some researches support that the resources have positive effect on dynamic capabilities. The more valuable resources a firm has accumulated, the greater dynamic capabilities it can develop (Wu, 2007; Liao et al., 2009; Griffith et al., 2006) .

The relationship between dynamic capability and performance is discussed by Robert and Grover (2011), Morgan et al.(2009), Griffith et al.(2006), Chien(2012), and Zott (2003). They all assert that dynamic capability positively influences a firm's performance both in direct and indirect channels. Their relationship is more complex than a simple and direct effect.

Thus research hypotheses are proposed as follows:

H1: There is a positive association between resource and performance for Vietnam's logistics service providers.

H2: There is a positive association between resource and dynamic capability for Vietnam's logistics service providers.

H3: There is a positive association between dynamic capability and performance for Vietnam's logistics service providers.

2. Methodology

Self-administered questionnaires were distributed to logistics service providers based in Vietnam, including shipping companies, shipping agencies, freight forwarders...etc. Questionnaires were translated from English into Vietnamese and vice versa. To ensure that the questionnaire is suitable with appropriate knowledge, the questionnaire included a series of questions designed in details and is easily understandable. All variables were measured by 5-point Likert scale (1= strongly disagree; 5=strongly agree). Surveyees were asked to indicate their degree of agreement with the 27 variables of three constructs in the questionnaire. Two hundred copies of questionnaires were distributed directly to the potential surveyees as well as by sending email. The respondent list draws from the list members of Vietnam ship-owners association; Vietnam Freight Forwarder Association; and Vietnam ship agents and brokers association (Vietnam maritime administration; 2011). Their feedbacks are returned to the author when whole questionnaire is completed. One hundred and thirty copies of responses were received (the valid response rate is 65%). No missing data were found in these feedbacks, and all feedback data are usable.

The variables employed to measure abovementioned three constructs were summarized from previous literatures. Variables in the resource construct are derived from an article by Lin and Wu (2013). Variables in the dynamic capability construct were summarized from articles published by Nieves and Haller (2014), Pavlou and El Sawy (2006), Nicholas Roberts et al. (2012), Makkonen (2014), Yang (2009), Lumpkin (2011), Zhao et al. (2001), Rodrigues et al. (2004), Wang et al. (2004), Calatone et al (2002), and Jerez-Gomez et al. (2005). Variables in the performance constructs are concluded from Robert et al (2012) and Jiao et al. (2013).

Structural equation modeling (SEM) technique is a powerful and effective tool to measure and calculate the relationship between constructs of interests (Hair et al., 2006).

3. Empirical analysis and results

11.5% of sampled firms had over 1,000 employees, whereas 64.6% of sampled had less than 200 employees; most sampled firms have each employed 21-50 (24.6%) full time workers. In terms of annual sales, 23.1% of firms were below 1 million USD; 56.9% of firms were between 1-20 million USD; and 9.2% of firms were over 100 million USD. Concerning the age of the firm, nearly half (49.1%) of responded firms have had operation time of more than 12 years and 32.3% of them had been operating for more than 20 years. The majority of respondents are from the carriers (i.e. 42.3%). Carriers include both ocean carriers at sea and container truck companies onshore; the second largest number of responses are from ship agencies(i.e. 29.2%); and very few feedbacks are from 'Others'. Feedback from "others" was mostly warehousing operators. Most respondents were local companies (55.4%) and 25.3% of respondents were managers or directors; most of respondents (up to 69.2%) are from business department (i.e. sale representative). Authors found most of the surveyees are senior staffs, thus we can ensure they have necessary knowledge to answer the questionnaire

Dynamic capabilities are composed of 3 constructs: sensing and seizing capability, integration capability and learning capability. So, firstly, confirmatory factor analysis (CFA) is used to assess the validity and reliability of 5 constructs: resource, performance, sensing and seizing capability, integration capability, and learning capability. After CFA, 4 unsatisfied variable were cut off, and

then (1) no pair of standardized residual values, which represent the differences between the observed correlation or covariance and the estimated correlation or covariance matrix (Hair et al., 2006), was greater than ± 2.58 ; (2) no specifically large modification indices (MI); (3) the criteria of fit indexes are satisfied (CFI= 0.926 > 0.9; TLI= 0.915 > 0.9, RMSEA= 0.073 < 0.08). Moreover, all t-values of variables were significant (t-values > ± 1.96) and all factor loadings ($\lambda > 0.5$) were within the acceptable region.

In addition, the scale reliability is satisfied because all reliability composite values are greater than 0.7; all variance extracted values are greater than 0.5; all Cronbach's alpha values are larger than 0.8. Discriminant validity is tested by comparing the variance extracted for any constructs with the square of correlation between these two constructs. The result is satisfied, that demonstrate evidence of discriminant validity for constructs.

Because the correlation coefficient of 3 constructs of dynamic capability shown in are high (0.66; 0.78; 0.79); the second-order model of dynamic capability will be adopted in this analytical model. The second-order model of dynamic capability construct was identified ($\chi^2_{(101)} = 175.5$, $p = 0.000$) and 3 criteria of fit indexes CFI, TLI and RMSEA were significant (CFI= 0.946, TLI=0.936, RMSEA= 0.076). Next, this second-order factor model of dynamic capability which had satisfied unidimensionality and convergent validity was analyzed with resource and performance constructs.

Relationships between resource, dynamic capability and performance constructs were examined by SEM which illustrates the hypotheses that resource affects dynamic capability and performance, and dynamic capability affects performance. The minimum requirements for full model identification were satisfied. The fit indexes (CFI, TLI, RMSEA) were satisfied (CFI=0.923; TLI=0.913; RMSEA= 0.074). It is enough to imply that this estimated model was a good-fit model.

All hypothesis (H₁, H₂, H₃) were supported, indicating that significant positive relationships between resource, dynamic capability and performance. H₁ have $\lambda = 0.327$, $t = 3.924$, $p < 0.001$; H₂ have $\lambda = 0.3$, $t = 2.889$, $p = 0.004 < 0.05$; H₃ have $\lambda = 0.555$, $t = 6.180$, $p < 0.001$ (as shown in Figure 1).

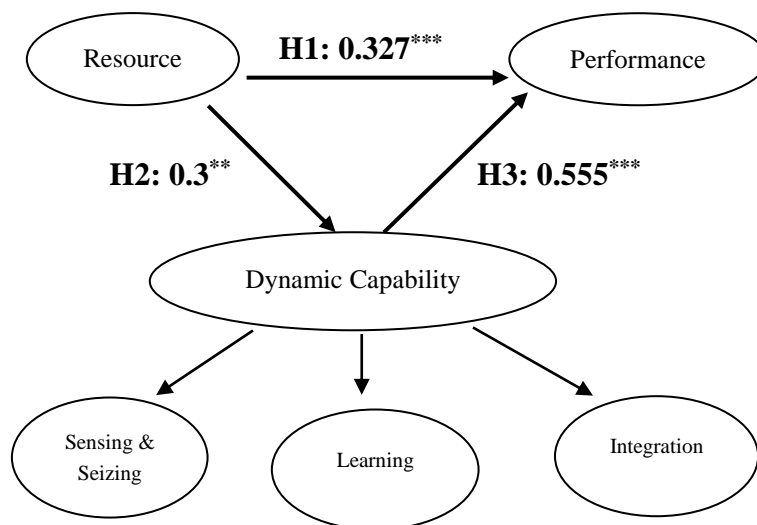


Figure 1 Hypothesized full SEM model of resource, dynamic capability and performance

4. Discussion and conclusion

According to the resource-based view (RBV) and dynamic capability view of firms, resource and dynamic capability play a key role in differential firm performance in determining start-up success (Newbert, 2008; Wu, 2007). The result of this research makes the following theoretical and practical contributions

Firstly, firms' resources have positive impacts on firms' performance. In this study, Vietnamese logistics service providers have achieved good financial performance by deploying valuable resources. Know-how, reputation, cooperative alliance experience, and capital are all valuable resources. Therefore, managers mind to accumulate the knowledge and capital, create the fame and alliance relationship as integral condition for good performance.

Secondly, the resources also have a positive effect on dynamic capability. The firms have better resource; it can make better use of its resource. The dynamic capability is the "capability" to "use resources" by integrating, building and reconfiguring both external and internal resources

(Teece et al., 1997)

Thirdly, dynamic capability is one of the critical drivers of performance and is an important mediator of the impact of resource on performance. As known, Vietnam is a developing country, so the market in Vietnam is always changing. Vietnam has joined WTO in 2007 and has launched lots of economic reforms. From the date of 11/01/2014, Vietnam logistics industry is opened by following WTO's requirements, i.e. foreign investors can establish a joint venture with Vietnamese partners without restriction on the foreign capital in that joint venture (Vietnam logistic information gate, 2014; Stoxplus, 2013). The market competition will increase; it gives Vietnam logistics area both challenge and opportunities. It is important for Vietnamese LSPs to understand the role of dynamic capability construct (sensing and seizing; integration; learning capability) to deal with the rapidly changing environment. Doing business in a changing business environment in Vietnam, logistics providers need to scan and explore opportunities; combine and operate flexibly resources, and adopt and create new capabilities in order to keep pace with the change of business environment.

In conclusion, top managers of the LSPs that want to achieve good performance should develop not only their resources but also their dynamic capability. Managers should have an active plan to accumulate these factors to generate an abundance of resources. Once managers have strategy to develop dynamic capability, they can improve their performances and effectively use the resources they accumulated.

Three study limitations should be highlighted. Firstly, for the current research, only 130 responses received which constitutes a small percentage of the Vietnamese LSPs. Future researches should add more samples in terms of geographical coverage and conducted a chronological study. Secondly, participants are requested to respond within a very short term time frame and a thoughtful response is simply not possible. Therefore, these research findings can be changed over long term time frame, especially in rapidly changing environment such as in Vietnam. Future research should try to ensure the quality of respondents as well as their responses. Finally, different firms have different strategic goals such as to improve market share, to increase revenue, and to improve profit. There are some firms paying attention on increasing their long-term market share by sacrificing their short-term profit. So the factors and measurement variables in the performance construct should include diversified variables and factors to generate a generalized research results.

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SUPPLY CHAIN COMPETENCIES: THE CONTRIBUTION OF WORK-BASED LEARNING IN EXECUTIVE EDUCATION PROGRAMMES

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ABSTRACT

This paper explores the role of work-based learning pedagogy in SCM executive education programmes. Raelin's (1997) individual level model of work-based learning is applied to an open access post-experience programme that includes a workplace learning component. Raelin's model provides a useful lens with which to evaluate the role of workplace learning in postgraduate programmes. These findings point to the synergistic value of both classroom ('codified/theoretical' knowledge) and workplace (knowledge discovered through action) environments. To paraphrase Revans (1982), 'action learning adds to traditional learning'.

INTRODUCTION

In recent years work-based learning has received increasing attention in executive education programmes (Raelin, 2011; 2009; Johnson and Spicer 2006; Anderson and Thorpe 2004). This pedagogy promotes a more iterative approach between work-based and classroom based learning. Recent investigations of professional development in the supply chain management (SCM) field support the classification of skills as general rules that can be taught in a classroom (i.e. context-independent knowledge) and competencies as context specific (i.e. drawing on knowledge to support decisions appropriate to the context) (Gammelgaard and Larson, 2001; Mangan and Christopher, 2005). This classification prompts educators of post-experience SCM students to use the workplace context as a learning environment. Therefore, the purpose of this paper is to explore the role of 'workplace learning environment' pedagogy in SCM executive education programmes. The paper first provides a review of such pedagogies and explores their applicability in the context of a part-time postgraduate level programme in lean supply chain management.

LITERATURE REVIEW

Vygotsky's (1962) seminal work into the social character of learning has done much to inform our understanding of 'situated learning'. Scholars in this field have questioned the extent to which knowledge can be separated from context (Brown *et al.*, 1989). This is of particular interest in post-experience management practice education as learning patterns of older students are different from their younger counterparts, in that learning by rote is more difficult for the former. Furthermore their return to education while in the workplace presents an opportunity to leverage not only experience to date but also their current working environment as a live learning laboratory (Mintzberg, H., 2004; Tushman, *et al.*, 2007). Such a learning laboratory is of particular interest to programmes that are designed to increase participant competency as well as widen/deepen their body of knowledge. Competencies are experience-based and context-dependent knowledge that is gained through organizational experience (Dreyfus and Dreyfus, 1986). For example, recent studies in the supply chain management field have identified problem-solving, decision-making and project management competencies as important competencies (Myers *et al.*, 2004; Mangan and Christopher, 2005). Thus increasing attention has been devoted to 'communities of practice' and 'situated learning' over the last two decades (Schwen and Hara 2003). Indeed the subsequent success of executive education programmes is increasingly assessed by measureable change achieved by graduates in the workplace compared to the simple post-session evaluations that we were

accustomed to in previous decades. Hence it is likely that the iterative learning process as identified above will become increasingly evident in programme pedagogy.

Raelin (1997) puts forward a comprehensive model of workplace learning. He considers two levels, the individual and the collective. At the individual level he presented an interactive process that includes: conceptualisation (“theory that allows practitioners to explicitly reflect upon and actively experiment with their practice interventions”, p.565), experimentation (theories-in-use), experience (that reinforces the tacit knowledge acquired during experimentation) and reflection (on content, process and premise). This process draws on a two dimensional framework as illustrated in figure 1 and as such emphasises the role and interplay between both theory and practice. Similarly his conceptualisation at the collective level considers the more theoretically-based applied science (where knowledge is explicit) and action learning (where knowledge is tacit) and practice-based action science and communities of practice.

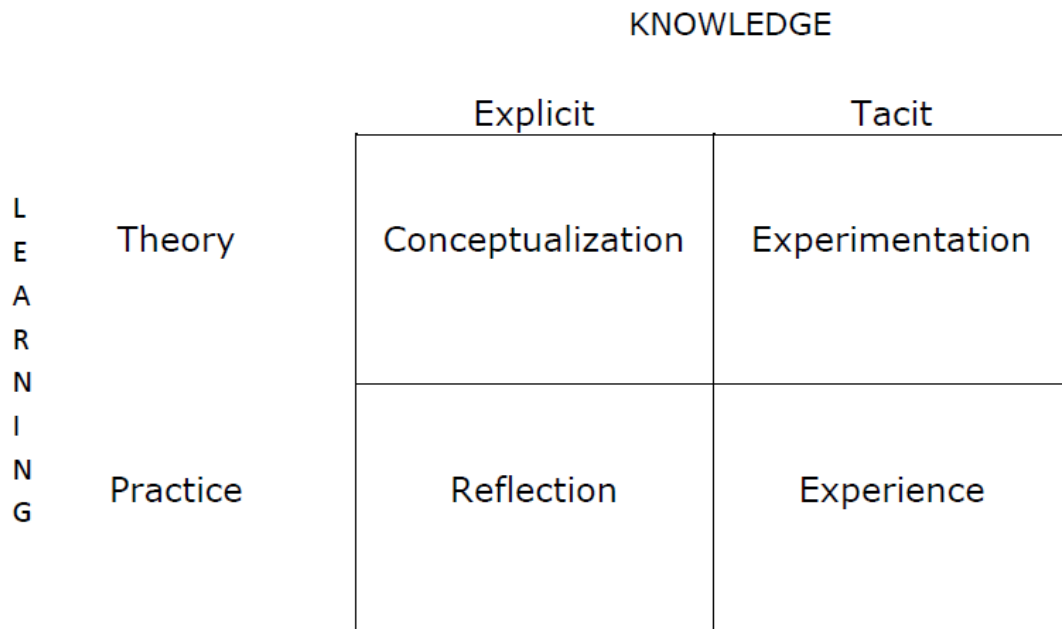


Figure 1: A Model of Work-Based Learning at the Individual Level (Raelin, 1997: 565)

Applied science links with ‘conceptualisation’ at the individual level. Raelin characterises this as positivist rules based science, thus from the action learner perspective it is theory going into the field. Such theory has been labelled ‘espoused theory’ (Argyris, and Schön, 1974) since at the individual level this is put into play as ‘theory-in-practice’ during experimentation.

Raelin considers experimentation/action learning constructs along the theory dimension. He emphasises the difference between classroom simulations (e.g. cases studies, games, etc.) and real problems as the focus of study. While he recognises the role of the former he stresses that ‘action research’ requires the experience of dealing with real problems in order for students to “convert theory into tacit knowledge” (p. 569).

In comparison action science challenges accepted theory and existing mental models, as such it prompts double loop learning, that is solving a problem by questioning the variables that govern the action rather than seeking to find the cause of the problem within an accepted set of governing variables, the latter is classified as single-loop learning (Argyris, and Schön, 1974). This starts with a practical problem and challenges the validity of existing assumptions, as such Schön (1983) labelled this term 'reflection-in-action', thus action science relates to 'reflection' at the individual' level.

Communities of Practice relate to 'experience' at the individual level. Given that work-based learning typically involves team activity most studies consider two key characteristics: (i) based on real work-based issues and (ii) involving a team (Cho and Egan, 2009). Revan's (1982) seminal work in the field of action learning focuses on the problem-centred 'learning set' that provides a forum to combine received knowledge with insightful questioning.

The scope of this study is confined to the individual experience of participants in a postgraduate level programme with a strong work-based learning element. Thus Raelin's individual level model of work-based learning provides a useful framework.

RESEARCH DESIGN

A case study design was adopted as this research aimed to explore, in some depth, the experience of the learner. The programme chosen was designed to explicitly incorporate workplace learning. This was an open access, part-time postgraduate programme that has been established for a number of years. Thus a number of client companies have repeatedly placed employees in the programme. This programme sought to address employer needs as well as those of the individual participants, as such it provided an opportunity to explore (albeit from the participant's perspective) the level of programme embeddedness in the client companies. The profile of participants indicated that each year in addition to repeat client business the programme attracted participants from new companies; this provided the opportunity to also explore the role of workplace learning in companies with a lower level of programme embeddedness. The impact of level of maturity in the relation to the programme subject matter (i.e. lean supply chain management) was also of interest.

Data collection consisted of two stages: (i) a web based survey of all participants of one class and (ii) depth interviews conducted with 6 of these participants. The web based survey was conducted two months after the completion of the programme. Fifteen of 20 participants completed the survey. The survey questionnaire addressed the four levels of the popular Fitzpatrick (1994) programme evaluation framework, i.e. satisfaction, learning, impact (on job) and business result. Given the interest in 'business results' the relevance of subject matter (for each module) was measured in terms of 'importance to employer'. This provided a basis for interpreting their score for overall effectiveness of the module 'for the business'. As part of the programme each participant completed a significant improvement project in the workplace, the benefits reported from this provided a second measure of impact on the business. Of course relevance and impact were also measured at 'individual participant' level. In addition the likelihood of recommending the programme to a colleague/friend was used as an overall measure of satisfaction.

Depth interviews were recorded with the permission of the interviewee and varied in length from 50 to 90 minutes. The interviews were conducted by an independent enumerator who was briefed on the interview objectives and

schedules. The first of the six interviews was conducted as a pilot. The researcher listened to the full recording of the first interview shortly after it was conducted and then debriefed the enumerator. As there were no significant changes to either the interview schedule or to the approach taken by the enumerator this respondent was included in the dataset. All interviews were transcribed for subsequent thematic analysis.

The finding from the web survey informed the selection of respondents for the depth interviews. The selection criteria used are outlined in table 1.

Selection Criteria:	Lean Maturity	Programme embeddedness	Industry	Function
R1	Very low	none	Services	Area manager
R2	Very low	Initial interest	Medical Device	Global supply chain
R3	high	high	Medical Device	Manufacturing
R4	medium	high	Pharmaceutical	Manufacturing
R5	low	medium	Food & Drinks	Customer Servile
R6	high	high	Food & Drinks	Sales

Table 1: Depth interview sampling frame

FINDINGS

While the impact of this programme on the participant's job and on business results was the main focus of this programme, it was important to establish the level of satisfaction and learning. The web survey indicated high overall levels of satisfaction and learning. The latter is supported by the marks achieved by participants across the various modules. All respondents reported that they would recommend the programme to colleagues and friends. Thus level of satisfaction did not present a distinguishing characteristic for selection of respondents for depth interview. It is interesting to find that about a half of the participants joined the programme very much on their own initiative with most of the remainder joining as a result of their own and their employer's initiative.

Given this it is not surprising to find that all participants indicated that lean supply chain management is important to their career. In addition the majority indicated that this area is also important to their employer. Furthermore the participants believed that overall the programme was effective from their employers' perspective. This is supported by the immediate benefit of improvement project (Lean Black Belt level) savings that averaged €1m/participant.

It is interesting to find that in some cases participants who joined the programme on their own initiative also considered it as important to their employer. These were participants who were either the first employee from their organisation to join the programme or were employees in organisations who had previously had participants on the programme but not from their function or division. Thus in addition to the selection criteria outlined in table 1, this also influenced section of respondents, R1 represented the former and R2 and R6 represented the latter.

Raelin's (1997) model of work-based learning at individual level provided an analytical framework to guide analysis of depth interview data. The key findings are presented below.

Conceptualisation

The degree of alignment of the client company with the programme (labelled 'embeddedness'), and of course also their lean maturity, impacted on the degree to which conceptualisation challenged participant's existing mental models. As expected participants who had little exposure to lean in the work environment climbed a rather steep learning curve while those who had been exposed to such lean concepts and principles were not challenged to the same extent.

"I would have struggled in the first module, lean tools and techniques. I think it was because I didn't have the same background as other guys on the programme. And the foundation module was excellent for me. ... At times during the black belt project I pulled out the foundation module, I looked to stuff in that for guidance for doing things" (R1)

All participants benefited from the leadership concepts introduced and also benefited from the various tools and techniques that were introduced. The former is not surprising given that the purpose of lean black belt level programmes is to support lean practitioners' transition into the role of lean champion within their organisation. Thus such programmes typically have a strong leadership module/component.

Experimentation

The level of programme embeddedness also influenced the extent to which participants experienced experimentation challenges, for example where the participant was a pioneer and joined the programme on their own initiative, it was necessary to translate theoretical concepts and advanced analytical techniques into ideas and terminology that made sense to his team: *"I couldn't go in and mention a Heijunka box at work. The only thing they would take out of that is the junk part!"* (R1) (A heijunka box is a visual scheduling tool used by lean practitioners). In comparison a participant from a company with a high level of programme embeddedness spoke of *"lads would have had a basic knowledge of lean"* (R3). Of interest in this case was the emphasis on 'structure' that the black belt project work brought to the workplace: *"But they weren't used to structure, I'd say that. They were used to the lean tools on a kind of an ad hoc basis"*. Thus it appears that the client company benefits from lean roll-out within the organisation. As an 'embedded' client this company had to-date over 20 participants on the programme and used it to engage various teams in live lean projects. Thus even for participants familiar with lean the experience of leading a project provided the opportunity to learn on-site and hence develop their competency in the field.

The use of teaching and learning tools and techniques supported experimentation in the workplace. These included not only typical project management tools (e.g. charter, contract, story boards, etc.) but also various assignments associated with supporting modules, for example: evaluation of supply chain processes, use of metrics, mapping the organisation's lean journey and personal development associated with the leadership module.

"I think what is most important is the structure piece. You need structure and you need milestones to deliver, so it just helps you know, make sure you're on track. I thought that was extremely important at the very start, ... so I had that contract in my hand to say, you've told me you're going to support me. I am going to [university] to do a course where I'm going to need to deliver this. I think that was key." (R2)

Therefore, such tools provided guidance and a tangible link between the teaching team in the University and the workplace team/line managers in the workplace. The 'contract' that this participant (R2) refers to above requires sign-off from the in-company project sponsor.

It is interesting to note that where the programme (and therefore by necessity commitment to lean deployment) was embedded in the organisation these tools played a difference role, one of good programme governance, as participants were confident in the support of their workplace team. For example the programme was well embedded in the organisation that R4 worked in:

"The Black Belt project was one of my objectives at work as well, you know I had timelines to meet anyway, so it was good to have them [programme project management tools] there anyway you know but I suppose it wasn't the only thing". (R4)

The supporting module assignment tools were also important as they provided a framework that prompted learning from the organisation's lean journey and also supported the learning journey:

"The lean assignments were good obviously in terms of just having the opportunity to think about [it], especially I suppose in looking at the different tools and what has worked and what hasn't worked" (R4)

"I went back and revisited my assignment submissions" (R6)

Overall the leadership assignment work and in-class activities had the greatest impact on workplace learning in terms of the Black Belt project, for example, *"Leadership sessions were great, both personally, career wise, as well as in specific relation to the actual project" (R5)*

Experience

The progressive development of supply chain management competencies at an individual level within the organisation was of particular interest in this study. Programme activities sought to challenge existing mental models. This was particularly manifest in adaptation of approaches to leadership that arose from linkages between conceptualisations of leadership (and followership) and associated learning tools with black belt project activity. While participants went into the field with these concepts (awareness) and tools, evidence of knowledge learned tacitly and then embedded in practice is of most interest.

"That helped me change the project immeasurably, how I engaged with people. .. this leadership piece, I initially thought it was a tangent, but very quickly it was entwined" (R6).

"I have learned an awful lot about it on the job as well as in [the university]." (R5)

"Before that [leadership] I wouldn't have caught the Go to Gemba piece... I think that is the fundamental piece.... All I would have cared about is that we delivered. Now I was like, it is how you deliver is equally important." (R2)

The findings support Raelin's claim as to the value of actual engagement in real problems/projects (authentic learning), in this programme responsibility for project was a key factor. This learning supports competency development as it relates to use and adaption of rules-based decision in-situ. These competencies include some of those considered important to development of supply chain management professionals: process management, problem-solving, decision-making and project management (Myers *et al.*, 2004; Mangan and Christopher, 2005). However given the scope of this study the findings are limited with regard to on-going evidence of 'competency' and related performance.

Notwithstanding the focus on the individual the importance of peer-to-peer learning at organisational level was evident, thus the findings support the role of communities of practice in the workplace. The extent to which the programme

influenced these communities varied and depended, at least to some extent, on the continuous improvement strategy at organisational level. Thus the impact of this on the emergence of these communities and their origin is of interest and merits further investigation at the 'collective level'.

Reflection

There were numerous examples of reflection-in-action, most of these could be classified as single-loop learning in that they were reflection on 'content' and 'process'. The most striking evidence of double-loop learning (reflection on 'premise') related to personal development and this was primarily associated with the interplay between leadership module activity and learning and application of this in the black belt project. Thus a further study at the collective level could investigate evidence of use and extent of 'action science' at this level.

"I think it accelerated my journey, career wise. It was a huge jump. It gave me a different mindset at the end of it. What else could I say about it? That whole leadership piece, I mean from start to finish. It had huge impact, it changed my black belt [project] in the way I approached it". (R3)

CONCLUSION

This study evaluates programme impact on both the learner and on the organisation. In respect of the former, the importance of the 'learning journey' is highlighted and there is clear evidence (from a participant's perspective) of positive impact on the organisation. The participants' experience highlights the importance of alignment between programme and organisational goals (including a shared language) and co-worker involvement. This is similar to Revans' (1982) learning 'set' that is designed to share problems, exchange possible solutions and plot next steps rather than just exchange knowledge/findings.

The findings address the four levels of Fitzpatrick's programme evaluation framework, but with a particular focus on impact (on job) and business results, and also support the emerging literature on effective 'work-based learning' pedagogy and, in particular, the use of tools and techniques. The latter include the use of assignments and projects designed to stimulate learning spaces in the workplace and/or to address particular 'organisational problems'. These assignments/projects supported an iterative process between classroom learning activity and experiential learning. In this regard the 'softer' concepts and tools (such as leadership concepts and activities) had the greatest impact in the workplace. These findings point to the synergistic value of both classroom ('codified/theoretical' knowledge) and workplace (knowledge discovered through action) environments. To paraphrase Revans (1982), 'action learning adds to traditional learning'.

The study has some obvious limitations as it is based on one programme (however participants represent a range of industries including, pharmaceutical, medical device, electronics, food and drinks) and data collection was restricted to participants. The next stage of the research will encompass embedded case studies of participant companies and include data collection from senior management, HR and participant's line managers. This work will pursue some of the findings from this study, including in-company learning sets and the learner and client company journeys.

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TEACHING SUPPLY CHAIN MANAGEMENT: CURRENT STATUS AND EVALUATION OF EFFECTIVENESS

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BACKGROUND

As the domain of Supply Chain Management & Logistics (SCM&L) develops both in strategic (e.g. segmentation of suppliers and relevant ways to manage arms-length versus collaborative relationships) and operational terms (e.g. the use of technology to enhance information sharing), the corresponding set of competencies required by practitioners also changes (Lorentz *et al.*, 2013). This has significant implications for the taught modules in terms of their content. For instance, there is evidence to suggest that Supply Chain (SC) management executive education is evolving to capture the complexities of the domain. In addition to lectures, case studies, simulation games and other experiential activities are now increasingly used (de Freitas *et al.*, 2012; Bernon and Mena, 2013). Similar evidence of re-orientation in the executive SCM&L teaching is provided by (Vollmann *et al.*, 2000), and Gravier and Farris (2008) who argued that the change in the content requirements is a typical attribute of logistics education. These changes make devising an effective and relevant syllabus a constantly moving target. In the quest for increasing the effectiveness of education Kopczak and Fransoo (2000) discussed the effectiveness of a SC postgraduate level course that brought together students from two universities to solve a specific business problem. The approach followed, based on experiential learning, was identified as a useful approach to teach students. However, they argued that this type of teaching is not very effective in transferring concepts and traditional inventory-related topics, and therefore they supplement it with lectures and case-based teaching. There is a wide range of material employed in SCM&L teaching (Johnson and Pyke, 2000), and due to the dynamic nature of the market and business requirements, SCM&L educators need to adopt more didactic skills compared to those employed in traditional lecture-based courses (Van Hoek, 2001).

Similarly, the Higher Education (HE) is also in a state of evolution considering technology developments and more recent teaching approaches. Past research on SCM&L education has focused – among other things – on the curricula (e.g. Wu, 2007; Lemke and Petersen, 2013; Lutz and Birou, 2013), the use of business games and simulation (e.g. Kaminsky and Simchi-Levi, 1998; Sparling, 2002; de Freitas *et al.*, 2012), the relevant assessment (e.g. Lutz and Birou, 2013), and the development of relevant skills and competencies (e.g. Onar *et al.*, 2013; Sohal, 2013; Wu *et al.*, 2013). SCM&L-focused research on teaching methods has to date been limited and has mostly focused on such methods in isolation. Most the previous research has basically focused on the curricula, meaning there is still an unfulfilled need to assess the teaching methods considering that the SCM&L education continues to evolve (Gravier and Farris, 2008).

Considering the developments in both technological and non-technological didactic methods in the delivery, project work and engagement with the industry, our research aims to investigate the effectiveness of the typical methods employed in SCM&L teaching. Therefore, in the context of SCM&L teaching, the question that guides our research is: 'How are the different methods employed perceived in terms of their effectiveness?' This

exploratory work, which is currently in progress, has already completed its pilot phase, and here we present a summary of the findings thus far. However, the main purpose of this paper is to communicate to the academic community the planned steps for further data collection and review the approach, considering the multitude of methods used in SCM&L teaching. The paper is structured as follows: the next section presents a brief review of the typical teaching methods used, followed by a summary of the results of the pilot study; the next steps in terms of are then presented, discussing the scope of the research, the survey instrument characteristics while the last section provides the final conclusions.

SCM&L TEACHING METHODS

Nowadays there is a multitude of methods used in SCM&L teaching in HE. For the purpose of our review, we have grouped the main ones into three main categories, namely *Delivery and Coursework*, *External Engagements*, and *Technology and Distance Learning*.

Delivery and Coursework

It has been advocated that SCM&L teaching requires a broadening of the didactics skills beyond the employment of traditional lectures (Van Hoek, 2001). More than ever before this presents opportunities and challenges for academic educators. Although still very common, the range of material employed extends beyond presentation/textbook slides and class questions and associated discussions to reinforce learning about a particular topic (e.g. Johnson and Pyke, 2000; Grant, 2001).

Similarly, case studies, initially used by the Harvard Business School in the 1920s (Breslin and Buchanan, 2008), have a long history in amalgamating theory and practice, and also assist in stimulating class discussion. They have been associated with effective teaching, in some ways more effective than lectures themselves (Böcker, 1987), especially in developing personal and interpersonal skills (Hassall *et al.*, 1998) and critical thinking (McEwen, 1994). In the context of SCM&L teaching cases studies and and/or managerial articles typically substitute textbooks in order to address practical implications regarding specific subdomains, and there are reports that case-based teaching and discussion dominate the curricula (Johnson and Pyke, 2000).

A more recent method used in teaching SCM&L is the use of business games and simulations (Gravier and Farris, 2008). The Beer Game, for instance, assists students in gaining practical knowledge of the bullwhip effect, and the impacts of lead time and information sharing on SC performance (Anderson and Morrice, 2000). Other relevant games are also used, such as the Siemens Briefcase, the Llenroc Plastics game, and the Poster game (Johnson and Pyke, 2000) to name but a few.

Class projects now form important parts of many SCM&L courses (Johnson and Pyke, 2000). To avoid mass education, there are reports about modules structured around autonomous work, without formal lectures, where student groups have to present their work on a weekly basis (Carravilla and Oliveira, 2004). It has been advocated that group projects equip students with experience in solving realistic problems (Gravier and Farris, 2008), and group coursework has been used as part of both traditional textbook-based and or problem-solving module delivery schemes (Alvarstein and Johannesen, 2001).

External Engagements

As part of the continuous evolution to keep SCM&L courses up-to-date and to enhance their practical relevance close collaboration between industry and educators (Gravier and Farris, 2008) is required. The visit of sites to enhance students' experience the effectiveness of their training has been discussed for its benefits in a variety of educational contexts (e.g. Backus *et al.*, 2006). Inviting guest speakers from the SCM&L industry is also a common approach used to effectively integrate current practical insights in the teaching process (e.g. Alvarstein and Johannesen, 2001).

Technology & Distance Learning

There are several means of education that are associated with the use of technology. For instance, ubiquitous Internet access allows for videos to be utilised during lectures. Indeed, videos have been part of past research to evaluate their effectiveness as a learning resource (e.g. Pullen, 2001). More recently, Palmer (2007) reported on the streaming video effectiveness in engineering management education, comparing responses provided by on-campus and off-campus students. He identified that the average rating of the video's educational value was high; however, off-campus students, which also received the video via CD-ROM, rated its educational value higher than on-campus students, which accessed the video online. The off-campus students were also more appreciative of the video's contribution in helping them understand the topics covered. Finally, he suggested that the use of video should be associated to an assessable task to increase its usage by students.

More recently, utilising virtual reality platforms, such as virtual factory tours (e.g. Kaibel *et al.*, 2006; Blümel and Haase, 2010) is often used as an alternative or complement to actual company visits. Virtual company tours assist in relating and applying the theoretical course aspects to reality, and students have the opportunity to visit the virtual company more than once (Andersson *et al.*, 2012). Furthermore, there is evidence to suggest that visual aspects and interaction with a multimedia system are preferred by students and assist them in understanding practical concepts (Nooriafshar *et al.*, 2004).

THE

PILOT

PHASE

The previous pilot research phase (Rogers and Braziotis, 2014) involved exploring the current and potential approaches employed in teaching SCM&L in HE by means of an online survey. The questionnaire, which went through a pilot stage with participants selected from three countries (UK, Germany and India), aimed to gauge key opinions and issues by subject educators. Based on discussions with these academics, as well as from the experience the authors have in convening and teaching SCM&L modules, we updated the list of methods retrieved from past literature to reflect the current practice, as summarised in Table 1.

Table 1: Methods employed in the research

Delivery and Coursework Methods	External Engagements Methods	Technology and Distance Learning Methods
<ul style="list-style-type: none"> • Class discussion/question in lectures to reinforce previous learning/ topic • Individual coursework/student projects • Group coursework/student projects • Competitions (e.g. 'Logistics Masters'), or other • Case Studies • Business Games/Simulation • Presentation/textbook slides 	<ul style="list-style-type: none"> • Company meetings/observations • Company visits • Guest speakers from industry • Guest speakers from academia 	<ul style="list-style-type: none"> • Videos • Virtual factory tours • Live video linkups • YouTube video clips • Massive open online courses (MOOCs)

The 14 questions included were in the form of both open-ended and closed questions, avoiding, for instance, leading or loaded questions (e.g. Forza, 2002). The questionnaire was filled anonymously and most of the questions, namely the non-demographic ones, provided the option to the participants to contribute individual comments. 50 usable responses were collected, representing a response rate of 8%. The participants occupied a variety of academic roles, with the majority being Professors (28%), followed by Associate Professors/Readers (22%), Senior Lecturers (20%), and Lecturers (18%). 58% of the respondents had more than 10 years of experience and most of the teaching on the subject takes place on postgraduate level, followed by undergraduate, executive and company training respectively.

The pilot survey provided some compelling results, by identifying gaps in the means currently used compared to what the educators would like to use. This was particularly evident for some 'traditional' and highly used methods, where considerable gaps indicated a reduction in the willingness to use these methods in the future. Such methods are predominantly relevant to the 'Delivery and Coursework' category, namely case studies, presentation/textbook slides, class discussions/questions in lectures to reinforce previous learning/topic, individual coursework/student projects, and group coursework/student projects, as well as one that is relevant to Technology and Distance learning, namely videos. Smaller gaps, still indicating a reduction in their employment in the future, were evident for methods that belong to the groups of 'External Engagement' (company meetings/observations, guest speakers from industry, and company visits) and 'Technology and Distance Learning' (YouTube video clips). Instead, the participants indicated a willingness to use additional methods in the future: for Delivery and Coursework methods the use of competitions (e.g. 'Logistics Masters') and business games/simulations; for External Engagement methods the use of and guest speakers from academia; and for Technology and Distance Learning methods the use of virtual factory tours, live video linkups, and massive open online courses (MOOCs).

Perhaps unsurprisingly, typical inhibitors in employing the means they would like to use were attributed to the time required for the preparation and the time available to use them during the lecture session, as well as the associated costs (e.g. license fees). Further barriers were identified in the form of availability of guest speakers from the industry, appropriateness/fit of case studies, multiple location teaching, online resources availability and (large) number of students.

Our interpretation from these results is that there is tentative evidence that educators want to utilise further means of training that have been considered essential for more than a decade, such as business games and simulations. The comparison between current and future approaches to teaching L&SCM indicates that indeed, it is in a state of flux. However, several additional aspects and relationships need to be further explored. In terms of the assessment methods employed, the pilot survey indicated the exam as the dominant instrument of assessment, higher than reports and presentation-based assessment. However, presentation and report assessment are employed primarily in postgraduate level teaching. Furthermore, as part of the pilot survey we also sought to capture what the educators believe students prefer as teaching methods. Case studies were highly ranked as teaching means that students find useful in the view of educators, or for which the academic educator receive the best feedback, while company visits emerged as the third choice, with videos and presentation/textbook slides following. Interestingly, these commonly used methods are the ones that educators plan to utilise to a lesser extent in the future. This contradiction reveals an area that also needs further research in order to understand the underlying reasons and implications. Clearly it is also important to include the actual views of students, as well as of their potential employers, in assessing the value of the preferred means in the eyes of the educators, namely business games/simulation and competitions. The underlying reasons and implications of the anticipated change in the methods of education will also have to be understood considering two additional factors: the pilot survey indicated that SCM&L is mostly taught

from a qualitative rather than a quantitative perspective, while the core topics for SCM&L courses are mainly inventory management and distribution and networks, followed by warehousing.

THE FUTURE APPROACH

Our research is based on the assumption that a major aim of a SCM&L course is to prepare students for industry to work in a SC-related role. As a result, we consider the relevant key stakeholders to be the *educators*, the *students*, and the practitioners (the latter being the ones to judge whether the students can fulfil the role). Integrating these subgroups should achieve an appropriate level of triangulation regarding the overall perception of what constitutes effective teaching in the domain (in terms of *feasibility* from the side of the educators, *learning* from the side of the students, and *readiness* to perform the role from the side of the practitioners), indicate potential gaps and provide informed insights on the current and future appropriateness of teaching methods, as well as on course content and assessment. Inviting participants from different countries will allow the incorporation of potential diversities within an international academic context.

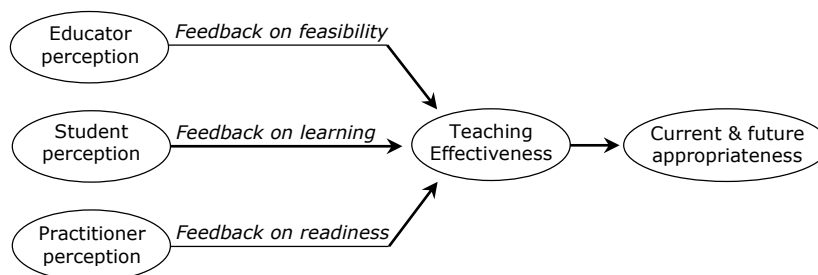


Figure 1: The research scope

Capturing the participants' demographic information

The first section of the anonymous survey instrument, which will be posted online, will include questions to capture the respective demographics for each subgroup of participants¹. For educators the main information to be retrieved in this section will be their academic level, level of HE teaching they participate in, country of employment, and years of teaching experience. For students the main information will be their level of studies, year of studying, country of studying, years of possible previous experience and the relevant industry, as well as whether they plan to seek employment in the SCM&L industry. It needs to be noted that PhD students will be considered as part of the educators, as it is a common practice for them to engage in teaching. For practitioners the main information will be their industry and sector, years of experience, size of the company in terms of people employed, country of employment and country of headquarters.

Capturing methods' feasibility potential: the educator perspective

For academics the next section will aim to capture the methods they currently use to teach SCM&L courses. For each method from the three categories identified in Table 1, the main question will address whether or not it is in use (e.g. 'Do you use case studies in your SCM&L teaching?'). A relevant aspect of the method sub-question will be to address the perception of the educators on the effectiveness of the method (i.e. 'If yes, how effective are case studies in teaching SCM&L concepts?'), allowing them to respond using a 5-point Likert scale ('Very Effective', 'Effective', 'Relatively Effective', 'Ineffective', and 'Very Ineffective').

Employing a combination of categorical and Likert-based questions, the subsequent section will capture the methods educators wish to use to teach SCM&L courses, as well

¹ Setting up the questionnaire online allows easy participation, as well as customisation of some of the questions depending on the subgroup the participant belongs to, such as in the case of demographics.

as the reasons preventing them from using them (e.g. technology limitations, time constraints owing to the duration of teaching sessions and cost/resource-related time constraints). The next set of questions will focus on their opinions regarding the core topics for SCM&L courses (scheduling, inventory management, warehousing, distribution and networks etc.), as well as whether their teaching is predominantly quantitative, qualitative, or a combination of both. The last question will capture the relevant course assessment methods employed.

Capturing the methods' learning potential: the student perspective

For the students sub-group a set of categorical and Likert-based questions will capture the current methods they are exposed to as part of their SCM&L studies, as well as how effective they find each method in terms of relevance/required knowledge. They will also be asked to indicate which teaching methods they wish to be exposed to in the future, and the reasons (e.g. in comprehending theoretical concepts, applying techniques, understanding real-case operations). The next set of questions will inquire on the core topics of SCM&L they are exposed to, as well as whether they find SCM&L teaching to be predominantly quantitative, qualitative way, or a combination of both. The last question will capture the relevant course assessment methods they would prefer.

Capturing the methods' readiness potential: the practitioner perspective

For the practitioners sub-group there will be no comparison between current and future use of the relevant methods. Instead, the practitioner-specific questions will inquire as to the perception of the level of preparation for each method on equipping students to be able to get immediately into a SCM&L-related role in the respective industry. Each method will be assessed using the combination of the categorical main question, and a Likert-based sub question to assess its effectiveness. They will also be asked to indicate the core topics that should constitute a SCM&L-related courses, appropriate emphasis on quantitative aspects, etc.

CONCLUSIONS

Prosser and Trigwell (1999, p. 4) argued that: "...to improve the quality of the students' approaches to learning and their learning outcome, university teachers may first need to determine students' perceptions of the assessment, their workload, the clarity of goals and standards, the teaching they receive and the learning choice they receive. Adjusting the context to afford changes in students' perceptions may be an important strategy in improving learning. Differences in these perceptions may relate to differences in to learning."

Considering the above statement, our research aims to contribute to the need to understand contemporary SCM&L education (Wu, 2007) by capturing the perceptions of the key stakeholders. With the exception of the current status of methods used in SCM&L teaching that practitioners cannot comment upon, the remaining of the questions are set for direct comparison of the perspectives of the sub-groups. In addition to the basic descriptive statistics (that should provide valuable information on the different perspective and what are the drives of change in the relevant courses) the research output could reveal interesting opinions on the current and future requirements of the key stakeholders in SCM&L education in a variety of HE settings across the world.

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