

**The 4th International Conference on Logistics and Transport
(ICLT 2012)**

**The 1st International Symposium on Value Chain Management
and Logistics (iSVCML2012)**



ICLT
INTERNATIONAL CONFERENCE
ON LOGISTICS & TRANSPORT



Thammasat University - Chiang Mai University

*The conference is co-hosted by International Researchers Consortium of
Value Chain Management and Logistics*

22nd -23rd November, 2012
at Centara Duangtawan Hotel
Chiang Mai, Thailand



PREFACE

This proceeding is issued to support the collaboration between by Faculty of Commerce and Accountancy, Thammasat University, and Faculty of Engineering, Chiang Mai University, on the 4th International Conference on Logistics and Transport (ICLT 2012) and the 1st International Symposium on Value Chain Management and Logistics (iSVCML2012) conferences. The conferences were held during November 22nd - 23rd which was initiated through the international symposium hosted by the department of industrial engineering of Chiang Mai University at Centara Duangtawan Hotel, Chiang Mai, Thailand.

This symposium is aimed to disseminate the knowledge among students and researchers in the field of value chain management, logistics and related topics such as R3A international logistics route in Lao PDR, Myanmar and China and the rising of the Greater Mekong Subregion as well as the ASEAN Economic Community. The conference was launched under the theme of “Supply Chain Risk Management”. The conference is co-hosted by Thai Researchers Consortium of Value Chain Management and Logistics. The conference will be an open space for sharing knowledge among students and researchers in the field of value chain management, logistics and related topics. The symposium also includes the (optional) after conference trip to visit R3A international logistics route in Lao PDR, Myanmar and China. You will be able to experience the rising of the Greater Mekong Subregion as well as the ASEAN Economic Community.

MESSAGE FROM SYMPOSIUM CHAIR

Under the theme of “Supply Chain Risk Management” by Faculty of Commerce and Accountancy, Thammasat University and, Faculty of Engineering, Chiang Mai University, we sincerely welcome you to the 4th International Conference on Logistics and Transport (ICLT 2012) and 1st International Symposium on Value Chain Management and Logistics (iSVCML2012). The conference will be held during November 22-23, 2012 at Centara Duangtawan Hotel, Chiang Mai - Thailand. The conference is co-hosted by Thai Researchers Consortium of Value Chain Management and Logistics. The conference will be an open space for sharing knowledge among students and researchers in the field of value chain management, logistics and related topics. The symposium also includes the (optional) after conference trip to visit R3A international logistics route in Lao PDR, Myanmar and China. You will be able to experience the rising of the Greater Mekong Subregion as well as the ASEAN Economic Community.

Representing the symposium organizing committees, I again would like to welcome you to join the symposium by submitting the paper. Finally, I am looking forward to welcome you in Chiang Mai.

With great pleasure,

Associated Professor Dr. Ruth Banomyong
ICLT Symposium Chair

Associated Professor Dr. Apichat Sopadang
iSVCML Symposium Chair

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and

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THE SERVICE DETERMINANTS OF FREIGHT FORWARDING INDUSTRY

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Abstract

Purpose: This research aims to find service determinants of four popular international freight forwarding business models in the Latin America.

Design/methodology/approach: To analyze the pros and cons of four popular freight forwarding business models and the importance of determinants in this industry, an analytical hierarchy process (AHP) and importance-performance analysis (IPA) techniques are employed to carry out the study. Thirty leading freight forwarders headquartered in Taipei and have done business with Latin America are surveyed by posting them questionnaire to know their perception on the degree of importance of these service factors and the degree of performance of various business models on these service factors. Twenty three of them have responded the survey. A following up telephone interviews with these freight forwarders after the survey are carried out to further interpret the survey findings.

Findings: Three factors of the service quality dimension have much higher degree of importance than the eight factors of the economic dimension.

Research Implications: Freight forwarders should be service-oriented instead of cost-oriented and revenue-oriented, and risks of neglecting service quality in the freight forwarding industry cannot be overemphasized.

Originality/Value: The business models and their service determinants of freight forwarders in the emerging economics are systematically studied for the first time.

Introduction

There are about 40,000 firms in the forwarding industry globally that have employed 8-10 million staffs (Delen, 2010). The annual revenue of a global forwarder can be as high as \$30.5 billion US dollars which has been achieved by the leading forwarder DHL in 2010. Forwarding is a very competitive business, and major international freight forwarders are always looking for their future development opportunity abroad. Latin America with more than 572 million in population and 210 million square kilometers in land area is reported to be one of the most potential economic growth regions in the 21st century. According to UN ECLAC (Economic Commission for Latin America and the Caribbean, 2011), the trade indices for goods in this region is largely grown from 2005 to 2010. Latin America and the Caribbean will grow by 3.7% in 2012 amid global uncertainty and volatility. Viewing this trade growing trend and the future importance of Latin America in world trade, the Republic of Korea and ECLAC has recently signed an agreement for expanding mutual cooperation. Taiwan has strong competition with Korea in the ocean shipping industry. Freight forwarding industry is the trailblazers for ocean carriers in the shipping industry. To understand the successful factors and business models of the freight forwarding industry is thus important from ocean carriers' viewpoint in Taiwan.

Literatures Review on the Functions of Freight Forwarders

Functions of freight forwarding business

Markides and Holweg (2006) cited Ran et al.'s (1993) report and indicated international logistics intermediaries including freight forwarders, customhouse brokers (CHBs), non-vessel operating carriers (NVOCCs) as well as export management companies, are all in the group of third-party logistics service providers (TPL). They are capable of offering complete logistics solutions for the international freight movement. Of tall the TPL stakeholders, the international freight forwarder (IFF) has traditionally been the primary logistics middleman for cross-national trade. Frequent consolidation and restructuring has resulted in tremendous volatility in the sector. Traditional

forwarders have to provide niche freight services by offering value-added services such as customs clearance, warehousing management, transportation management, information technology and special freight handling (Chandler, 1994). Apart from customs clearance (CHB) and NVOCC services, freight forwarding companies can furthermore provide insurance, warehousing and distribution and various other value-adding services such as information technology, consultancy, packing and labeling inhouse or outsourced. Thus their incomes are generated from air-freight, sea-freight, rail-freight, road haulage, warehousing, custom-house brokerage, insurance, and other value activities (Markides and Holweg, 2006).

Lin and Liang (2011) studied the service quality of the ocean freight forwarder industry in Taiwan by fuzzy zone of tolerance technique, they found twenty two service attributes can be grouped into four service dimensions, including convenience of operation process, aggregated service, transit handling excellently, and rationalization of freight rate. They found five of the twenty two service attributes required a major improvement, namely, electronic data interchange, cargo tracing service, availability of cargo space, the competency of emergency handling, the ability of claims handling and freight rate. A study on the diversification development of international freight forwarders (IFFs) in Bangladesh by Haque (2011) reveals Bangladesh IFFs are lag in the IT service and the value added service. Rathbone(2009) indicated five major causes result in the leading freight forwarders from the general shipping companies: automated processes, cutting-edge information technology, forward-looking leadership, innovative customer service, and empowered employees. Abdel-Maksoud & Kawam (2009) studied the highly competitive freight forwarding market in the United Arab Emirates (UAE), they found cost and quality of services offered to customers are two of the most critical factors influencing the competitiveness for freight forwarding (FF) and logistics firms. In addition, five important variables were identified by the senior executives they interviewed as value creating, including: staff responsiveness, staff professionalism, internal operations, customer satisfaction and loyalty.

Table 1 Key Successful Factor (KSFs) of freight forwarders

Sub-Dimensions	KSFs (Factors)	Authors												
		Davies (1981)	Ozsomer et al. (1993)	Hardaker et al. (1994)	Chandler(1994)	Murphy & Daley (1999)	Lai & Cheng (2004)	Liang et al. (2006)	Markides & Holweg (2006)	Drewry (2010)	Abdel-Maksoud & Kawam (2009)	Rathbone (2009)	Lin & Liang (2011)	Haque & Ahmad (2011)
Revenue	Revenue from other surcharge	✓	✓			✓				✓	✓			
	Revenue from ocean freight (Rationalization of freight rate)	✓							✓	✓		✓		
	Revenue from inland transport				✓		✓		✓					
	Revenue from value-added service charge (value creating)			✓	✓		✓	✓	✓	✓				
Service Quality	Cargo tracking ability (Convenience of operation process, EDI & cargo tracing service, Automated process)		✓	✓					✓	✓	✓	✓	✓	
	Customer complaint response speed (Innovative customer service, staff professionalism)			✓		✓			✓	✓	✓		✓	
	Cargo on time arrival rate (Transit handling excellently)		✓	✓		✓			✓			✓	✓	
	Low cargo damage and loss record(Aggregated service)		✓			✓		✓	✓			✓	✓	
	Customer satisfaction & loyalty											✓		
	Internal Operation											✓		
Cost	Ocean freight cost	✓			✓					✓				
	Documentation cost	✓			✓					✓				
	Communication cost	✓						✓	✓					
	Terminal handling cost	✓			✓				✓					

Source: this research.

There are several import sources of revenues for the freight forwarding industry, including ocean freight (Markides & Holweg, 2006; Drewry, 2010; Lin & Liang, 2011), other surcharges (Davies, 1981; Ozsomer et al., 1993; Murphy & Daley, 1999; Markides & Holweg, 2006), inland haulage (Chandler, 1994; Lia & Cheng, 2004; Drewry, 20100, and revenue from valu-added services(Hardaker e at., 1994; Chandler, 1994; Lai & Cheng, 2004; Liang et al, 2006; Drewry, 2010; Abdel-maksoud & Kawam, 2009).

Service quality of the freight forwarding industry should include cargo tracking ability (Ozsomer et al, 1993; Hardaker et al., 1994; Lai & Cheng, 2004; Drewry, 2010), Customer complaint response speed (Hardaker et atl, 1994; Murphy & Daley, 1999; Drewery, 2010; Abdel-Maksoud & Kawam, 2009; Haque & Ahmad, 2011.; Rathbone, 2009), cargo one time arrival (Ozsomer et al., 1993; hardaker et al., 1994; Drewery, 2010; Lin & Liang, 2011; Haque & Ahmad, 2011), low cargo damage and loss record (Ozsomer et al., 1993; Murphy & Daley, 1999; Markides & Holweg, 2006; Drewry, 2010; Lin & Liang, 2011; Haque & Ahmad, 2011), customer satisfaction & loyalty (Lin & Liang, 2011), and internal operation (Lin & Liang, 2011).

As the higher the cost the lower the economic competitiveness, thus the control of cost has its impacts on the competitiveness of a freight forwarder. The cost factor mainly contain ocean freight

paid to the vessel operating carriers (Davies, 1981; Chandler, 1994; and Abdel-Maksoud & Kawam, 2009), documentation cost paid to the ocean carriers and the other freight forwarders who received the co-loaded cargoes, the communication cost between forwarders, its partner forwarders, and the shippers, and the terminal handling cost paid to the ocean carriers (Chandler, 1994; Abdel-Maksoud & Kawam, 2009).

Business models of freight forwarding (FF) industry

Drewry Maritime Research (2010) has made an in-depth analysis of and suggests best practices for monitoring logistics activities in the global freight forwarding sector. The freight forwarders' business model can be grouped according to their profit margins and revenues. Their resilient margins can be generated through adequate control on their variable costs, and revenue can be generated through their consolidation and wholesale freight services. However, according to the authors' knowledge, a clear analysis on the business models for freight forwarding industry is simply not available currently.

Interview with industry executives and review literatures (Tzeng & Liao, 1997), the general business models of FF industry are structured. There are four business models for the freight forwarders who want to enter into the Latin American freight market. Global logistics solution providers have offered their prompt delivery service and door to door service by multimodal transport network worldwide. Companies such as DHL and TNT are examples of the global cargo consolidators. Non-vessel operating common carriers are major forwarders solicited and consolidated cargoes and issued their own bill of lading to their shippers. International cargo consolidators are forwarders provide cargo consolidation service without taking any responsibility to the shippers. They simply consolidate the cargoes and relay them to the other freight forwarders or carriers. The fourth FF business model is to be as a key agent for major foreign ocean carriers. This model simply handles imported and exported cargoes designated by their foreign ocean carriers.

Following a personal interview with several executives of freight forwarding companies, the author summarize service factors reported in previous researches and in the interview, an analytical hierarchical structure is shown in the Figure 1.

Research Methodology and Participants

Research Methodology

Two techniques were employed to carry out this research: the Analytic Hierarchy Process (AHP) technique and the Importance and Performance Analysis (IPA) technique. The AHP technique is firstly used to find the weight for the FF performance dimensions and criteria, followed by the use of the IPA to illustrate the critical criteria that need to be improved.

The AHP technique can be used to simplify a complicated system by constructing a hierarchic structure. Elements at any level are comparable, and elements in the same level of the hierarchy should be independent from each other. A criterion under a dimension should be correlated with the dimension in its upper level, and judgments about the elements in a hierarchy do not depend on the lower level elements. An AHP structure should follow the homogeneity axiom, which states that the elements being compared should not differ from each other too much.

The AHP technique is based on three axioms, namely, the reciprocal axiom, the homogeneity axiom, and the principle of hierarchic composition. There are three procedures in implementing the AHP technique: decomposition, comparative judgments, and the hierarchic composition or synthesis of priorities. The pairwise comparison between each dimension and criterion should satisfy the transitivity relationship; however, a perfect transitivity relationship is not required. When the transitivity relationship does not exist, the consistency index (C.I.) and consistency ratio (C.R.) are employed to test the degree of consistency of the respondent's responses.

Martilla and James (1977) were the first to propose the IPA technique to analyze automobile dealers' services and customers' patronage of the dealers' service department. Service attributes with a high degree of importance and low degree of satisfaction were considered to require more resources and inputs from the car dealers to keep their customers' patronage.

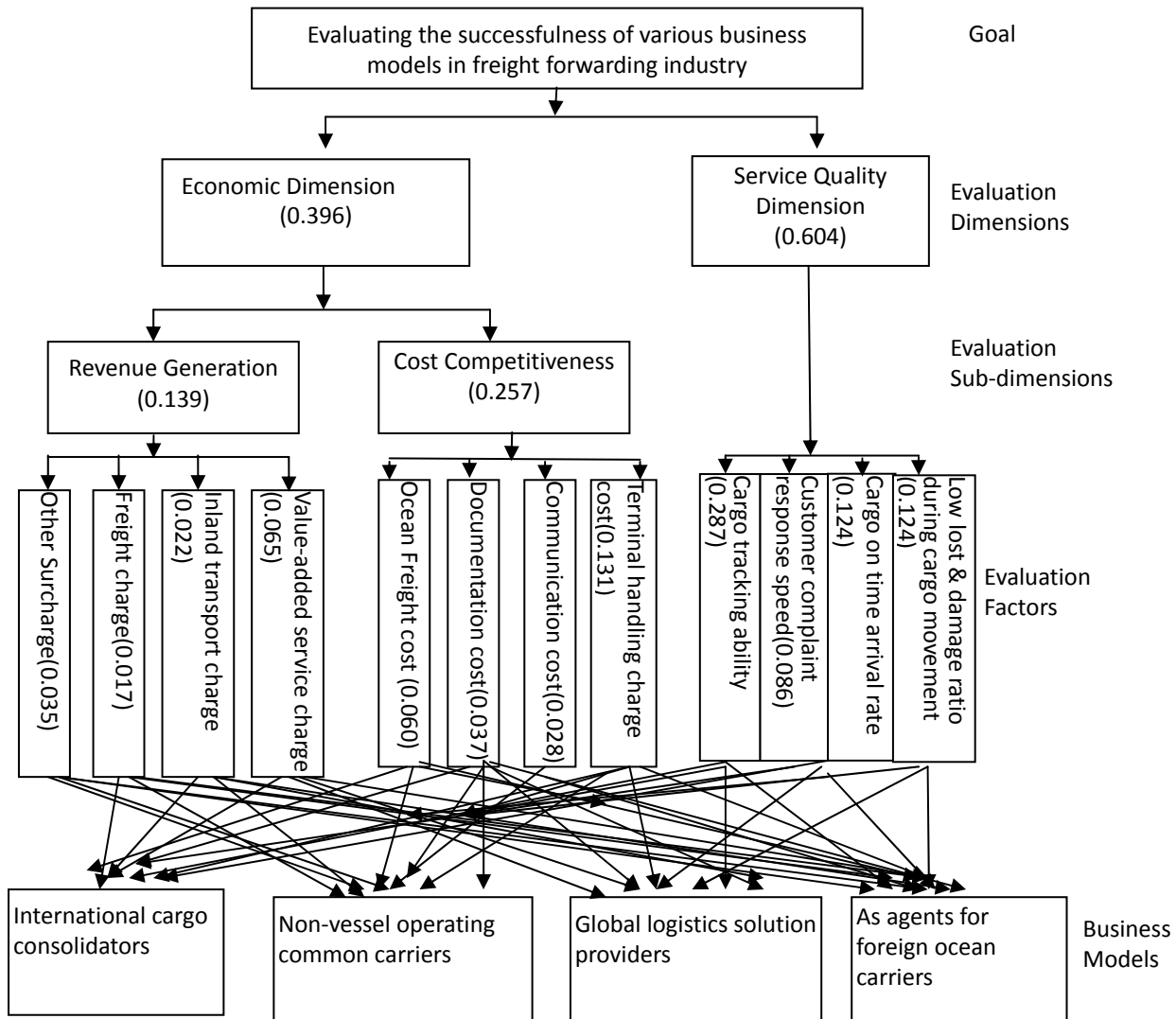


Figure 1 Hierarchical structure and KSFs and freight forwarding business models

Participants

There are only one major ocean freight forwarding association in Taiwan, the International Ocean Freight Forwarders and Logistics Association, Taiwan (IOFFLAT). Of the IOFFLAT 662 members, 640 of them are local FFs headquartered in Taiwan and 22 international members from Singapore and Hong Kong. Viewing the IOFFLAT members' serial number, the local member number is currently 1,498 and the international member number is 22. Thus it is about 42.7% of IOFFLAT member are still in operation in Sept. 2012. Survey participants were selected by reviewing freight forwarders' corporate profiles of the Freight Forwarder Association in Taipei. Freight forwarders who have annual revenue over US\$ 300 million were chosen as the potential participants. It is found the forwarders with high annual revenue were mostly large forwarders who have business connection with forwarders in Latin America. Thirty leading freight forwarders home based in Taipei were targeted to respond to the survey. Questionnaires were distributed in the July in 2012 via post mail. There are 23 participants respond the survey and achieved a high response rate of 76.6%. The high response rate is achieved because the author has contacted with the potential respondents by telephone and asks for their agreement to participate this survey before the questionnaires are posted. In addition, a promise to mail a summary of the survey findings to the participants also is helpful to increase the response rate.

Analyses of Findings

It is found leading forwarders in Taipei perceived service quality is the most important dimension influence the successfulness operation of a freight forwarder in Latin America., followed by cost competitiveness dimension, and the revenue generation dimension. Looking into the details of the twelve factors in the three dimensions, cargo tacking ability, and cost of terminal handling charge and cargo on time arrival rate are the top three important factors with the degree of importance more than 10% from the freight forwarders' viewpoint. Revenue from ocean freight charge, revenue from inland transport charge, and cost of communication are found to be the three least important factors influenced a freight forwarder's successful operations in Latin America (see Figure 1).

Concerning the overall weighted performance evaluated by these 26 senior executives, 'the global logistics service providers' (GLSP) have the highest competitiveness among the four types of freight forwarding business models, followed by 'global cargo consolidators'(GCC), 'as agent exclusively for an ocean carrier', and 'the non vessel operating common carriers' (NVOCC) (see Table 3).

The median value on the importance of the twelve service attributes for the four types of freight forwarding business models is 0.063. Median performances values of the four business models on the twelve service attributes are 4.442, 4.462, 4.538, and 3.788 (see table 3). Thus the origin of the importance-performance analysis matrix is found. Service attributes located in the upper left quadrant imply the service attributes have higher degree of importance but have lower degree of performance, thus to input more resources to improve these service attributes is the first priority for a freight forwarders.

Among the four types of freight forwarding business models, it is found that the global logistics service providers have the highest overall weighted performance, followed by non-vessel operating common carriers, global cargo consolidators, and as agents for foreign carriers (see table 3).

Table 3 Performance of four FF business models on the 12 service attributes

Business Models	GCC	NVOCC	GLSP	Agent
Service attributes (Degree of importance)				
RVAS: Revenue from value added service (0.065)	4.692	4.808	4.885	4
RITC: Revenue from inland transport charge (0.022)	4.462	4.731	4.846	3.769
ROFC: Revenue from ocean freight charge (0.017)	4.423	4.500	4.423	3.154
ROS: Revenue from other surcharges (0.035)	4.577	4.692	4.462	3.808
CTHC: Cost of terminal handling charge (0.131)	2.923	3.654	3.923	2.692
COC: Cost of communication (0.028)	2.769	3.462	3.500	2.654
COD: Cost of documentation (0.037)	2.769	2.538	2.692	3.154
COF: Cost of ocean freight (0.060)	2.654	3.192	2.962	2.577
CTAR: Cargoes on time arrival rate (0.124)	4.462	4.808	4.692	4.346
CCRR: Customer complaint response rate (0.086)	4.346	4.654	4.654	4.308
CTA: Cargo tracking ability (0.287)	4.462	4.423	4.846	4.654
LLDR: Low lost and damage record (0.107)	4.538	4.269	4.615	4.385
Weighted performance Score	4.054	4.241	4.411	3.942
Median value of the performance of the 12 service attributes	4.442	4.462	4.538	3.788

Note: Median values of the importance of the 12 service attributes is 0.063

Figure 4 to figure 7 are the IPA illustration for global cargo consolidators, NVOCC, global logistics providers, and as agents for major carriers. 'Revenue from other surcharges', 'revenue from inland transport charge', and 'revenue from ocean freight' attributes are the three determinants for global cargo consolidators' successful operations (see figure 3). Because global cargo consolidators only

issue cargo receipts and do not issue their own bill of lading and do not contacted with ocean carriers directly, they normally solicit shippers' freight and intermediate the freight service between shippers and NVOCC. They normally consolidate the less than container load cargo and forward the full container load cargo to NVOCC to make profit from the ocean freight payment differences between the full container load cargo rate and the less than container load (LCL) rate. The three attributes are major important incomes for the consolidators, but when the consolidators relay the LCL cargo to NVOCC, the NVOCC also charges the consolidators very high fees on these three charge items. Thus consolidators cannot easily generate significant profit from these three charge items currently.

For non-vessel operating common carriers (NVOCC), 'cost of terminal handling charge'(CTHC), and 'low lost and damage record'(LLDR) are found to be the determinants. However, the NOVCCs have over-performed on 'the revenue from inland transport charge'(RITC), 'revenue from other surcharge'(ROS), and 'revenue from ocean freight charge' (ROFC) service items. NVOCCS can move their resources from the three charge items to 'cost of terminal handling charge' (CTHC), and 'low lost and damage record' (LDR) items (see figure 4).

This is because of NVOCCs normally used the low ocean freight strategy to solicit shippers' patronage. This low ocean freight rate is about the same rate that NVOCCs have to pay to the ocean carriers. NVOCCs also ask for low inland transport charge and low surcharge to operate in a highly competitive freight market. NVOCCs have to pay a very high terminal handling charge (THC) to carriers. Although these THCs can be recovered by charging the LCL shippers even higher unit THC rate, NVOCCs' high THC charge is always complained by the LCL shippers. NVOCCs require an improvement on this service attribute via negotiating lower THC with ocean carriers.

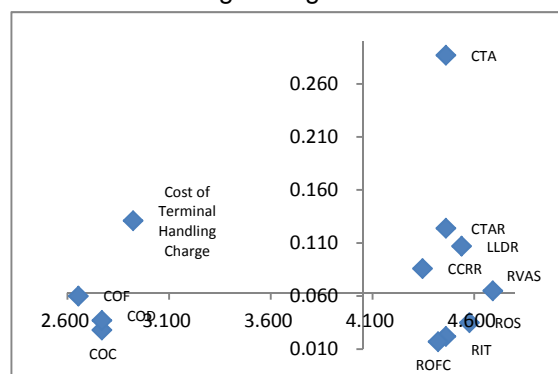


Figure 3 IPA of global cargo consolidators

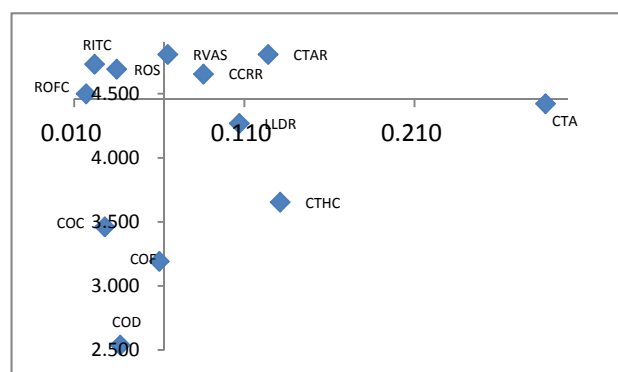


Figure 4 IPA of non-vessel operating common carriers

For global logistics service providers, 'cost of terminal handling charge' (CTHC) attributes is found to be the determinant service attribute, and the 'revenue from inland transport charge' (RITC) service attribute is found to be the over-performed attribute (see Figure 5). This finding is somewhat surprised to the authors, as most global logistics service providers are mostly using air transport as their major transport mode to move cargoes across nations. THC has a broad definition. It refers not only to the terminal handling fee in the container port, but also refer to the ground handling fee at the

cargo terminal in an airport. Global logistics service providers all have their own ground handling work force in major airports worldwide. Outsource these ground work force to a HRM (human resource management) contractor can reduce the cost of ground handling fee in a low throughput air cargo terminal.

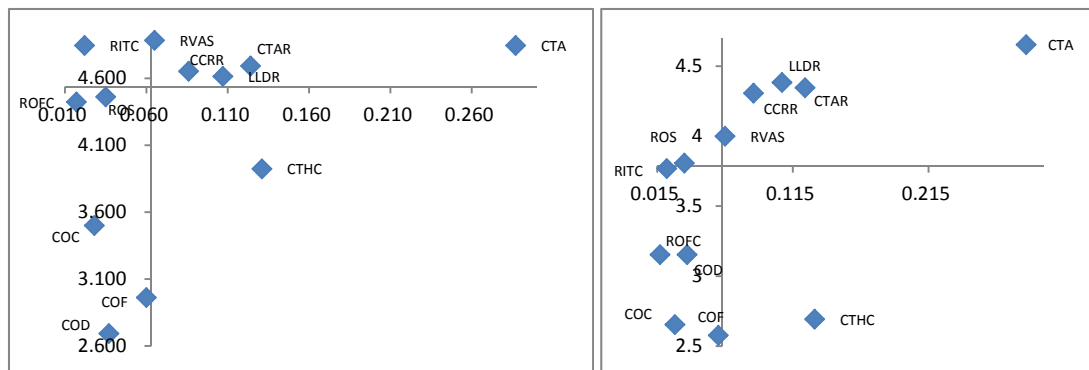


Figure 5 IPA of global logistics service providers Figure 6 IPA of as agents for major carriers

For 'as agents for major carriers' forwarding business model, 'cost of terminal handling charge' is found to be the only determinant service attribute, and 'revenue from other surcharges' is found to be the only over-performed attribute (see Figure 6). Local FFs operate as agents for major carriers mostly simply involve in soliciting cargoes for a very limited number of ocean carriers. Although these FFs also consolidate and forward these cargoes to the other FFs through their subsidiary companies, most of the time, they solicit cargoes for their principal ocean carriers only. Their major revenues are generated from the freight which does not include the THC. In a recessed freight market, one of ocean carriers' major revenue is generated from the THC they received. Thus ocean carriers are usually keen at raising their THC fees when the freight market is soft. The THC fee should be greatly reduced if an ocean carriers' agent want to improve its competitiveness during a soft market.

Discussions and conclusions

It is found that in three of the four freight forwarding business models, the revenue from inland transport charge is found to be the over-performed service attributes. This implies most forwarders do not think this service attribute is very important to the successful operation of their business. However, they over-charge shippers the inland transport charge. Evergreen Marine Corporation (EMC) did decide to set up its branch office in the UK when its British agent keep the profitable inland service routes for itself and relayed the non-profitable inland service routes to EMC in the early 2000s. Inappropriate profit from inland transport service will make both carriers and shippers disappointed.

On the other hand, 'cost of terminal handling charge' is the determinant attributes in three of the four freight forwarding business models. In the short sea service routes, the terminal handling charge (THC) is the major cost the shippers have to pay. How to negotiate with the ocean carriers to reduce the THC and consequently reduce the THC charges to shippers is the key successful factor for forwarders.

In addition, the importance of service quality dimension is higher than the economic dimension. Among the two sub-dimensions of the economic dimension, the cost competitiveness sub-dimension is about twice more important than the revenues competitiveness sub-dimension. Forwarders should provide their best service quality with the possible lowest cost, and the factors in the revenue sub-dimension should be employed as the last resort to compete with their cohorts.

As this research has only surveyed Taiwanese freight forwarders, future research can have a survey on a large geographical region and to include the shippers' viewpoint to have a more general conclusion.

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EVALUATING THE PERFORMANCE OF LOGISTICS SERVICE PROVIDERS

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ABSTRACT

Purpose: The aims of this research are to gather insights on logistics outsourcing in Singapore from the perspective of the 3PL customer (i.e. service user), determine the importance of decision criteria as perceived by service users and develop a decision-making framework to assist 3PL service users when they select a 3PL provider.

Design/methodology/approach: Selected professionals in the manufacturing and service sectors were surveyed to gather perspectives on the 3PL market as well as to shed light on the criteria they consider to be important when selecting a 3PL provider. Information from 30 respondents was used in the analysis. The structure for the selection of a 3PL provider was conceptualised as a two-level multi-criteria decision-making model. The analytical hierarchy process (AHP) was used to compute the criteria weights based on the judgements of selected supply chain managers from oil and gas, PC manufacturing and commodity trading companies.

Findings: 90% of the respondents reported that their company outsourced their logistics activities. The most outsourced activities tended to be transactional, operational and routine in nature. The least outsourced activities tended to be more strategic and IT-intensive in nature. The four criteria (delivery, cost, quality and flexibility) and 12 associated sub-criteria were found to have a high level of importance. The weights derived from the AHP method reflected the differences in priorities for the selected industries and the products that flow through their supply chain.

Research Implications: Different businesses have different considerations when selecting the most appropriate 3PL provider. Quality and delivery seem to be important considerations for the oil and gas industry, while flexibility and quality are important for PC manufacturers. Commodity trading companies tend to be cost-oriented. 3PL providers need to be agile to align with different customers' expectations.

Originality/Value: The decisions involved in selecting a 3PL service provider are examined from the perspective of the 3PL service user across different industries.

Introduction

In this globalised and competitive environment, the effective management of product, information and cash flows are essential to supply chain success (Chopra and Mendl, 2013). Many logistics functions are now being outsourced to third-party logistics (3PL) service providers. One compelling reason for logistics outsourcing is that it allows businesses to concentrate on their core competencies. 3PL providers are capable of supporting their clients with expertise and experience that would otherwise be difficult to develop in-house or to acquire. 3PL customers are able to leverage on 3PL providers to improve customer service, respond to competition and reduce assets (Handfield *et al.*, 2011).

The selection of a 3PL provider is essential for businesses looking to reduce supply chain costs and improving service quality for their customers. Companies who outsource their logistics activities to 3PLs are realising the importance of measuring and evaluating logistics performance. This paper aims to study the 3PL market in Singapore from the perspective of the 3PL customer (i.e. service user), determine the importance of decision criteria as perceived by service users and develop a decision-making framework to assist 3PL service users when they select a 3PL provider (Wai, 2012).

Literature Review

Many papers have been published on the performance measurement and selection of 3PL providers. Some recent studies on 3PL performance evaluation are included here.

Jharkharia and Shankar (2007) developed a methodology for the selection of a 3PL. They formulated an Analytic Network Process (ANP) model with three levels of decision-making: determinants, dimensions and enablers.

- Determinants (Level 1): Compatibility, quality, cost and reputation
- Dimensions (Level 2): Long-term relationships, operational performance, financial performance and risk management. These dimensions support their respective determinants.
- Enablers (Level 3): 16 enablers were identified. These enablers support their respective dimensions, but are allowed to have interdependencies among themselves.

The ANP approach was applied to a medium-sized fast-moving-consumer-goods company. The results showed that compatibility between the user and the 3PL was the most important determinant that influenced the selection process.

Maukar and Dewi (2009) studied the performance of one 3PL company in Indonesia that provided transport and warehousing services in several large cities. They measured the performance of this company using two levels of decision-making. The main criteria (or Level 1 performance indicators) considered in their study were: quality, delivery, cost and flexibility. Within each criterion, they identified several sub-criteria (or Level 2 performance indicators). The weights were obtained for each performance criteria using the analytic hierarchy process (AHP). Their findings indicated that the delivery criterion resulted in the highest weight.

Liu and Lyons (2010) studied the relationship between 3PL performance and service provision of UK and Taiwanese 3PLs. They extensively reviewed past studies and found that there was general consensus that delivery, quality, flexibility, cost and innovation can describe the operational performance of 3PLs. The study used the postal questionnaire for data collection. The sample of 3PL customers was drawn from large manufacturing companies in the UK and Taiwan. Their results suggested that excellence in operations was more important than providing a wide range of services.

Miodrag and Clausen (2011) developed a performance measurement system for forwarders in Germany. This system was designed to support small and medium-sized forwarding companies. Three criteria were identified as company targets: financial, performance and quality levels. Within each target level, several sub-criteria or second level indicators were used. Their paper did not specifically mention about the weights for the indicators.

Methodology

Figure 1 shows the study methodology adopted to achieve the research objectives. The methodology allowed us to gather insights on logistics outsourcing in Singapore, test the importance of the chosen decision criteria for 3PL selection and develop a decision-making model for 3PL selection.

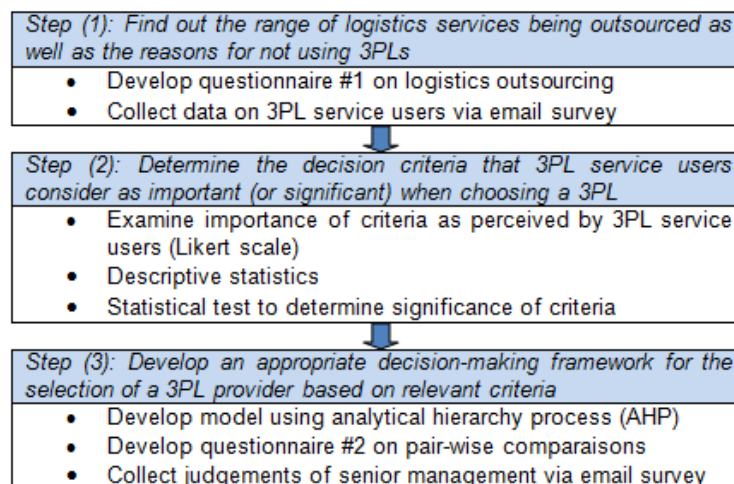


Figure 1: Study methodology

Survey on logistics outsourcing

The first questionnaire was designed to be easy to self-complete and captured information on: (1) company and respondent profile; (2) whether the company outsourced logistics activities to 3PLs; (3) range of activities outsourced; (4) rating of decision criteria perceived as important by 3PL users on a Likert scale of 1 to 7; and (5) reasons for not using 3PLs if logistics was not outsourced.

Similar to Maukar and Dewi (2009), we conceptualised the model for the selection of a 3PL provider as a two-level problem. Figure 2 shows the structure of the multi-criteria decision-making model. Decision criteria (Level 1) chosen were delivery, cost, quality and flexibility. For sub-criteria (Level 2), we considered 12 performance indicators of 3PL capabilities. Table 1 describes the decision criteria.

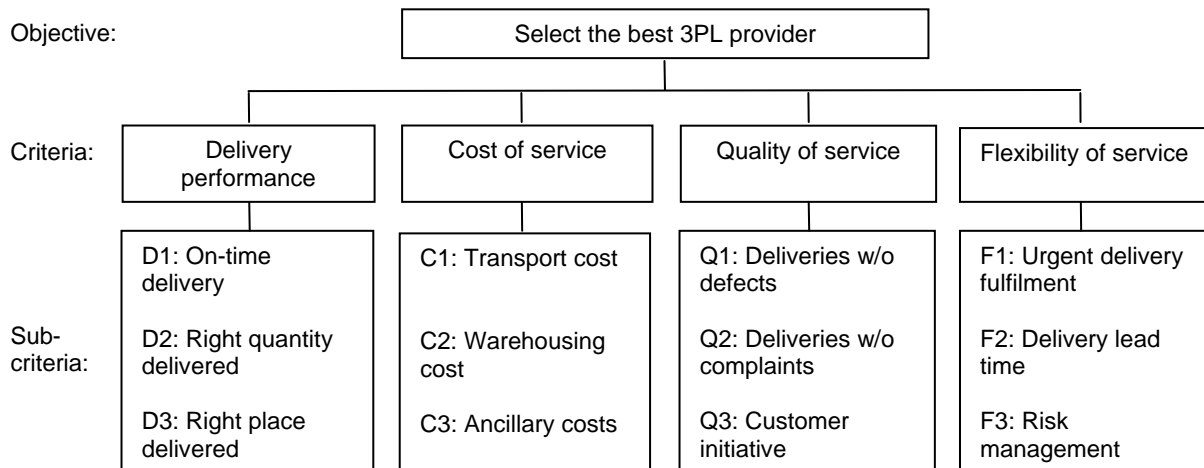


Figure 2: Structure of decision-making model for 3PL selection

Criteria	Sub-criteria	Description	Remarks
Delivery performance	D1: On-time delivery	Number of deliveries delivered on-time divided by total deliveries	On-time delivery affects supply planning and customer satisfaction
	D2: Right quantity delivered	Number of deliveries delivered at the right quantity divided by total deliveries	Short- or over-shipment affects production or supply schedules; cause custom delays; affects customer satisfaction
	D3: Right place delivered	Number of deliveries delivered to the right place divided by total deliveries	Wrong delivery of items to wrong location causes unnecessary surcharges in transport; affects customer satisfaction
Cost of Service	C1: Transport cost	Total transport cost divided by total revenue	Efficiency in delivery cost
	C2: Warehousing cost	Total warehousing cost divided by total revenue	Efficiency in warehouse cost
	C3: Ancillary cost	Handling costs, port charges, etc divided by total revenue	Transport and warehousing costs may not reflect how efficient a 3PL moves goods
Quality of service	Q1: Deliveries without defects	Number of deliveries without defects divided by total orders	High ratio indicates low defective rate
	Q2: Deliveries without complaints	Number of deliveries without complaints divided by total orders	High ratio indicates high service quality level
	Q3: Customer initiative	3PL's commitment to enhance customer success	Commitment of the 3PL to propose value-added solutions to reduce supply chain cost
Flexibility of service	F1: Urgent delivery fulfilment	Number of urgent deliveries fulfilled divided by total number of urgent delivery requests	Ability to accommodate last minute requests improves shippers ability to provide better customer service
	F2: Delivery lead time	Ability to provide quicker delivery lead time to customers	Lower delivery lead time increases customer satisfaction for shippers
	F3: Risk management	Ability to handle unexpected events, e.g. change of route or transport mode	Increases shippers' confidence in a 3PL to manage unexpected events

Table 1: Description of the decision criteria used

The sampling technique chosen for this study was purposive or judgemental sampling (Saunders *et al.*, 2009). The questionnaire on logistics outsourcing was emailed to 33 professionals from different companies in Singapore in April/May 2012. The companies they represent were mainly in the manufacturing and services sector. Before emailing the questionnaire, the respondents were contacted and briefed on the survey objectives. Eventually, information from 30 respondents was used in the analysis. As we worked with individuals that we knew, data were obtained at a very high response rate (91%).

This technique was considered practical given that this was an exploratory study and we were dealing with very small samples due to time and resource constraints. The limitation with this technique is that the sample cannot be considered statistically representative of the total population.

Survey on pair-wise comparisons

The model structure enabled the use of a mathematical technique for decision-making known as the analytic hierarchy process (AHP). Developed by Saaty (1980), the AHP is a widely used approach to handle multi-criteria decision-making. It uses a method for assigning ratings and weights that is considered reliable and consistent. To derive the weights, the AHP requires the judgements of decision-makers known as pair-wise comparisons, i.e. the relative importance of one criterion over another.

The second questionnaire was designed to capture these pair-wise comparisons on a scale of 1 to 9. Figure 3 shows an example of comparisons made between delivery performance versus cost of service, and delivery performance versus quality of service. Here, delivery was considered 5 times more important than cost, while delivery was perceived as equally important as quality.

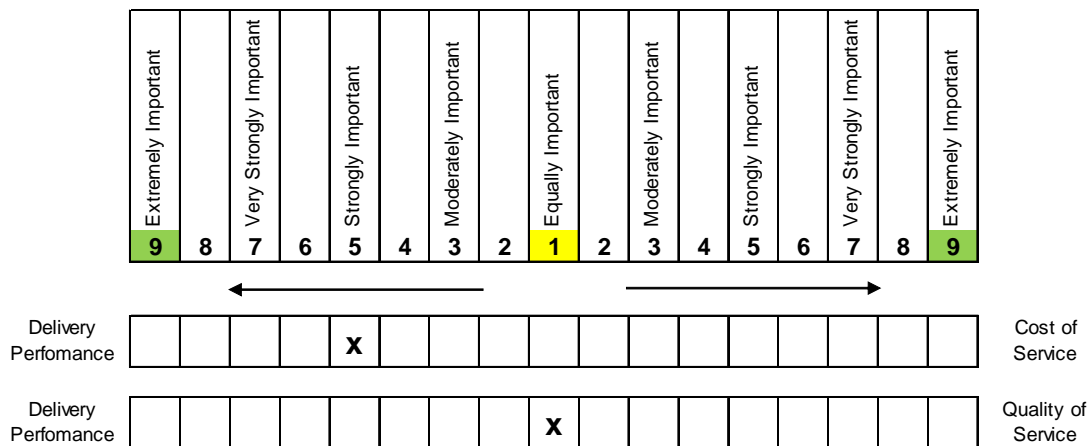


Figure 3: Example of pair-wise comparisons

We applied the multi-criteria decision-making model structure to three different industries by seeking the judgments of senior supply chain managers from these industries. For the survey on pair-wise comparisons, the self-completion questionnaire was emailed to six supply chain managers who had agreed to participate in the following industries:

- Oil and gas – 2 participants
- PC manufacturing – 2 participants
- Commodity trading (e.g. dry bulk, engineered metal, polymer products) – 2 participants

Results and Discussion

Company and respondent profile

Figure 4 shows the percentage distribution of the 30 respondents by type of industry from the first survey. The companies in the sample represented a range of industries in Singapore. Electronic and electrical equipment manufacturing had the highest percentage representation (27%), followed by wholesale trade (23%), petrochemical manufacturing (14%), and machinery and equipment manufacturing (13%). Most respondents were executives (67%) and in junior management (23%).

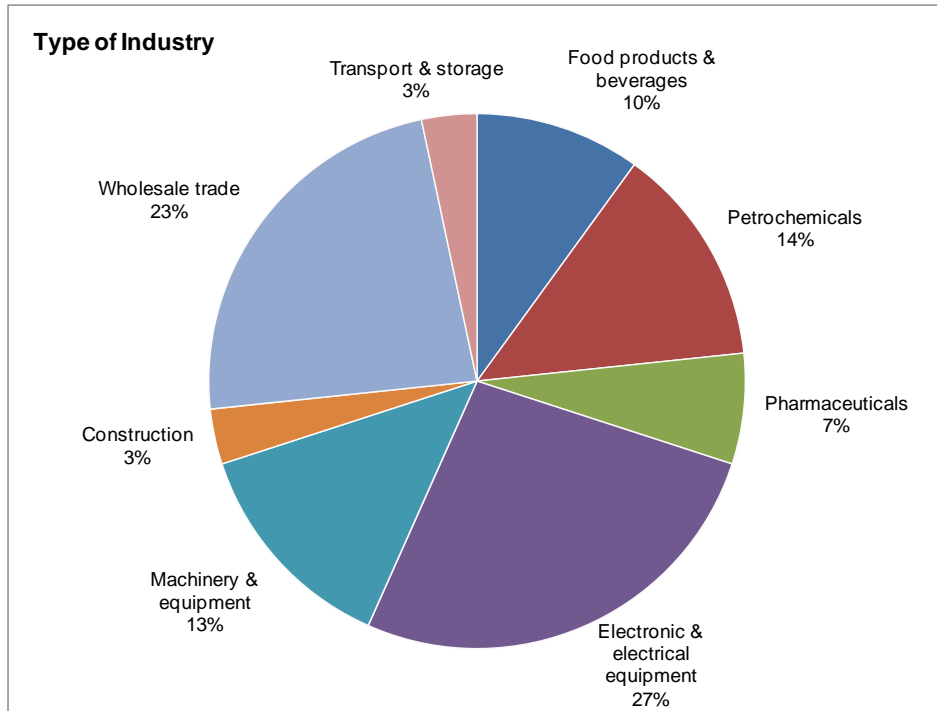


Figure 4: Percentage distribution of respondents surveyed by industry type (n = 30)

Extent of logistics outsourcing

Out of the 30 respondents, 27 (90%) reported that their company outsourced their logistics activities. This finding reaffirms the important role that 3PLs play in providing logistics capabilities to Singapore-based businesses. Figure 5 summarises the range of logistics activities that were reported as outsourced. The distribution was not uniform and some activities were more often outsourced than others. Clearly, 3PLs have not taken over the customer's entire logistics and supply chain operations.

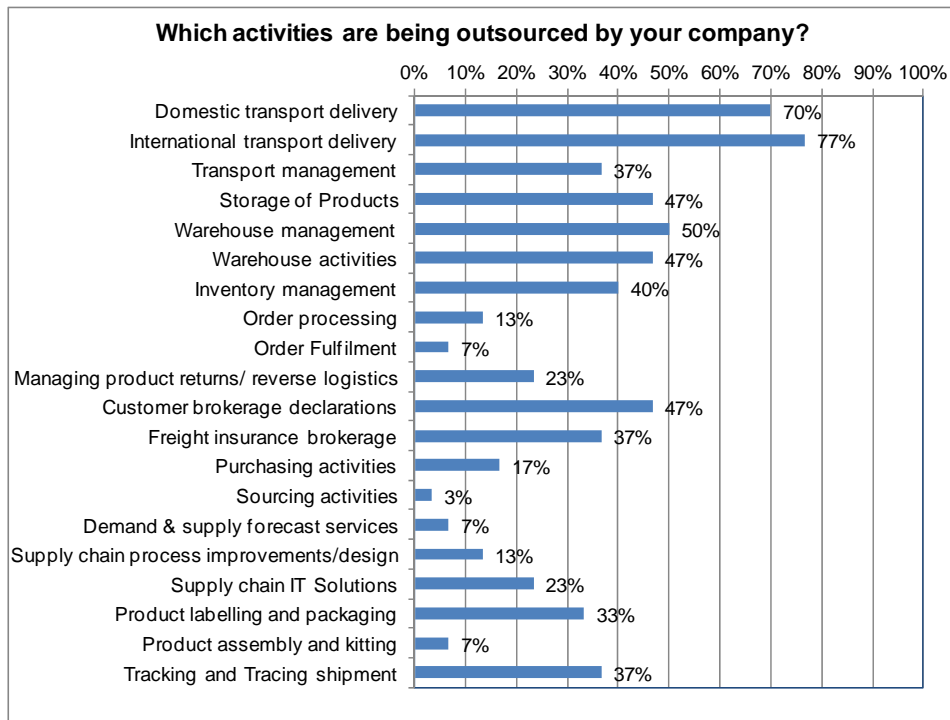


Figure 5: Percentage of respondents who reported the activity was outsourced

The most outsourced activities were international (77%) and domestic (70%) transport. This was followed by warehousing (47-50%) and customs brokerage declarations (47%). These activities tend to be logistics tasks that are transactional, operational and routine in nature. These functions can be readily supplied by many 3PL providers who have been in this business for many years.

The least outsourced activities were sourcing (3%), order fulfilment (7%), demand and supply forecasting (7%), product assembly and kitting (7%). Being more strategic and IT-intensive in nature, companies are less inclined to outsource these important functions. The findings seem to agree well with the trends reported by Langley and Capgemini (2010) in their annual study on third-party logistics.

Of the three respondents (10%) who stated that their company did not outsource logistics activities, they were asked to give reasons for not using 3PLs. The main reason cited was that control over the outsourced function would diminish which could jeopardise the company's service level. Other reasons mentioned were: logistics was a core competency of the company; cost reductions would not be realised; service level commitments would not be realised; the company has more expertise than most 3PL providers; and issues related to security of shipments.

Perceived importance of decision criteria

Table 2 summarises the importance of the decision criteria as rated by the 27 respondents in terms of the mean and standard deviation. Mean ratings for the four main decision criteria were high, ranging from 5.93 to 6.74. The respondents placed delivery (6.74), quality (6.44) and flexibility (6.04) ahead of cost of service (5.93) when selecting a 3PL.

Mean ratings for the 12 sub-criteria were also high, from 5.85 to 6.63. These values mirrored that of the four decision criteria. Delivery sub-criteria (D1, D2 and D3) had the highest mean ratings of 6.52 to 6.63. Cost sub-criteria (C1, C2 and C3) had the lowest mean ratings of 5.85 to 6.04.

The statistical t-test (Walpole et al., 2007) was applied to test whether the mean values were greater than 4 (neutral point) at the 5% level. The null hypothesis (H_0) was $\mu = 4$; the alternative hypothesis (H_1) was $\mu > 4$ (one-sided). The results indicated that the mean ratings for all decision criteria were significantly greater than 4 at the 5% level. Hence, the 3PL users considered these decision criteria to be important in the selection of a 3PL provider. The findings supported the inclusion of these criteria for the second survey on pair-wise comparisons.

Criteria	Rating		Means T-Test Result
	Mean	Std Dev	
Delivery performance	6.74	0.53	Reject H_0 . Mean is significantly greater than 4 at 5% level.
D1: On-time delivery	6.63	0.49	
D2: Right quantity delivered	6.52	0.51	
D3: Right place delivered	6.56	0.58	
Cost of service	5.93	0.92	
C1: Transport cost	6.04	0.90	
C2: Warehousing cost	5.85	1.03	
C3: Ancillary cost	5.96	0.98	
Quality of service	6.44	0.58	
Q1: Deliveries without defects	6.44	0.80	
Q2: Deliveries without complaints	6.48	0.70	
Q3: Customer initiative	6.11	0.80	
Flexibility of service	6.04	0.76	
F1: Urgent delivery fulfilment	6.44	0.70	
F2: Delivery lead time	6.11	0.70	
F3: Risk management	6.19	0.74	

Rating: 1 = extremely unimportant, 2 = very unimportant, 3 = somewhat unimportant, 4 = neutral, 5 = somewhat important, 6 = very important, 7 = extremely important

Table 2: Perceived importance of decision criteria (n = 27)

Application of the AHP method

The application of the AHP method involved the following steps:

- (1) Express the pair-wise comparisons provided by each participants as pair-wise comparison matrices; a (4 x 4) matrix for the main criteria and four (3 x 3) matrices for the sub-criteria.
- (2) Compute the relative weights for each criterion based on the judgements given by each participant.
- (3) Check for inconsistent pair-wise comparisons. A consistent judgment is one that returns a consistency ratio (CR) of less than 0.10 (or 10%). If CR is greater than 0.1, we discuss with the participant to improve the consistency of the comparisons.
- (4) If consistent, consolidate the judgements of individual participants and compute the consolidated weights for each criterion.
- (5) Finally, adjust the consolidated sub-criteria weights according to the weights of the main criteria.

In step (2), the relative weights for each criterion were determined by raising the pair-wise comparison matrix to powers that were successively squared each time. This squaring processing stopped when there was no significant change between all elements of the pair-wise comparison matrix in two successive steps of squaring. When this happened, the row sums were calculated and normalised to obtain the eigen-vectors. We used an Excel spreadsheet developed by Goepel (2012) to facilitate the computations.

Consolidated AHP weights

Table 3 summarises the derived AHP weights of the four criteria and 12 sub-criteria when selecting a 3PL provider. The figures in italics are the consistency ratios (CR) for the criteria and sub-criteria. The consolidated weights were grouped according to the type of industry of the participants. The CR values across the three industry groups were less than 0.1 indicating that there was reasonable consistency in the judgements of the consolidated pair-wise comparisons.

Criteria	Oil and Gas			PC Manufacturing			Commodity Trading		
	Weight	Relative Weight	Adjusted Weight	Weight	Relative Weight	Adjusted Weight	Weight	Relative Weight	Adjusted Weight
Delivery performance	0.328			0.197			0.148		
D1: On-time delivery		0.129	0.042		0.268	0.053		0.068	0.010
D2: Right quantity delivered		0.105	0.034		0.268	0.053		0.611	0.091
D3: Right place delivered		0.766	0.251		0.464	0.092		0.321	0.048
Sub-criteria Total		1.000	0.328		1.000	0.197		1.000	0.148
Consistency Ratio		<i>0.092</i>			<i>0.000</i>			<i>0.077</i>	
Cost of service	0.047			0.066			0.599		
C1: Transport cost		0.685	0.032		0.417	0.028		0.699	0.418
C2: Warehousing cost		0.120	0.006		0.218	0.014		0.141	0.084
C3: Ancillary cost		0.195	0.009		0.364	0.024		0.161	0.096
Sub-criteria Total		1.000	0.047		1.000	0.066		1.000	0.599
Consistency Ratio		<i>0.097</i>			<i>0.044</i>			<i>0.044</i>	
Quality of service	0.420			0.359			0.156		
Q1: Deliveries w/o defects		0.762	0.320		0.509	0.183		0.741	0.116
Q2: Deliveries w/o complaints		0.129	0.054		0.141	0.051		0.137	0.021
Q3: Customer initiative		0.109	0.046		0.350	0.125		0.122	0.019
Sub-criteria Total		1.000	0.420		1.000	0.359		1.000	0.156
Consistency Ratio		<i>0.055</i>			<i>0.094</i>			<i>0.001</i>	
Flexibility of service	0.205			0.378			0.097		
F1: Urgent delivery fulfilment		0.432	0.089		0.315	0.119		0.408	0.039
F2: Delivery lead time		0.159	0.033		0.404	0.153		0.475	0.046
F3: Risk management		0.409	0.084		0.281	0.106		0.116	0.011
Sub-criteria Total		1.000	0.205		1.000	0.378		1.000	0.097
Consistency Ratio		<i>0.015</i>			<i>0.012</i>			<i>0.002</i>	
Main Criteria Total	1.000			1.000			1.000		
Consistency Ratio	<i>0.084</i>			<i>0.028</i>			<i>0.084</i>		

Table 3: AHP weights for criteria and sub-criteria used for 3PL selection

Among the four main criteria, the oil and gas participants placed the highest weight on quality of service (0.420) when selecting a 3PL, followed by delivery performance (0.328) and flexibility of service (0.205). Cost of service had the lowest weight (0.047). Quality sub-criteria “deliveries without defects” and delivery sub-criteria “right place delivered” were important considerations for oil and gas companies. This can be due to the strategic value of the product being transported.

The PC manufacturing participants viewed flexibility (0.378) and quality of service (0.359) as the two criteria with nearly similar weight, followed by delivery performance (0.197). Cost of service had the lowest weight (0.066). Quality sub-criteria “deliveries without defects” and flexibility sub-criteria “delivery lead time” were found to be important for PC manufacturers. This can reflect the greater challenges in delivering defect-free products in a timely manner to fulfil customer demand.

The commodity trading participants placed a high emphasis on cost of service (0.599). Quality of service (0.156), delivery performance (0.148) and flexibility of service (0.097) had very low weights by comparison. This is not surprising as the commodity trade is likely to be conscious of profit margins depending on the trade terms used in the transport of goods. “Transport cost” had the highest weight of all the sub-criteria.

Conclusions and Recommendations

This paper attempts to contribute to the research on the performance evaluation of third-party logistics (3PL) service providers taking into account the viewpoints of the 3PL customer or service user. The study provides a methodology to investigate the extent of logistics outsourcing and to develop a decision-making model for 3PL selection.

The survey on logistics outsourcing in Singapore showed that 90% of the respondents reported that their company outsourced their logistics. The most outsourced activities tended to be transactional, operational and routine in nature, such as transport and warehousing. The least outsourced activities tended to be more strategic and IT-intensive in nature. The main reason cited for not using 3PLs was that control over the outsourced function would diminish which could hurt the company’s performance.

3PL service users considered the four criteria of delivery, cost, quality and flexibility together with the 12 associated sub-criteria (or performance indicators) to be important in the selection of a 3PL provider. The selection of a 3PL provider was modelled as a two-level multi-criteria decision-making problem. The analytical hierarchy process (AHP) was used to compute the criteria weights. The model was applied to three different industries (oil and gas, PC manufacturing and commodities trading) to see whether the derived weights were sensitive to these industries.

The results showed that the derived weights were different for these industries which can be explained by the unique characteristics of the product delivered, customer demand and trade terms. Quality and delivery were found to be important considerations for the oil and gas industry, while flexibility and quality were found to be important for PC manufacturers. Commodity trading companies tended to be cost-conscious. The implications are that different industries place different levels of importance on the 3PL selection criteria. To be competitive, 3PL providers need to be agile to align with the different expectations of 3PL users.

This paper has a few limitations. We noted the concerns of the small sample size and the sampling technique used for the logistics outsourcing survey. There is room to increase the sample size and to use a probability sampling technique to obtain a more representative sample. Another limitation is that the AHP assumes that the various criteria and sub-criteria are independent of each other. The possibility of interdependence among the criteria cannot be ruled out in this study. One approach is to explore the use of the analytic network process (ANP), which is a general form of the AHP that allows for interrelationships among the decision levels.

There is scope to include more participants for the pair-wise comparisons to reduce the possibility of bias. Further, the participants made the pair-wise comparisons independent of each other. There is room to consider group decision-making to reduce the possibility of conflicting judgements.

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EVALUATION OF THE DISTRIBUTION SYSTEM OF FERTILIZER STATE-OWNED COMPANY

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ABSTRACT

Purpose: This paper is aimed to evaluate the distribution system of one of Indonesia Fertilizer State-owned company which is obliged to apply specific distribution regulations dedicated for public service obligation of the company.

Methodology: The distribution cost of the existing system is compared with the proposed ones through some scenarios of distribution to improve the system and a mixed integer programming is developed to represent the optimization problem of the proposed system.

Findings: It is found that the proposed system could reduce the distribution cost by simplifying the distribution channelization and rearranging the clustering system of distribution warehouses while it keeps guarantee the security of supply.

Practical Implications: The proposed system may help to diminish the delay problem on product delivery due to shorter distance and more simple channelization. Moreover, the reduction of the distribution cost may come to the reduction of the subsidy that should be provided by the government. Finally, this current research must be followed by detail analysis of the feasibility of the implementation of the proposed system, particularly of the social impact of the closure of the warehouses.

Originality: The idea of public service obligation in distribution system becomes the originality of this paper and its value is to show that the government may increase the efficiency while the supply is kept secure at the same time.

Keywords: Distribution System, Public Service Obligation State-Owned Company

Paper type: Case Study

Introduction

This research work is a part of a series of research on distribution system of Public Service Obligation State-Owned Company (PSO-SOC). In Indonesia, PSO-SOC has an obligation to serve the entire demand on public commodities or services. Its working orientation is not for profit but for security of supply. Government gives subsidy as well as fee when the expenditure of the PSO-SOC larger than the revenue and in the other way PSO returns back the balance to the government if the expenditure smaller than revenue. However, the PSO-SOCs are still permitted to conduct their own programs beyond their main task but it is undertaken under limitation and controlling of the government. Hence, beyond their task on public commodities or services, some of PSO-SOCs expand their business to commercial market (Soehodho *et al.*, 2009).

The PSO-SOC under consideration deals with production and distribution of fertilizer in various types of products for both public and commercial market. Fertilizer is an important commodity for agriculture industries, hence the government concerns to regulate its distribution system in order to ascertain the fulfillment of its demands, especially of public demands. For public demands, government stipulates the maximum selling price of the products and it is constituted in the Minister of Agriculture Regulation.

Today, the public demands still encounter the shortage of fertilizer due to some problems. One of them concerns to the distribution or transportation issues. As continuation of our previous researchs which concern to one of the issues of PSO-SOC strategic plan, namely Location Model, this current research is focused to apply the proposed Location Model to the current system of the PSO-SOC under consideration. The objective of this current research is to evaluate the operation of PSO-SOC's distribution system.

From the existing distribution system, we investigate some scenarios which may be implemented in order to improve the efficiency of the distribution system of public commodity, in the context of reduction on transportation cost. The scenarios are focused on the rearrangement of the existing distribution network, and the best scenario is attained through the use of network flow problem-based model, namely Minimum Cost Flow problem (Ahuja *et al.*, 1993). We focus the investigation to the primary distribution from plant to distributor's warehouses.

Furthermore, the structure of this paper is as follows. Section 2 introduces the distribution system of the PSO-SOC under consideration. Section 3 deals with the model development. In section 4 we analyze the existing system and then the improvement will be analyzed in section 5. Finally, section 6 provides conclusions and future research directions.

Distribution System of the PSO-SOC Under Consideration

The company under consideration is one of the five affiliated companies of Indonesia Fertilizer Holding Company (PSO-SOC) which deals with fertilizer. Since fertilizer is an important substance which affect the productivity of agriculture, government regulates the distribution channel from the plant to the point of final customer, that is retailer, in the form of regulations of Minister of Agriculture and Minister of Trade. The company under consideration manages its own plant and the 3-stage distribution network which consists of:

- Plant / Plant Warehouse
- Producer's Distribution Warehouses (31 warehouses)
- Distributor's Distribution Warehouses (≈ 250 warehouses)
- Retailers (≈ 4864 kiosks)

Fig.1 shows the distribution network of the company. Such kind of distribution channel is particularly applied only for subsidized products whereas it is not necessary for the commercial products to follow the regulation. The commercial products are distributed based on the least cost distribution principle which thoroughly depends on the location and amount of the demand. Moreover, their distribution systems utilize the logistics facilities of subsidized products.

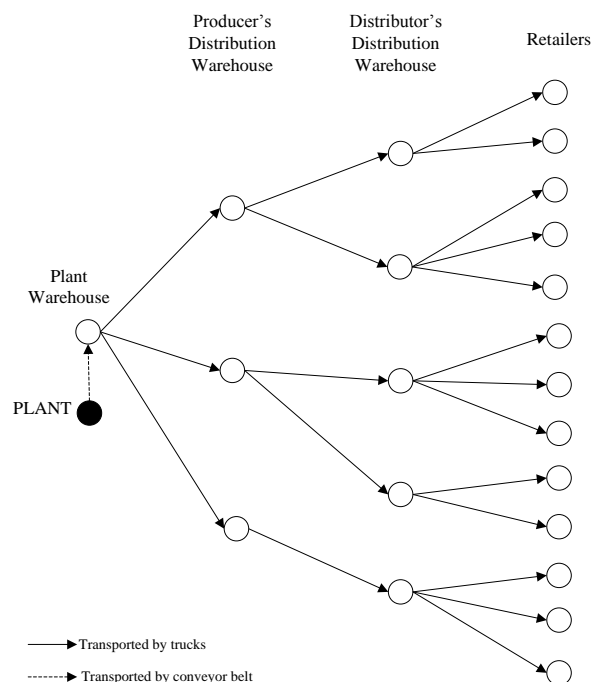


Figure 1. Distribution network of subsidized products

From the plant, fertilizers are transported to the plant warehouse by the conveyor belt to be packed and loaded onto the trucks. Furthermore, the products are transported to the producer's distribution warehouses (PWs) by trucks of third party company. PWs are designated to be a buffer and maintain

certain amount of products to guarantee the security of supply for the public demand. Though the minimum stocks in such warehouses are fulfilled, the trucks from the plant still have to drop the products in the warehouses due to regulation. Consequently, there will be loading and unloading process before the products transported to the following distributor's warehouses. Furthermore, from PWs the products are transported to distributor's warehouses (DWs) by trucks of third party also and then distributed to the retailers by local transporters.

From the economic point of view, we found that the primary distribution (from plant to DWs) of such system is lack of efficiency. We argue, firstly that in order to guarantee the minimum stock, the company is not always required to drop in on the PW. As long as the minimum stocks are fulfilled, the trucks may go directly to the DW. It will save both time and cost due to keeping away from loading and unloading, warehouse rental cost as well as inventory cost. This argument is supported by the fact that the company has made use of IT-based inventory system, so they could control the stock easily.

Model Development

In order to represent the problem of the efficiency of the distribution system, we base our model on the idea that there is tradeoff between the number of facility and the cost of distribution. Cost of distribution can be classified into primary (trucking/line-haul) cost and secondary (final) delivery cost (Rushton *et al.*, 2006). Primary distribution concerns to the movement of the full pallets of the product from point of production (finished product) to points of distribution, whereas secondary distribution concerns to the movement from point of distribution to the end consumers. For the primary transportation, the bigger the number of distribution points, the bigger the primary cost is. However, for secondary transportation the increase of the number of distribution points will reduce the transportation cost. In our case, the primary distribution is from plant to DWs, so as the final points of the primary distribution are DWs and the PWs are functioned as distribution centers. From this point, it raises the idea to reduce the number of PWs to diminish the cost of primary distribution, while the number of DWs is assumed to be fixed.

The development of mathematical model which represent the problem of the efficiency of the primary distribution between plant and DWs is focused to the variables of transportation cost and loading/unloading cost, as well as fixed cost of facility. However, since the company under consideration includes the loading/unloading cost into the transportation cost, so we unite both variables into one variable, namely transportation cost.

Furthermore, our model is applied to the 2-stage distribution network as shown in Fig.2. Such network enables the products to be transported either from plant to DWs via PWs, or from plant to DWs directly. The formulation of the model is set up as cost minimization problem with quantity of products distributed on each link as decision variable, along with the decision to open or close warehouses. The formula of our model is as follows :

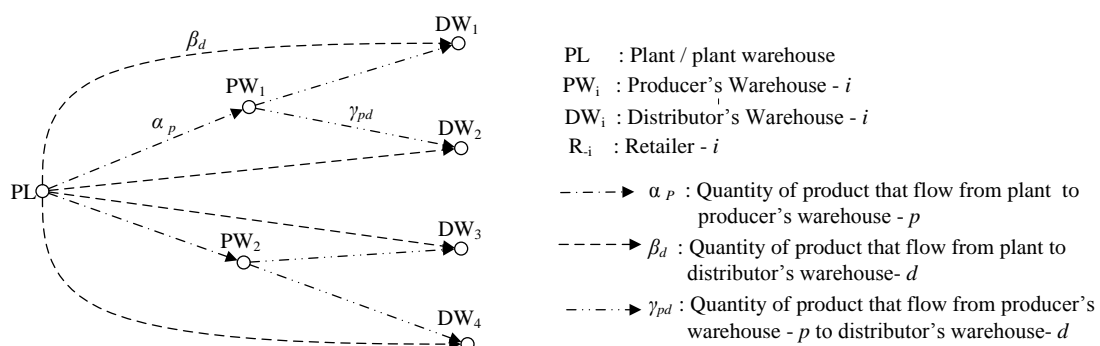


Figure 2 An example of primary distribution network

$$\min Z(\alpha_p, \beta_d, \gamma_{pd}) = \sum_{p \in P} u_p \alpha_p + \sum_{d \in D} v_d \beta_d + \sum_{p \in P} \sum_{d \in D} w_{pd} \gamma_{pd} + \sum_{p \in P} X_p FC_p . \quad (1)$$

subject to :

$$\alpha_p = \sum_{d \in D} \gamma_{pd} , \quad \forall p \in P . \quad (2)$$

$$\sum_{p \in P} \gamma_{pd} + \beta_d = \lambda_d , \quad \forall d \in D . \quad (3)$$

$$\sum_{p \in P} \alpha_p + \sum_{d \in D} \beta_d = S . \quad (4)$$

$$\alpha_p \leq X_p \cdot \sum_{d \in D} \lambda_d , \quad \forall p \in P . \quad (5)$$

$$X_p = [0,1] , \quad \forall p \in P . \quad (6)$$

$$\alpha_p \leq Cp_p , \quad \forall p \in P . \quad (7)$$

$$\alpha_p \geq 0 , \quad \forall p \in P . \quad (8)$$

$$\beta_d \geq 0 , \quad \forall d \in D . \quad (9)$$

$$\gamma_{pd} \geq 0 , \quad \forall p \in P, \forall d \in D . \quad (10)$$

Subscripts:

p : indicate Producer's Distribution Warehouse
 d : indicate Distributor's Distribution Warehouse

Sets :

P : Set of Producer's Distribution Warehouses
 D : Set of Distributor's Distribution Warehouses

Decision Variables:

α_p is quantity of product that flow from plant to producer's warehouse - p

β_d is quantity of product that flow from plant to distributor's warehouse- d

γ_{pd} is quantity of product that flow from producer's warehouse - p to distributor's warehouse- d

$X_p = 1$ if Producer's warehouse - p is opened , 0 otherwise

Input Parameters:

u_p : unit transportation cost from plant to producer's warehouse - p

v_d : unit transportation cost plant to distributor's warehouse- d

w_{pd} : unit transportation cost from producer's warehouse - p to distributor's warehouse- d

λ_d : demand at distributor's warehouse- d

S : quantity supplied from plant

Cp_p : capacity of producer's warehouse- p

FC_p : fixed cost of facility of producer's warehouse- p

Eq.1 denotes the objective function of our model. The fractions of such equation represent transportation cost (includes loading/unloading cost) from plant to PWs, from plant to DWs, and from PWs to DWs and also fixed cost of facility which represents the rental cost of PWs. Eq.2 shows that total inflow minus total outflow in PWs is set as zero since those nodes are set as intermediate nodes. Eq.3 is related to demand satisfaction of the DWs. Eq.4 shows that total amount of product which are sent from the plant should not be more than its supply capacity. Eq.5 guarantees that there will be no inflow and outflow in every closed PW. Eq.6 concerns with the binary number constraint and Eq.7 is aimed to ensure the capacity of the PW is not violated. Eq.8 ~ Eq.10 are non negative flow constraints.

Since such mixed integer programming is characterized by the problem of finding binary variable X_p to make location decision, hence we must examine all the combinations of composition of PWs and we make use of ADD algorithm to solve this problem (Daskin, 1995; Soehodho *et al.*, 2010). The principle of ADD algorithm is it adds facilities to the solution until the algorithm fails to find a facility whose

addition will result in a decrease in the total cost. Each candidate PW added to the solution has to reduce the cost as much as possible, while the previously selected PW is held fixed in the solution.

Analysis of the Existing Condition

Since the size of the existing distribution network is reasonably large, we cluster the network into some zones and this paper is focused on one of the zones and it is shown in Fig.3. The zone consists of 6 PWs and 53 DWs. The product flows from the plant to the plant warehouse through the conveyor belt. Since both the existing system and the improved one use the conveyor belt, in this case we ignore the cost of transport from the plant to the plant warehouse. DW1 ~ DW41 received the products through the PWs, while due to unsettled problem of finding the best place for PW, DW42~DW53 temporarily receive the products directly from the plant warehouse. The clustering system of the DWs along with the associated PW is set based on the administration boundary consideration. From this point of view, we take a note that some DWs are located quite far from the associated PW, and we argue that geographic consideration (distance-based consideration) may be more appropriate to achieve lesser transportation cost and easier access. For that reason, we try to propose a new clustering of DWs, along with the strategy to shorten the trip from plant to DW by design through-trip from plant warehouse to DW without stopping by at the PW. According to the flow and the associated unit cost of the current system (Fig.3), the system costs 736.939.000 IDR.

The Improvement of the System

In order to find better design of distribution network we utilize mathematical model of Eq.1 ~ Eq.10 to achieve the lesser cost (i.e objective function) than the existing one. Therefore, we modify the existing distribution network by 2 scenarios as follows :

Scenario 1 : Direct trips from plant warehouse to DWs are permitted

Scenario 2 : Direct trips from plant warehouse to DWs are not permitted and there must be PWs to buffer minimum stock of product

For both scenarios, we do not change the current condition in which DW42~DW53 receive the products directly from the plant warehouse

In order to exercise the scenario 1, we modify the original network as shown in Fig.2 by adding direct links from plant warehouse to all DWs (scenario 1a) and also by adding such modified network by some links from certain PWs to certain DWs in which there is vague location in term of administration boundary and geographic consideration (scenario 1b). The first notion is related to the strategy of through-trip from plant warehouse to DW without stopping by at the PW, while the second one concerns to both through-trip and the clustering system of DWs. Moreover, scenario 2 is exercised by using original network which is modified by only adding some links from certain PWs to certain DWs. Since we fully utilize all the existing facilities, there is no additional node on the all modified networks. Such modified networks are used to test whether the current system could be enhanced by changing the network design. Furthermore, solution of the mathematical model is found through the use of the developed source code (Nahry, 2010). The solution of the three scenarios along with the existing system are presented in Table 1.

Scenario	Feature of modified network	Objective Function (IDR)
Existing		736.939.000
1a	Open potential direct links from plant warehouse to all DWs	476.152.000
1b	Open potential direct links from plant warehouse to all DWs and some links from certain PWs to certain DWs	476.152.000
2	Open potential some links from certain PWs to certain DWs	691.781.000

Table 1. Solutions of 3 scenarios

From table 1, Fig.4 and Fig.5, it can be seen that even the working networks are different, the optimal solutions of both scenarios 1a and 1b are similar and they show that all the product flow directly from plant warehouse to DWs. Such solutions cost IDR.476.152.000 (64.62% of existing system). From scenario 2 (Fig 6), we can see that if we do not allow the product to flow directly from plant warehouse to DWs, we could still rearrange the existing clustering system in order to reduce the cost. In our case, we can reduce the cost to IDR 691.781.000 (93.87% of existing system) by opening only PW1, PW4 and PW6. The cost reduction comes from avoiding of the rental cost of PW2, PW3, PW5, as well as loading and unloading cost. Eventually, if the PWs must exist and be functioned as a buffer of supply the solution of scenario 2 may be the best solution for the system rather than the existing one.

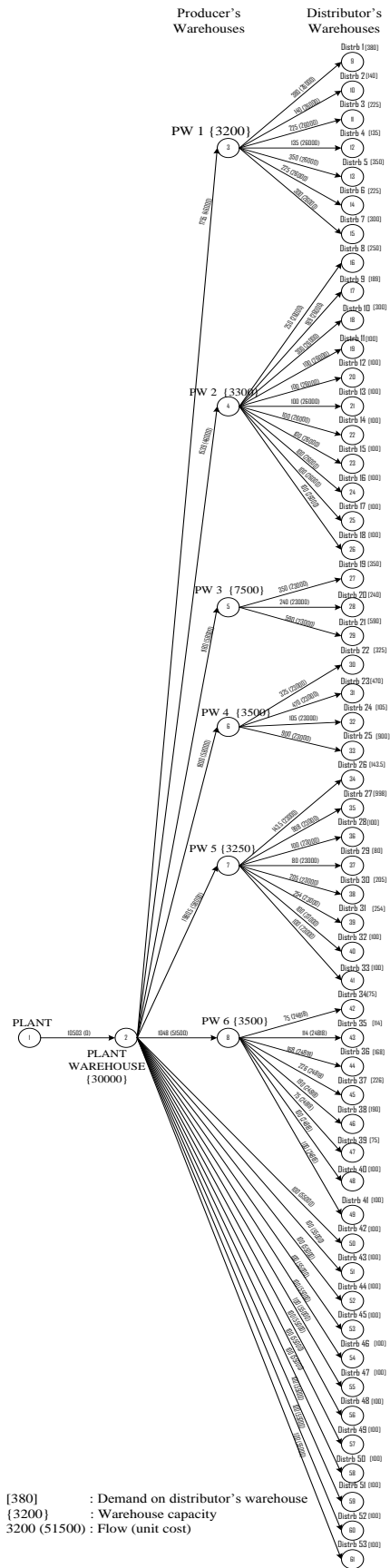


Figure 3 The existing network of zone under consideration

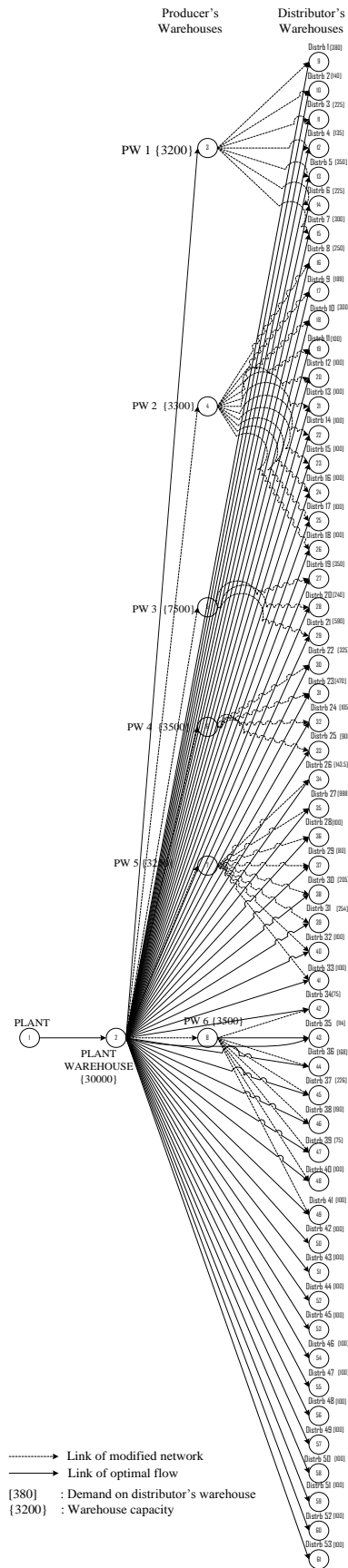


Figure 4 The proposed network of scenario 1a and its optimal solution

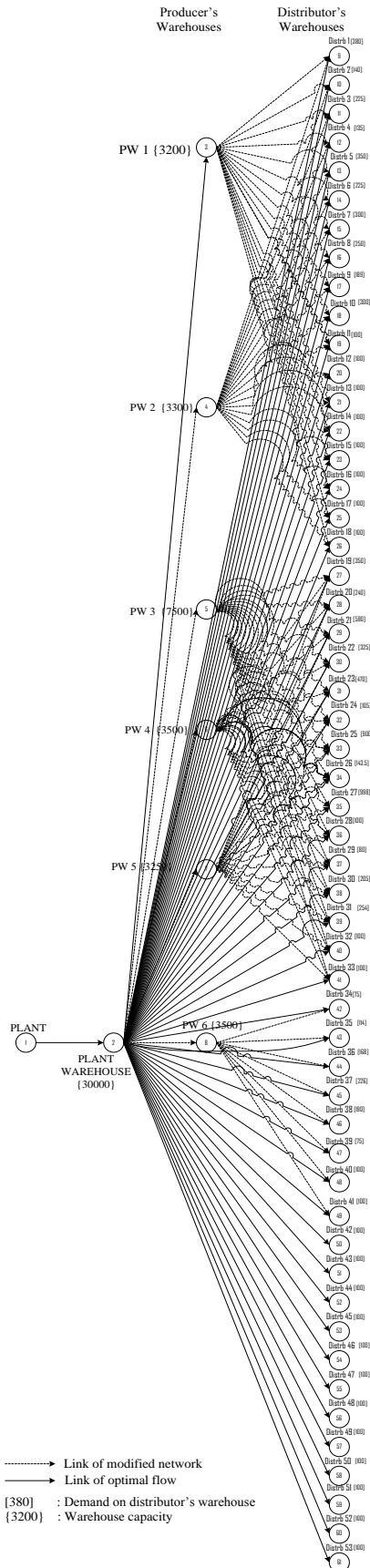


Figure 5 The proposed network of scenario 1b and its optimal solution

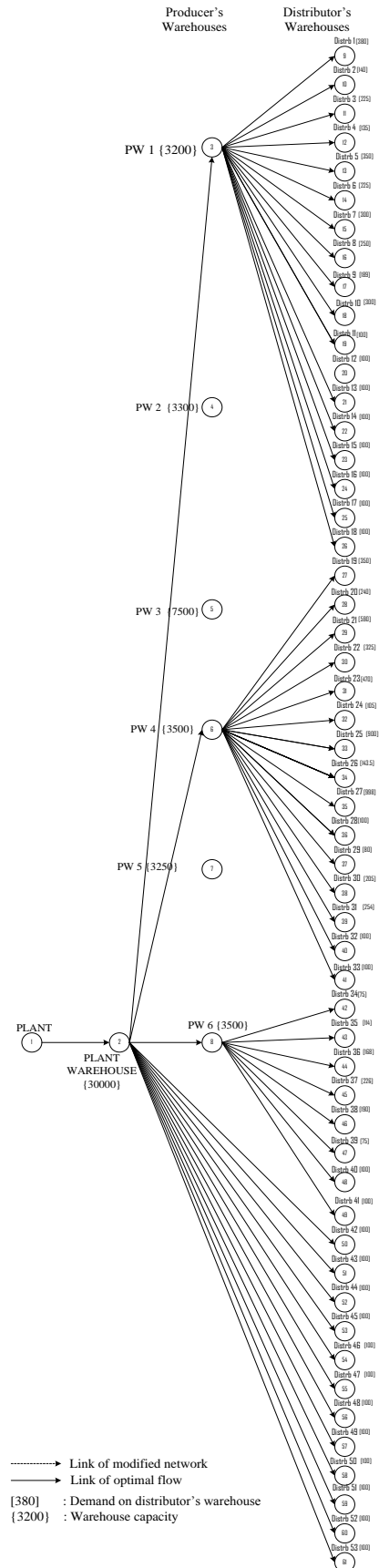


Figure 6 The proposed network of scenario 2 and its optimal solution

Conclusion

A new distribution system has been proposed in order to reduce the distribution cost from plant to the distributor's warehouses of the existing system. The proposed system is based on the idea of reducing the number of producer's warehouses to keep away from loading/unloading cost, rental cost as well as inventory cost. The proposed system also evaluates that the existing clustering of the distributor's warehouses could be enhanced by taking into account the geographic consideration (distance-based consideration) rather than merely administration boundary consideration. Consequently, both ideas may also help to diminish the delay problem on product delivery due to shorter distance and more simple channelization. Moreover, the reduction of the distribution cost may come to the reduction of the subsidy that should be provided by the government. Finally, this current research must be followed by detail analysis of the feasibility of the implementation of the proposed system.

Author Biographies

Nahry is a faculty member in Department of Civil Engineering, Universitas Indonesia. She received her Master and Doctoral degree in Transportation from Universitas Indonesia. She has been doing a lot of research works on Public Transport Planning and Operations as well as Logistics.

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EQUIPMENT TRADE AND TRANSPORTATION TRENDS FOR ASIA-EUROPE-AFRICA

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ABSTRACT

Purpose: To provide clues for enhancing multimodal transportation and trade policies, the transportation and machinery equipment trade and transportation trends for the 3 continents of Asia, Europe and Africa, AEA, were analyzed.

Methodology: For the study area a multimodal network was defined. The relevant time-series information was extracted from centralized databases consisting of 4 categories: transportation and machinery equipment trade, transportation, geographical and socio-economic characteristics. The deployed techniques included: preliminary statistical analysis, regression and elasticity analyses, shortest path algorithm, gravity modeling and liner programming.

Findings: The study identified possible relations between trade and transportation. Gravity modeling introduced GDP and transportation variables as the determinant factors for trade. The coefficients of gravity models often showed increasing time trends. The comparison between optimal trade distributions, based on linear programming, and their observed distributions, showed significant differences. Further study of the AEA trades can enhance trade routing and policy development.

Limitations: The study database was limited to information accessible from centralized and international databanks. The trade information was aggregate at national and total transportation and machinery equipment level. The study AEA network was a simplified version of the actual multimodal network. Information about network actual link flows was not accessible. The origin and destination of trades were assumed to be the country's capital.

Originality/value: For the first time, trade and transportation trends for the 3 land connected continents of the AEA were analyzed based on a newly defined multimodal network.

Keywords: Regional transportation, multimodal transportation, trade modeling, gravity modeling, linear programming, Asia, Europe and Africa, freight multimodal routing.

Paper Type: Research paper.

Introduction

Freight transportation plays a key role in trade and economic development. It supports production, trade and consumption activities by ensuring the efficient movement and availability of raw materials, intermediate products and finished goods. Over the years, interest in explicit consideration of commodity and goods movement in the transportation planning has steadily increased (Park and Regan, 2005, Vaziri and Omrani, 2011). A recent study suggested that 10% increase in transportation costs would reduce 20% of trade volume (Rodrigue et al., 2009). The United Nations Commodity Trade Statistics Division confirms that more than one third of total value of global trade volume is related to transportation and machinery equipment (Comtrade, 2010). Transportation cost has a significant effect on final goods' prices, and trade partners are expected to select the nearest demand and supply nodes. The effect of the transportation distance and cost on the transportation and machinery equipment trade is a subject of debate as many geopolitical and economic factors can play significant roles. The continents of Asia, Europe and Africa, AEA, have the advantage of land connectivity and are accommodating more than 80% of world population. Around 90% of total export of European, 79% of Asian and 76% of African countries went to other countries in Asia, Europe and Africa during 2009 (Comtrade, 2010).

The study reported herein tries to shed some light on the effect of transportation on the AEA intra and intercontinental transportation and machinery equipment trade. The relevant time-series data were extracted from centralized and international databases. The database consisted of variables grouped into 4 categories: transportation and machinery equipment trade, transportation, geographical and socio-economic characteristics. The study deployed techniques included: preliminary and univariate statistical analysis, regression analysis, shortest path algorithm, elasticity analysis, sensitivity analysis, gravity modeling and liner programming. The international trade flows were analyzed for a 40 year period covering 1965 to 2005. The trans-continental multimodal transportation network covered 125 countries of AEA (Vaziri and Dashtestaninejad, 2010).

Database Development

The study database consisted of pertinent time-series information for international trade extracted from international and centralized databases. It comprised of country's data in 4 categories: transportation and machinery equipment trade, TMT, transportation, TRS, socio-economic, SEC, and geographical, GEO. The time-series covered a 40 year period of 1965 to 2005. For each year of the study period, 9 variables were finally selected for detail analysis as shown in Table 1. The geographical scope covered 125 countries, 45 in Asia, 31 in Europe and 49 in Africa. The TMT data were extracted from the United Nations Commodity Trade Statistics Division databanks (Comtrade, 2010). The SEC and GEO were also extracted from United Nations databases (Vaziri and Omrani, 2011). The TRS data were developed from United Nations sources (Vaziri and Dashtestaninejad, 2010). The AEA multimodal transportation network, with distance and cost attributes, consisted of 5323 nodes, including the 125 capital nodes. Deploying network analysis algorithms, such as shortest path algorithm, TRS variables were determined for capital cities of country pairs i and j . The C_{ij}^{MM} is the optimal transportation cost for the multimodal network which included all the 4 modes of highway, H, railway, R, sea, S and air, A. The D_{ij}^{HRS} is the optimal distance with 3modes of highway, H, Rail, R, and sea, S. The D_{ij}^{Air} is the direct air distance for air mode, A.

Table 1: Data base structure and description

No.	Category	Symbol	Unit	Description	Number of observation
1	TMT	T_{ij}^{EX}	\$	Export of transportation and machinery equipment, from country i to country j in dollar	125×125
2		T_{ij}^{IM}	\$	Import of transportation and machinery equipment, from country j to country i in dollar	125×125
3	TRS	C_{ij}^{MM}	\$/unit of transport	Multimodal transportation cost between country i and country j	125×125
4		D_{ij}^{HRS}	Km	Multimodal distance between country i and country j	125×125
5		D_{ij}^{Air}	Km	Direct distance between country i and country j	125×125
6	GEO	A_i	Thousand Km ²	Area of country i	125
7		L_i	Dummy	Landlocked of country i	125
8	SEC	P_i	Thousand persons	Population of country i	125
9		GDP_i	\$/year	Gross domestic product of country i	125

To shed some light on database structure and scope, preliminary univariate and multivariate statistical analysis was performed. As an example, the summary of preliminary univariate statistical analysis for the year 2005 is presented in Table 2. Furthermore, correlation matrices were developed showing the existence of significant correlation between variable pairs. They often showed significant correlations between trade, GDP and transportation variables. The negative correlations between transportation and trade variables suggested the negative influence of transportation cost and distance on trade.

Table2: Univariate statistical analysis for year 2005

No.	Var.	Unit	Min	Max	Mean	St. dev.	Coef. of var.	Valid cases
1	T_{ij}^{EX}	\$	0	7.64×10^{10}	1.84×10^8	1.69×10^9	8.75	12524
2	T_{ij}^{IM}	\$	0	5.68×10^{10}	1.74×10^8	1.47×10^9	8.46	12400
3	C_{ij}^{MM}	\$/unit of transport	24	7004	2000	991.21	0.49	15500
4	D_{ij}^{HRS}	Km	60	18268	6720	3566.85	0.53	15500
5	D_{ij}^{Air}	Km	12	14748	5240	2899.47	0.55	15500
6	A_i	Thousand Km ²	0.06	17075	678	1794.20	2.65	125
7	L_i	Dummy	0	1	0.74	0.44	0.60	125
8	P_i	Thousand persons	30	1.31×10^6	4.43×10^3	1.55×10^5	3.50	125
9	GDP_i	\$/year	3.02×10^8	4.55×10^{12}	2.24×10^{11}	6.10×10^{11}	2.72	123

Trade Modeling

Several trade modeling approaches can be distinguished: a microscopic level with a microeconomic point of view, a meso level with spatial interaction modeling, and a macroscopic level with a macroeconomic point of view. The spatial interaction modeling approach was found suitable for the study database. The models often used for spatial interaction modeling are based on gravity distribution and linear programming modeling (Vaziri and Omrani, 2011).

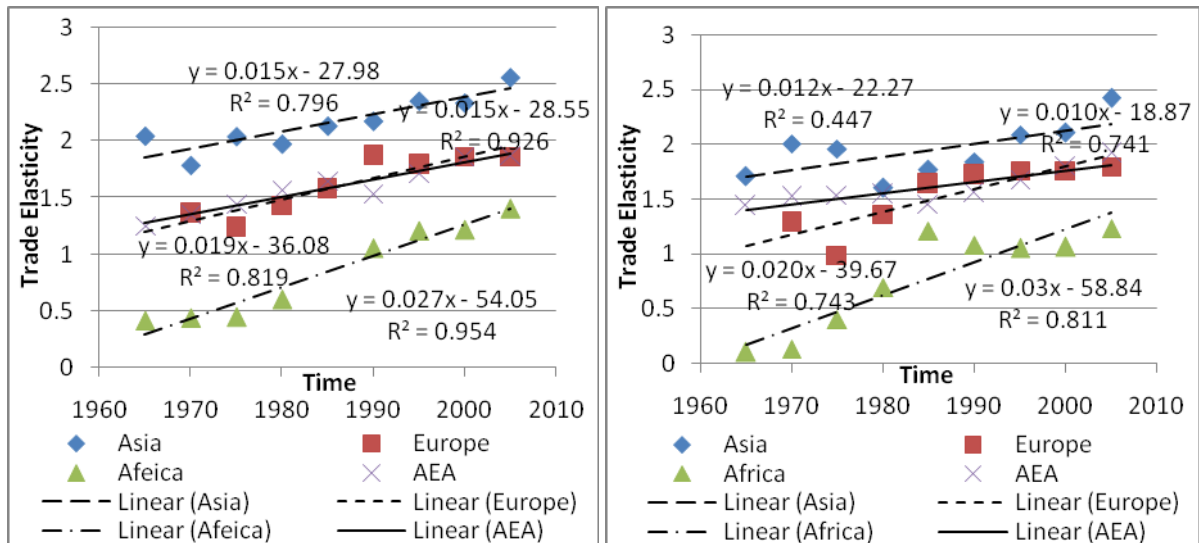
The gravity model was originated by Newton gravity rule of mechanical physics. The trade gravity model between two countries in its basic form assumes trade increases with country size or incomes and decreases with spatial impedance. Three different spatial trade impedance variables were defined and examined in this study: the conventional air distance and the multimodal distance and costs. Deploying stepwise regression analysis and a confidence level of 95%, for each year of the study database, gravity models of transportation and machinery equipment trade were developed. Table 3 shows the modeling results for 1965 to 2005 for five year intervals for the AEA 125 countries. The variables are defined as in Table 1 and the trade variable C7subscript reflects that transportation and machinery equipment has code 7 in the UN commodity system.

Table3: Transportation and machinery equipment gravity models

Year	Model	R ²	Model	R ²
1965	$T_{ij,C7}^{EX} = 10^{-5.103} \frac{GDP_i^{1.318} GDP_j^{0.225} POP_j^{0.230} 10^{0.372LL_j}}{D_{ij}^{HRS1.430} A_i^{0.286} A_j^{0.106}}$	0.59	$T_{ij,C7}^{IM} = 10^{-4.066} \frac{GDP_i^{0.118} GDP_j^{1.304} POP_i^{0.601} 10^{0.234LL_i}}{D_{ij}^{HRS0.959} C_{ij}^{MM0.791} A_i^{0.149} A_j^{0.346} 10^{0.304LL_j}}$	0.60
1970	$T_{ij,C7}^{EX} = 10^{-6.769} \frac{GDP_i^{1.386} GDP_j^{0.427} 10^{0.250LL_j}}{D_{ij}^{HRS1.262} POP_i^{0.159} 10^{0.203LL_i} A_i^{0.278}}$	0.58	$T_{ij,C7}^{IM} = 10^{-10.042} \frac{GDP_i^{0.534} GDP_j^{1.631} 10_i^{0.251LL_i}}{D_{ij}^{HRS1.059} POP_j^{0.385} A_j^{0.377} 10_j^{0.178LL_j}}$	0.60
1975	$T_{ij,C7}^{EX} = 10^{-8.763} \frac{GDP_i^{1.482} GDP_j^{0.512} 10^{0.500LL_j}}{D_{ij}^{HRS1.515} C_{ij}^{MM0.791} A_i^{0.517} 10^{0.229LL_i}}$	0.56	$T_{ij,C7}^{IM} = 10^{-9.237} \frac{GDP_i^{0.512} GDP_j^{1.143} POP_j^{0.109} 10^{0.375LL_i}}{D_{ij}^{HRS1.169} A_j^{0.641} 10^{0.166LL_j}}$	0.58
1980	$T_{ij,C7}^{EM} = 10^{-10.694} \frac{GDP_i^{1.590} GDP_j^{0.528} 10^{0.445LL_j}}{D_{ij}^{HRS1.197} A_i^{0.553} A_j^{0.081} 10^{0.226LL_i}}$	0.60	$T_{ij,C7}^{IM} = 10^{-11.070} \frac{GDP_i^{0.521} GDP_j^{1.529} POP_i^{0.100} POP_j^{0.213} 10^{0.340LL_i}}{D_{ij}^{Air0.721} C_{ij}^{MM0.518} A_i^{0.141} A_j^{0.640} 10^{0.389LL_j}}$	0.58
1985	$T_{ij,C7}^{EX} = 10^{-14.853} \frac{GDP_i^{1.963} GDP_j^{0.657} 10^{0.362LL_j}}{D_{ij}^{HRS1.163} POP_i^{0.364} A_i^{0.449} A_j^{0.100} 10^{0.133LL_i}}$	0.63	$T_{ij,C7}^{IM} = 10^{-11.973} \frac{GDP_i^{0.555} GDP_j^{1.671} POP_i^{0.231} 10^{0.174LL_i}}{D_{ij}^{HRS0.611} C_{ij}^{MM0.606} A_i^{0.169} A_j^{0.536} 10^{0.476LL_j}}$	0.60
1990	$T_{ij,C7}^{EX} = 10^{-11.987} \frac{GDP_i^{1.564} GDP_j^{0.582} POP_i^{0.118} 10^{0.198LL_j}}{D_{ij}^{HRS0.904} C_{ij}^{MM0.267} A_i^{0.427} A_j^{0.114}}$	0.63	$T_{ij,C7}^{IM} = 10^{-11.114} \frac{GDP_i^{0.598} GDP_j^{1.487} POP_i^{0.204}}{D_{ij}^{Air0.564} C_{ij}^{MM0.806} A_i^{0.158} A_j^{0.374} 10^{0.208LL_i}}$	0.66
1995	$T_{ij,C7}^{EX} = 10^{-8.211} \frac{GDP_i^{1.276} GDP_j^{0.537} POP_i^{0.114} POP_j^{0.166} 10^{0.143LL_j}}{D_{ij}^{Air0.847} C_{ij}^{MM0.749} A_i^{0.324} A_j^{0.058} 10^{0.084LL_i}}$	0.63	$T_{ij,C7}^{IM} = 10^{-9.520} \frac{GDP_i^{0.558} GDP_j^{1.529} POP_i^{0.265} 10^{0.120LL_i}}{D_{ij}^{HRS0.756} C_{ij}^{MM0.754} A_i^{0.174} A_j^{0.271} 10^{0.086LL_j}}$	0.66
2000	$T_{ij,C7}^{EX} = 10^{-9.879} \frac{GDP_i^{1.444} GDP_j^{0.617} POP_j^{0.127} 10^{0.076LL_j}}{D_{ij}^{HRS0.959} C_{ij}^{MM0.779} A_i^{0.188} 10^{0.288LL_i}}$	0.62	$T_{ij,C7}^{IM} = 10^{-10.514} \frac{GDP_i^{0.656} GDP_j^{1.404} POP_i^{0.204} POP_j^{0.115}}{D_{ij}^{Air0.760} C_{ij}^{MM0.985} A_i^{0.060} A_j^{0.297} 10^{0.210LL_j}}$	0.64
2005	$T_{ij,C7}^{EX} = 10^{-11.498} \frac{GDP_i^{1.550} GDP_j^{0.622} POP_i^{0.092} POP_j^{0.166} 10^{0.090LL_j}}{D_{ij}^{HRS1.038} C_{ij}^{MM0.760} A_i^{0.327} 10^{0.165LL_i}}$	0.64	$T_{ij,C7}^{IM} = 10^{-11.548} \frac{GDP_i^{0.633} GDP_j^{1.511} POP_i^{0.289} POP_j^{0.212}}{D_{ij}^{Air0.897} C_{ij}^{MM0.989} A_i^{0.106} A_j^{0.427} 10^{0.099LL_i} 10^{0.126LL_j}}$	0.64

The table confirms the negative relationship between transportation and machinery equipment trade and the transportation variables. To more distinctly highlight the effect of transportation variables on the developed models, a second and refined set of models were developed using only GDP and one of the transportation variables C_{ij}^{MM} , D_{ij}^{HRS} and D_{ij}^{Air} . These models were similar to Table 3 in terms of coefficient sign and value, and R².

In a gravity model, the elasticity of the dependent variable with respect to an independent variable is its calibrated coefficient (Vaziri and Omrani, 2011). To evaluate the sensitivity of trade with respect to transportation variables from 1965 to 2005, variation of calibrated coefficients were studied. Linear regression models were calibrated to estimate the trend of coefficient of C_{ij}^{MM} , D_{ij}^{HRS} and D_{ij}^{Air} . For

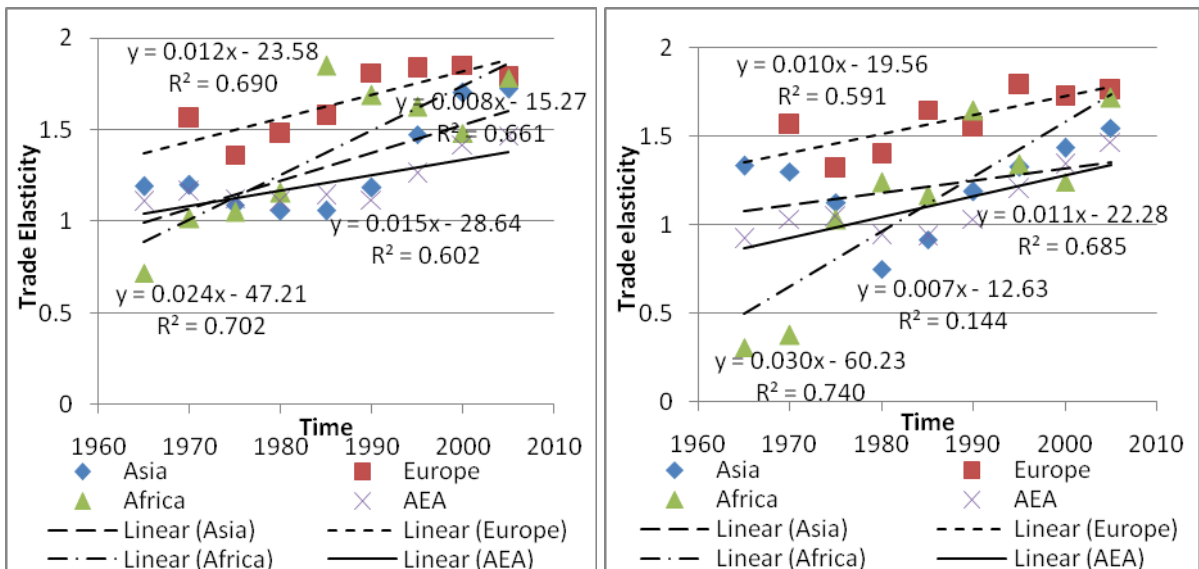


within AEA and continents separately, the results of linear regression analysis for the refined set of gravity models are presented in Figures 1 to 3. Upward trends of transportation coefficients for within

a) Export

b) Import

Figure 1: Trends of trade elasticity with respect of C_{ij}^{MM}



a) Export

b) Import

Figure 2: Trends of trade elasticity with respect to D_{ij}^{HRS}

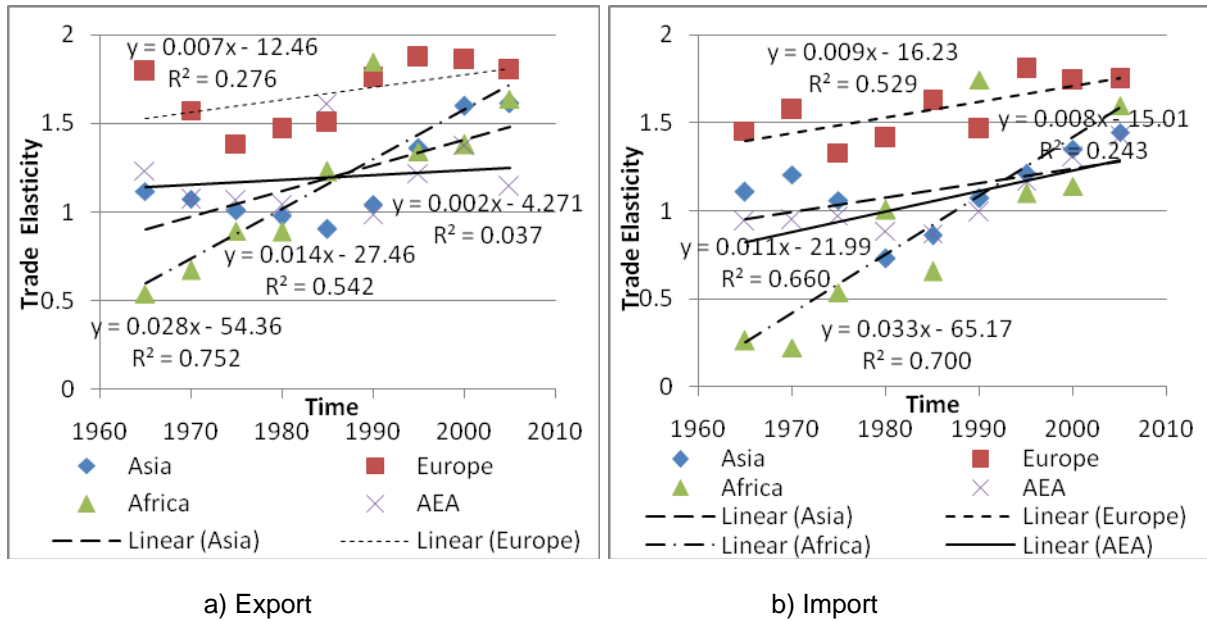


Figure 3: Trends of trade elasticity with respect to D_{ij}^{Air}

AEA and continents separate are evident in these figures. The elasticity is often more than one, reflecting that trade was elastic with respect to transportation variables. Furthermore, R^2 's show that fitness of linear models differ among continents, nevertheless are often at acceptable levels.

The results of linear regression modeling revealed that the transportation sensitivity of trade has increased over time. The figures show that Asia had the highest and Africa the lowest trade elasticity's with respect to transportation cost, with AEA and Europe trade elasticity's in between of Asia and Africa. With respect to transportation distance, Europe had the highest and Africa the lowest trade elasticity in almost all of the cases. Africa had lowest transportation sensitivity of trade although its sensitivity showed higher gradient of improvement since 1965. This could be of great interest to international organizations and national policy makers to further develop and finance Africa's transportation infrastructure and facilities. The study rejects the notion of the "death of distance", as some past studies were advocating (Vaziri and Omrani, 2011). The upward trend of distance and cost effect on trade shows the aforesaid hypothesis is not always applicable at least for the global transportation and machinery equipment trade. In contrast, AEA countries tried to reduce transportation costs over time by choosing "closer" suppliers of goods. Nevertheless, this was far from linear programming optimal solutions.

To determine potentials for transportation improvement of trade, linear programming, LP, was deployed to compare observed trade distributions with its possible optimal values. The objective function, reflecting AEA or continents separately total transportation "cost", was minimized using simplex algorithm. The LP determined possible redistribution of trade with the consideration of the trade supply and demand constraints of individual countries. Due to language, historical, socio-cultural and geopolitical reasons, it is not always possible to deploy LP solution in actuality; nevertheless it provides clues to the potentials for improvement. Tables 4 and 5 show the results of LP for transportation and machinery equipment trade for multimodal networks for AEA and each continent separately. The tables show the percentage of possible improvement if trade was redistributed based on optimal LP solutions. The improvement potentials were often more for Europe than Asia and Africa. Significant trade improvement potentials were observed for all the 125 countries of AEA.

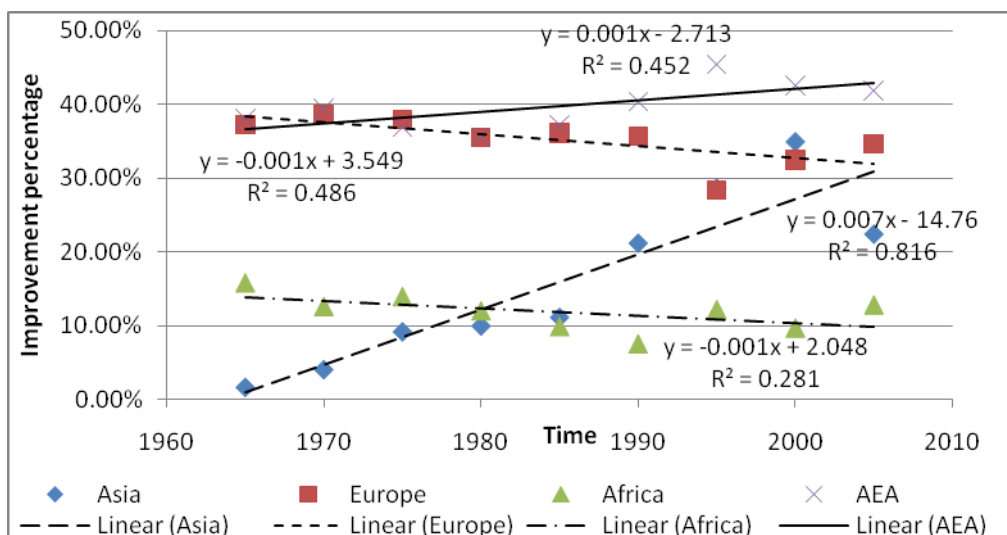
Table 4: Possible improvements in export trade redistribution

Year	Based on C ^{MM}				Based on D ^{HRS}			
	AEA	Asia	Europe	Africa	AEA	Asia	Europe	Africa
1965	37.98%	1.68%	37.30%	15.85%	44.21%	1.51%	39.86%	40.76%
1970	39.45%	4.07%	38.67%	12.60%	43.70%	3.97%	44.59%	33.44%
1975	36.87%	9.19%	38.05%	13.95%	40.97%	5.59%	46.49%	29.24%
1980	35.51%	9.99%	35.55%	12.00%	40.49%	7.50%	39.89%	19.67%
1985	37.21%	11.15%	36.13%	9.83%	43.92%	11.16%	39.58%	26.60%
1990	40.43%	21.19%	35.71%	7.44%	49.11%	23.50%	37.65%	16.85%
1995	45.45%	28.64%	28.38%	12.18%	59.29%	32.99%	51.51%	28.70%
2000	42.60%	34.91%	32.49%	9.63%	55.52%	40.62%	35.42%	8.94%
2005	41.85%	22.41%	34.65%	12.81%	54.16%	34.53%	36.64%	16.60%

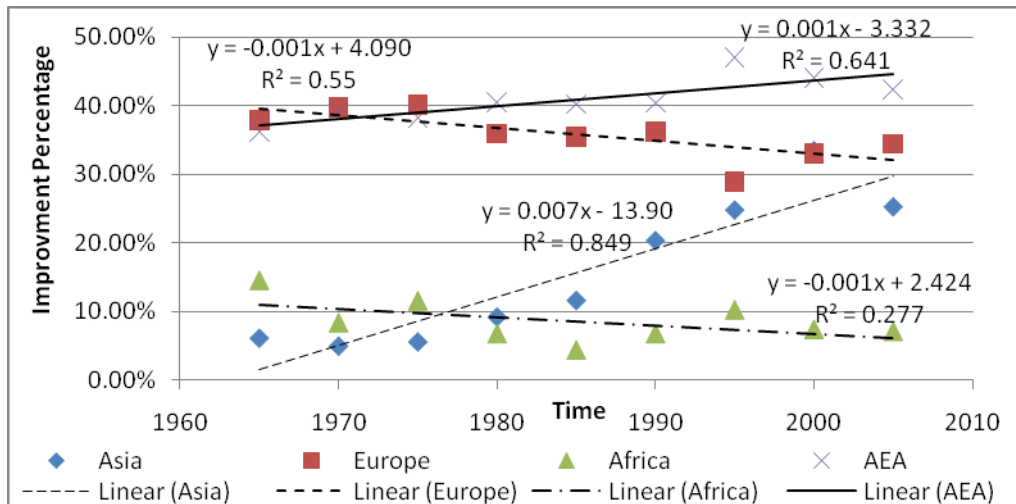
Table 5: Possible improvements in import trade redistribution

Year	Based on C ^{MM}				Based on D ^{HRS}			
	AEA	Asia	Europe	Africa	AEA	Asia	Europe	Africa
1965	36.13%	6.03%	37.93%	14.52%	42.04%	9.81%	40.85%	29.46%
1970	39.24%	4.86%	39.78%	8.35%	46.17%	4.03%	42.17%	24.72%
1975	38.27%	5.48%	40.15%	11.54%	44.21%	7.48%	41.90%	36.27%
1980	40.44%	9.13%	35.92%	6.74%	45.26%	6.07%	40.42%	19.63%
1985	40.18%	11.55%	35.48%	4.35%	49.23%	14.69%	39.69%	55.75%
1990	40.40%	20.32%	36.21%	6.75%	48.45%	20.92%	38.53%	18.31%
1995	47.08%	24.78%	28.92%	10.21%	60.76%	30.01%	32.46%	24.82%
2000	43.99%	33.46%	33.03%	7.37%	56.76%	38.93%	36.20%	9.53%
2005	42.31%	25.25%	34.43%	7.08%	54.19%	36.06%	36.63%	10.31%

To determine the trends of improvement potentials through time, regression models for AEA and continents separately were developed. The results are shown in Figures 4 and 5. As the figures show, the potentials for Asia significantly grew over time compared with Europe and Africa. In other words, Asia trade showed a diverge trend from LP optimal distributions through period of 1965 to 2005. Where as Europe and Africa trade showed a converge trend to LP optimal distributions.



a) Export



b) Import

Figure 5: Export and import improvement potentials through time based on C_{ij}^{MM}

Linear approximation model revealed that coefficient of time variable for continents were significantly different. Over the study period, the difference in percentage between observed and optimal distributions for transportation and machinery equipment trade decreased for Europe and Africa, in contrast for Asia and AEA.

Conclusion

The study shed some light on transportation and machinery equipment trade trends in 3 continents of Asia, Europe and Africa, AEA. The trade and transportation among 125 countries, based on spatial interaction models during the period of 1965 to 2005, were assessed and evaluated. The study AEA transportation multimodal network consisted of 5323 nodes connected by highway, railway, air and sea links. The study database consisted of national time-series information for 9 pertinent variables: transportation and machinery equipment import and export trades between country pairs, multimodal optimal transportation cost between country pairs, multimodal optimal distance between country pairs, air distance between country pairs, GDP, population, area and landlocked. The study deployed techniques included: preliminary and univariate statistical analysis, regression analysis, shortest path algorithm, elasticity analysis, sensitivity analysis, gravity modeling and liner programming.

The database preliminary statistical analysis showed significant correlations between trade, GDP, and transportation variables. The cross-sectional gravity confirmed that transportation and machinery equipment trade between country pairs are related to their GDP's and transportation costs or distances. Elasticity analysis based on the developed gravity models highlighted that the transportation variables seems to play an important role on AEA region transportation and machinery equipment trade and this effect is increasing in parallel with globalization trends over time for the whole AEA region, and its 3 continents. This effect is expected to be even more significant in the near future with the current growing trends of energy price and economic crises. Trade elasticity with respect to cost and distance had highest values for Asia and Europe respectively. Africa had lowest transportation sensitivity of trade among studied areas although its trade sensitivity grew significantly over time. The optimal transportation and machinery equipment trades, based on linear programming solutions, were compared with observed distributions. Comparison revealed that up to 60% of the AEA total transportation costs can be reduced if the observed trades follow the LP optimal distributions. The differences mostly attributed to the historical, socio-cultural, language, geopolitical and other factors which were not considered in this later optimization exercise. Percentage of possible improvement decreased during the study period for Europe and Africa. In contrast, percentage of possible improvement for AEA and Asia trade increased, indicating that observed distributions diverged from the optimums. This study was a preliminary step toward the AEA time-series transportation and trade appraisal. Deploying the study methodology and results can enhance pertinent policy making and infrastructure development at the AEA national and regional levels. The study database and results were limited to extractable information from centralized and accessible international databanks, nevertheless, the same methodology can be used for other geographical and spatial/temporal information to enhance trade and commerce.

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Bahador Ghadiri is a M.S. transportation and logistics engineer at the municipality of the historic city of Esfahan.

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CAPACITY PLANNING IN CONTAINER HANDLING FACILITY

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ABSTRACT

Purpose: Uncover unmet plans (underutilized resources) and the met/realized plans (undervalued capacity) fuelled by work methods mediation and establish basis for Ideal Capacity.

Design/Methodology/Approach: To test the Equipment Efficiency and Work Methods, Productivity Standards, Existing Capacity; and Ideal Capacity by Sampling of historical data, current operations reports, performance reports before and after mediation of methods; and Observational Research (naturalistic and participant modes). T-test, ANOVA, and F-Test were used where deemed applicable.

Findings: Improving Equipment Efficiency and Work Methods does improve Productivity Standards at a certain efficiency level not exceeding the equipment's allowable capability; Productivity Standards does not directly affect Existing Capacity; while Productivity Standards, if updated and dependable, is a better basis of Ideal Capacity. But Existing Capacity is a sure yardstick of Productivity Standards' relevance and operational performance.

Research Limitations/implications: Sensitivity of internal information and confidentiality clause delimit the presentation of the detailed computation and efficiency of variable equipment attributes is no longer itemized. Between operator's speed and equipment's speed, the latter prevails and test is no longer necessary.

Practical implications: Negative variance of Ideal Capacity against projected Demand necessitates resource balancing and provision options. Positive variance provokes added marketing efforts or productivity programs. No variance means status quo.

Social implications: Reliable Productivity Standards are beneficial when considering reaction to changes in Gross Domestic Product (trade influx) and in the overall growth of this logistics network.

Originality/Value: In container handling where ideal capacity is based on traditional experience (existing capacity), this study objectively views the ideal capacity through buoyant and dependable Productivity Standards setting.

Keywords: equipment efficiency, existing capacity, container handling, ideal capacity, productivity standards, work methods

Paper type: Case Study

Introduction

Capacity is basically the measure of volume of liquid/solid or space available for a certain container or storage area. For humans, capacity is in the form of aptitude, ability, skill, competence or function. For operations, capacity is the output produced within the number and availability of machines, workers and workers' skill, allowable delays/defects/scrap/errors, other resources and supply factors, and surrounding regulations.

A more usable definition of capacity would be the volume of output per elapsed time and the production capability of a facility (www.zarate-consult.de, 2012).

Container handling facility, the gateway of goods situated at ports, serve as logistics platform coordinating a node for network of parties that Nair and Huynh (2011) identified as shippers, ocean carriers, terminal operators, and forwarding companies. Ports fulfil three key functions—the regulatory function, the landowner function, and the operator function. These functions are detailed in the succeeding scenario:

If docking does not necessitate vessels to wait at a nearby anchorage at the port of call, they are promptly guided by expert pilots (proficient on the unique local seabed contours and safer navigation) as stowage brings them to designated berth. After ports authorities' and customs' formalities, stevedoring services of port terminal operators commence. Gang complement for unlashing is mandatory for containerized vessels prior to discharging of containers by means of quay cranes and the support of trucks transporting the containers from the quay side to the yard. After containers from the yard to the berth are loaded, lashing of loads then seals the stevedoring operations. As arrival and departure cycle is completed, port and customs formalities recur prior to stowage back to anchorage area as the ocean liner is finally released and sails to the next port of call.

However, based on this caselet, in-between discharging and loading or prior to loading, the vessel may opt to have temporary hiatus at the anchorage. A number of reasons for vessel waiting time at the anchorage may be due to: (1) full berth occupancy; (2) terminal handling limitations; (3) freight and load delay; (4) vessel-related or crew-related circumstances; (5) statutory regulations and port state control or compliance; and (6) weather-imposed.

The 3rd to 7th probable reasons for anchorage waiting time are uncontrollable and externally driven. The 1st, and 2nd probable causes may be manageable at the quay-side, terminal operator's end. Thus, a rundown focus is on full berth occupancy, and terminal handling limitations that include pilotage and stowage.

Terminal Handling Limitations may be the ability of the operator to manage resources, comply with regulations, adapt to market mechanism, and other positioning strategies. Even the Stowage and Pilotage Availability may just be a minimal portion of the delay if two vessels arrive at the same time or due to pilot contracts/shifting/scheduling issues only.

Yet, the Full Berth occupancy may reflect two opposing manifestations. Firstly, this circumstance may represent that everything occurs as planned. Secondly, this may be a resultant of unmet plan dragging some slight, prolonged stay of vessels at dockside. Slight because if substantial berthing time extensions are needed, they are better sent back to anchorage to allow other vessels on queue. However, unmet allocated berthing time may again be caused by terminal operations or the shipping lines/shippers/forwarders. The latter, may only be imposed by terminal operator in the form of lead time cut-off or policy sanctions but the former, must be traced back to the planning assumptions used or unproductive execution of plan.

Unmet plan due to planning inaccuracy with supposed terminal standards is considered an operational inefficiency. Throughput is measured in terms of twenty-foot equivalent units or TEUs as what Nair and Huynh (2011) mentioned as a standard maritime industry measurement used when counting cargo containers of varying lengths.

On the surface, realized plan that is consistent with terminal standards and verifiable assumptions established by operations, is already claimed as productive port performance. It is neither an aspect to be complacent with because as UK Parliament's Committee on Transport (2003) puts it: Throughput is only one indicator of port performance. It does not necessarily reflect efficiency. However, there is no simple relationship between efficiency and capacity. *High utilization can lead to a reduction in operational efficiency, increased congestion and reduced service levels on both shipside and landside.*

Growing Capacity is always apparent in global logistics. The Port Technology Organization (2011) for instance cited the following at the shipbuilding's point of view: (a) Global boxship deliveries to increase TEU capacity by 5%; (b) Total global capacity is expected to reach 16.8M TEUs in 2012 based on Braemar Seascope's Containership Fleet Statistics; (c) 59 of the 230 containership expected to be delivered in 2012 will have a total capacity of 10,000 TEUs or more; (d) Vast majority of ultra-large containerships are currently deployed on *Asia-Europe services*; (e) The 2012 delivery influx would be sufficient tonnage to create another *5 loops deploying 10 x 13,000 TEU vessels*; (f) Orders of smaller capacity ships of 5,100 TEU is up by 2.9% in 2011 and 3% in 2012; and (g) By 2011, the *10,000 TEU capacity vessels constitute 49% of the global orderbook* while the *5,100 TEU capacity vessels has the 20% share* of the global orderbook.

Not only in shipbuilding but in port expansion as well in 2011 that: (a) *India* is to increase its annual capacity to more than 3B tons by 2020 according to its Minister of Shipping. Seaborne trade represents 80% of India's total exports; (b) *Jebel Ali Port in UAE* is to expand as DP World contractor announced the US\$850M project to reach a capacity of 19M TEU by 2014, a 4M TEUs per annum rise. In 2011, the growth was 11% and over a million TEU per month being handled in the port; (c) Expansion plans for *Dublin Port* may double trade in 20 years or by 2040 starting 2011. For the past 30 years, volume of goods going through Dublin Port had quadrupled; (d) *New Zealand Port of Tauranga* has started in 2011 the expansion worth NZD30M. Trade volume increased by 18% in 2011; (e) *Saudi Arabia* to spend \$613M on port expansion in *Dammam, Yanbu, and Jubail Ports*. Dammam is set to double its capacity within the next 3 years; (f) China is planning \$7.1B expansion of *Dandong Port* which is to increase the port's annual capacity from 60M to 100M tons; (g) While the UK's economic outlook remains uncertain, the economy's ability to return to growth will only be possible if the UK has the necessary infrastructure. Berths 8&9 of *Felixstowe* will ensure the country has the port capacity to enable this growth, creating an additional one million TEU capacity per annum; and (h) Container traffic through *Canada's Pacific Gateway* is expected to double over the next 10 to 15 years, and nearly triple by 2030. Current projections indicate approximately four million TEUs (twenty-foot equivalent units) of additional capacity will be needed to meet West Coast container demand by 2030 (Nightingale, 2011).

In 2012 updates of Port Technology news, the following are the expansion plans: (a) French Firm, Bollore Group, to double capacity of *Ivorian container facility* by 2015 with \$79M infrastructure upgrade at Abidjan Port, Africa; (b) APM Terminals to invest over \$100M to boost capacity at *Port Poti, Georgia* to increase Poti's capacity over the next 3 years by a further 50% from the 178,000 TEU in 2011; and (c) a 568-meter quay capable of serving 2 sea-going vessels and 3 barges simultaneously shall increase the capacity of *Antwerp Port* by 18%.

In 2000-2008, US container port traffic grew by an astounding 42.56% (Nair and Huynh, 2011).

There is no indication of slowing down of container handling demand and port capacities as consumption is set to increase as population increases.

Capacity Planning issues at the port can result in various forms of operational inefficiencies such as ship delays, missed feeders, extra manpower, yard congestion, re-handling, increased idle times for trucks and emission (environmental concern), and longer lead times for shipper. Approximately 55% of port-related costs can be reduced by improving ship turn-around times and cargo handling needs (Nair and Huynh, 2011) although 5.3% of delays is said to be caused by worse climactic conditions (Varbanova, 2011).

The purpose of this study is to uncover unmet plans (underutilized resources) and the met/realized plans (undervalued capacity). Thus, assess the declared, existing capacity of a certain port (with variable equipment efficiency ratings) if it is indeed the ideal capacity by looking at the operational inefficiencies that may serve as areas for improvement.

Literature Review

The selected, succeeding literature were valuable citations by which analysis and direction of the study outcome were anchored. Some also fuelled the arguments and clarification to challenge the usual practice or gave credence to known theories and uncommon facts. .

Capacity further means as the maximum amount of work that an organization is capable of completing in a given period of time. In a simple model (www.zarate-consult.de, 2012), it might be calculated as $[number\ of\ machines\ and/or\ workers] \times [number\ of\ shifts] \times [utilization] \times [efficiency]$.

An optimal berth utilization as per the world standard, defined by United Nations Conference on Trade and Development (UNCTD) is about 65% to 70%. The world's benchmark for Throughput per day is about 30 to 40,000 tonnes. The *turn-around time* for high productivity ports is in the range of 1.8 to 2.4 days. The *parcel size* is about 120,000 tonnes. (Australian Port Association and other bulk Ports in the world in TransCare Logistics India, 2007).

In Bulgaria, as cited in Varbanova (2011), the main reasons for lack of schedules integrity on container feeder lines in the region are due to the following: port utilization/congestions and delayed berthing

(65.5%); delay during cargo operations due to port equipment (20.6%); delays due to worse climactic conditions (5.3%); delays due to time lost for waiting of pilots, tugs (4.7%); and a total of 3.9% for accidental delays at ports, delays in supplies of fuels, channel passages, etc.

In other parts of the globe where productivity rates are simply crane productivity, berth utilization rate and turn-around times, in UK Parliament's Committee on Transport Ninth Report (2003), the measures of productivity are broader and proportional to other costs of operation. The Ports Comparative Terminal Productivity is measured in terms of Port, Quay Length (m), Terminal Area (Ha), Throughput of a given period or year, TEU per meter of Quay, and TEU per Hectare.

Edullantes (2007) said that an era of opportunities and challenges in port operations is plausible because Asian and world economies continue to expand by which port operators and shipping lines eventually face tougher shipping demands. In Makassar Terminal Services alone, the annual growth is more than 10% annually at a high productivity rate of over 25 TEUs per hour per crane. Yet, major ports in Indonesia deal with shortage of capacity, resulting in longer vessel waiting time and turnaround time. There are over 2,000 ports in an archipelago of over 13,000 islands.

It is difficult to see progress in container handling equipment - methods of handling containers are essentially unchanged since the dawn of containerisation. There are two underlying factors to consider. Firstly, port planning and operational research and studies should be interdisciplinary in that they straddle the border lines of different engineering disciplines. Planning of ports and harbours usually comes within the bounds of civil engineers working for administrative authorities such as national or municipal governments or port authorities. Secondly, planning and design of container terminals have always depended mainly on empirical experience, while a corpus of theoretical knowledge, which could help inform this experience and in turn be verified or modified by it, has been lacking. At the onset of containerisation, it was indispensable for terminal operators to build up experience. It was relatively easy to perform daily operations based only on what that **experience** indicated was the storage capacity of the terminal (Watanabe, 2001).

An Operations Analyst once argued that Productivity Standards depend on government regulations. A justification for not updating the productivity rates of the quay cranes by which the capacity plans and port stay or berthing time are estimated and based. Estimated Time of Completion (**ETC**) and eventually, Estimated Time of Departure (**ETD**) of the Vessel calling at the port are dependent on usual productivity rate assumption. From the time the quay cranes were acquired, the productivity rates may have only updated once or twice for a span of 8 years. The basis of which was, in fact, the final stevedoring reports with mere figures without remarks on the nature of operations that transpired.

SGV & Co/Ernst and Young Principal, Washington Roqueza (1993) clarified to the author that Work Standards are based on three aspects: *Product-Based*, *Equipment/Machine-based*, and *Methods-Based*. As to how often should standards be updated, he further stressed that the need is as often as there is change among (or in any of) the three aspects.

Ahmad, Idris, and Kader, (2007) wrote that container terminal capacity should be periodically reviewed. It has to be audited against demand and current performance.

On Capacity Planning and Expansion, a seasoned terminal manager who is adept with technology's significance said: "You don't open a terminal to try and steal some business from the existing market. You open a terminal because there's a pent-up demand for capacity. As that capacity is brought online, you obviously look at the demand side to make sure you're not OVER providing, and at the same time, that you're not UNDER providing" (Milliken, 2007).

There is a growing realization that simply producing large quantities of a standard product does not necessarily mean one is productive. Organizations must produce what the marketplace needs, when it needs it, and at a competitive price. The ideal of meeting customer needs and expectations without error or waste has now entered the vocabulary. So the output side of the calculation is more complex now. When considering labor productivity, the input is simply the quantity of labor expended. In a more sophisticated analysis, the industrial engineer will also consider things such as how effective the labor is by measuring performance, utilization, and method levels (Smith, 2001 in Rao, 2012).

The key to the strategic success of planning and scheduling as partly mentioned in Lockamy III and Cox III (1994) are quality, delivery and lead time. Measurements monitored within this area are: (1) *Conformance to Daily Production Schedules* (2) *Planning Customer Service*; (3) *Operations cycle time*; (4) *Scrap/Delay/Lost Time cost*; (5) *Customer Service*; (6) *Inventory Performance*; and (7) *Departmental budget*.

Research Methods

As primary data source, the two types of Observational Research, naturalistic and participant as Mitchell and Jolley (1996) mentioned, were adapted. In gathering sample of actual work methods and performance of equipment, the naturalistic observation, was extremely helpful. In the case of the work methods improvement mediation, after discussion with and approval from the section head, a pilot trial of the enhancement in methods was applied which is known as participant observation.

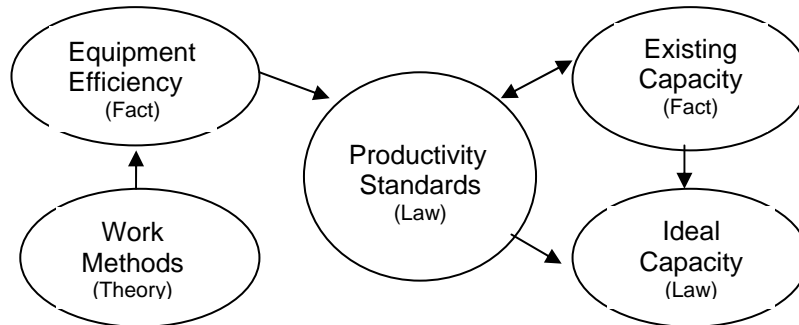


Figure 1. Capacity Planning Research Framework

Validation and further sampling on the secondary data (planned and actual performance reports and other documentation pertaining to subject workers and equipment) were scanned and analyzed.

Figure 1 illustrates the variables tested in this capacity planning framework study.

Hypotheses

1. Improving Equipment Efficiency and Work Methods will improve the Productivity Standards
2. Increasing Productivity Standards will directly increase Existing Capacity
3. Productivity Standards and Existing Capacity are reliable bases of Ideal Capacity

Research Design

To test hypothesis No.1: Discharging and loading processes were observed and areas for improvement were noted. Actual Observation (Control Set-up) was conducted against the Mediation of Proposed Methods (Experimental Set-up) which was coordinated with the section head concerned. Worker skill and methods and his intervention with machine shall be randomly verified in actual and other samples shall be based on performance reports. Prior and Post Experimental data on trial of proposed or improvements in work methods were analyzed.

For Hypothesis No. 2: Productivity Rates of past periods were tested with the sampling period's Existing Capacity based on reported performance. Equipment Logsheet, working time, downtime, idle time, set-up time, and maintenance time were verified. Utilization rate was compared against the productivity rate set-out for equipment. Between man and machine, the efficiency rating of the machine shall override the efficiency rating of man or machine/equipment operator.

For Hypothesis No.3: Planned discharging and loading for a certain vessel, the ETC and ETD, equipment and worker complements were traced with the actual performance reports. The Plan against Performance Reports and against Overall Available or Ideal Capacity (Assigned and Unassigned Berthing Time) were compared.

The sampling period shall cover two weeks, one week day-shift observation and one week night-shift observation. The berthing schedule, discharging and loading sequence, the gang complement and quay crane as well as truck allocation shall be secured and compared with the performance reports for the same production schedule of 2 weeks. The quay crane acquisition date, the existing efficiency rating, the utilization rate for the past 2 weeks prior to sampling period, the current deployment times, the model and brand were noted.

There is no more test needed for increasing Equipment Efficiency against Productivity Standards or against Capacity since *High utilization can lead to a reduction in operational efficiency, increased congestion and reduced service levels on both shipside and landside (UK Parliament's Committee on Transport, 2003)*. T-Test, Analysis of Variance and F-Test for analyzing Multiple Group Experiment were utilized where deemed applicable among the 3 hypotheses.

Findings

The overall results are presented in Table 1 wherein Hypothesis 1 is True, Hypothesis 2 is Not Always Applicable while Hypothesis 3 favors Productivity Standards more than Existing Capacity on certain circumstances.

Hypothesis 1	Hypothesis 2	Hypothesis 3
YES, True	NOT ALWAYS	Only with Updated Standards; Existing Capacity applicable if matches the Standards but at times underperformed

Table 1. Overall Results Summary

The comparative results of the observation, report scanning, work methods mediation, and records analyses are summarized in Table 2.

Tests on Hypothesis Area Observed	Hypothesis 1 (Improving Equipment Efficiency and Work Methods will improve Productivity Standards)	Hypothesis 2 (Increasing Productivity Standards will directly increase Existing Capacity)	Hypothesis 3 (Productivity Standards and Existing Capacity are reliable bases for Ideal Capacity)
On Board Job	Gang composition is too much. Reduction not easy. Contract and protection from the labor union	N.A. – Deployment Negotiated and Dictated by the Collective Bargaining Agreement (labor)	Yes because of previously accepted agreement between terminal operator and labor union
Dockside	Quay crane operator works at normal pace as planned using schematic diagram. Delays during positioning and releasing of containers atop the yard trucks just situated below the crane. Both are unique and dependent to each other; Variable condition per equipment	Not consistent; quay cranes have reach constraint due to built; if r seasonal weather not considered during standard setting; or quay crane preventive maintenance and set-up time are not inclusively established in the Performance Report (basis of Existing Capacity).	NO because equipment operational history of Existing Capacity is not in the performance report; thus, Existing Capacity is Independent is not affected by Productivity Standards. It is reactive. Fluctuating productivity rates of equipment; sometimes have notation of repair but mostly, no remarks.
Dockside/Landside Interface	Yard trucks not consistently parked on a convenient position. Drivers position the trucks off-lane, The crane has to tilt the cable to fit the locks of the container on the chassis. Delay is 1.5	Truck's productivity rate (planned assumptions) matches with existing capacity if quay crane performance has no unpredictable interruptions and	No, because what is assumed standard during dry season and rainy season when records were scanned, were just the same. Maintenance standards were not on a per machine basis when considered by Planning.

	minutes per TEU. If 23 TEU/hr/crane, then that is 50% more : $23 \times 1.5 = 34.5$ minutes extension for a supposed 1 hr work	truck drivers do not cause any delay; Truck and quay crane performance is supposedly complementary and no lost time or waiting time for both.	Machines are variable and when actual allocation of machine, the net productivity rate sometimes are assumed instead of the per machine or equipment rate. Standards are not comprehensively considered in what Varbanova (2011) cited.
Landside	Turnaround time of trucks delayed; Outgoing containers, prioritized. Yard congestion or lane choking	Overall quayside and landside performance (ETC) is more than 30% unmet	No; utilization not optimized with congestion or movement obstruction in the yard, predetermined yard location, distances, and transport times

Table 2: Comparative Summary of Naturalistic and Participant Observation

If quay side manner of movement of containers is improved, trucks aligned and positioned orderly under the quay crane, not tilted, the productivity rate may even reach 34 to 35 TEUs per hour per crane which is still attainable in other ports. Some ports even reach around 50 TEUs. ETC is also bound to have minimized deviation from actual time of completion of discharging/loading.

Conclusions and Recommendations

Improving Equipment Efficiency (Quay Cranes and Yard Trucks) and Work Methods (flow and manner of equipment operation) correspondingly improved the Productivity Rates by 50% more. Improvements are on the elimination of unwanted moves, process slowdown, misuse of equipment or awareness of its capabilities/limitations, and dependable information systems (diagrams and reports).

Increasing Productivity Standards does not directly increase Existing Capacity especially if the constraints considerations are not at explicit precision and predetermined interruptions are not allocated in the planning stage. Existing Capacity may also exceed Productivity Standards if Plan assumptions were understated but most of the time, missed the Productivity Standard as manifestation of non-updated productivity rates and uncalculated delays translate to more than 30% unmet ETC. Planning and standards setting lose its essence if unmet plans persist.

Productivity Standards and Existing Capacity are NOT reliable bases of Ideal Capacity. They are if normal condition and assumptions (standards) are up-to-date; and if berths are fully utilized without lost times and unacceptable delays (not selective equipment-related or formalities/weather/tug-related); But in the analyses of the variances between the three variables, Productivity Standards, if dependable and realistic (proactive), are better basis of Ideal Capacity. Existing Capacity is Reactionary but a sure yardstick of Standards applicability and operational performance.

Lastly, with Work Methods enhancement, with skilled and enlightened personnel, efficient equipment at optimal, not maximum utilization, with updated and dependable assumptions/Productivity Standards, and with corrective/reflective Existing Capacity execution and documentation, the ultimate outcome, Ideal Capacity, may be computed. It is on the basis of a per variable equipment productivity with respect to total working time available (number of shifts) for work, factored in with the utilization rate as delays, interruption and interface anticipated plus the differentiation in trends of vessels size and built.

Such computed capacity may therefore be used as comparison to the projected demand. If negative variance (pent-up demand), at some periods, then a decision for either berth or both berth and quay crane and other complementary support services be acquired or provided. Positive variance provokes added marketing efforts or energy consumption and other preventive measures. If no variance at all, maintain status quo.

Reliable Productivity Standards assumed in Ideal Capacity are beneficial when considering reaction to changes in Gross Domestic Product (trade influx of imports and exports) and in the overall growth of this logistics network (terminal operators, shippers, shipbuilders, ocean liners, and forwarders).

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JAPANESE FOOD DESERT ISSUES AND SUPPLY CHAIN

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ABSTRACT

Purpose: The purpose of this paper is to clarify the relation between factors generating Food Deserts, and these issues; the retail industry's shift in strategy and consumption and supply chain factors.

Design/methodology/approach: This research focuses on the point of "collapse of the supply chain of food" in Japan.

Findings: The following conclusions have been obtained through this research;

1. A new market is created by the retail industry's measures for Food Desert issues.
2. Measures for Food Desert issues contribute to a performance improvement in the retail industry.
3. The struggle against Food Desert issues means shifting the strategy of retail industry. Therefore, a new strategy is needed simultaneously with a reconstructed supply chain.

Research Impact: The result from this research, which not only can be contributed to the dissolution of future Food Desert issues but also to offer the strategy shift to the retail industry.

Originality/Value: The composition of Food Desert issues in Japan differs greatly from Britain, which is where these problems originated. Here, taking Food Desert in Japan as Shopping Refugee and connect it to the strategy shift of retail industry which straggle in the changing society with Low birthrate and longevity. That is, this study is regarded as research not of a social problem, but an economic problem, or a problem of corporate management.

Keywords: Food Desert, Shopping Refugee (Senior residents in shopping deserts), Low birthrate and longevity, Retail Industry, door-to-door food delivery service, shuttered shopping street, Supply Chain

Paper Type: Research paper

Definition and History of Food Deserts

Origin of Food Desert Issues

The British Government named the phenomena "Food Deserts". Food Desert issues are a social problem generated by two combined elements; a "collapse in the food supply chain", and a "community of socially vulnerable groups" which arise in a rapid change of the socio-economic environment.

Research into Food Desert issues, has been advanced from various angles, such as geographic, sociological, nutritional, and medical viewpoint, and Europe has played a leading role in this advance since the 1990s. The emergence and growth of large stores (large-scale department stores) in Britain's suburban areas was realized by the advance and growth of suburban living and motorization alongside the successive discontinuance of business among small grocers in the city from the 1970s to the 1990s. As a result, the poor who cannot move from the city, have no choice but to buy at the remaining grocery stores, where the offered perishable food products are in bad condition. Thus, the case in Britain, sees low income groups- such as the poor, people with limited mobility, elderly people, physically handicapped persons, and foreign worker,- comprise the socially vulnerable groups that are the victims of Food Deserts.

This suburbanization of a commercial function has been remarkable in the USA as well, where Food Deserts are a serious issue for the poor, especially in African American communities. Thus, Japanese Food Deserts are different from those in Western countries including Britain, and USA, where the problem exist for low income groups, such as foreign workers.

Food Deserts Issues in Japan

It was around 2000 that Food Desert issues actualized in Japan with the so-called "Shopping Refugees (senior residents of shopping deserts)". The Ministry of Economy, Trade, and Industry defines the shopping refugee as "an elderly person, aged 60 and over, who feels inconvenienced by shopping." The population of such refugees is about 6 million (as of May, 2010). Shopping Refugees are the elderly people who are forced to travel long-distances due to the suburban advance of large stores.

Considering the "collapse of the food supply chain" as the generating factor of Food Desert issues in Europe, we see that "the suburbanization of a large store" and the resulting health impairment, as is common among the "Shopping Refugees" of Japan, delineate a food supply chain collapse, and therefore, the "Shopping Refugees" problem in Japan is a Food Deserts issue by definition. However, the backgrounds generating the deserts differ. The quickly-progressing low birthrate and elderly longevity serve as a backdrop to the "Shopping Refugees" in Japan. The victims of European and USA Food Deserts include foreign workers, single mothers, along with elderly people. However, the type of victims in Japanese Shopping Refugee issues is limited to the elderly people with limited means of transportation. This is the point of difference between Japan and Europe's Food Desert Issues.

The mechanism Food Deserts Issues of generating in Japan

The regulation and deregulation for large scale store

The generating factors of the Shopping Refugees (=Food Deserts) problem in Japan are- the collapsing of perishable-foods supply chains, and the increase in the elderly population (low birthrate and longevity). Since small shopping streets were lost in connection with the suburbanization of large stores, the collapse of the perishable-foods supply chain is the phenomenon brought about by being unable to do shopping nearby and instead being forced to travel long-distance to do shopping.

Regulation and the relief thereof, heavily influence the suburbanization of large shopping stores. Although opening a large store saw stiff restrictions with a law enacted in 1974, the regulations gradually eased from around 1990, and were abolished altogether in 2000. Since suburban regulation was so loose, the suburbanization of large stores began from the 1990s and accelerated with the easing of restrictions.

It cannot be over-emphasized that motorization was pivotal in making this suburban expansion possible. In addition, service industries, retail chain, and transportation companies declined and withdrew in depopulated districts and provincial towns, where profitability is low. This, withdraw results in dead zones for food, transit, and the like. Therefore, in depopulated districts or provincial towns, elderly people with no means of transportation will encounter difficulty in acquiring food

In summary, Japan's Food Desert issues are a problem of Shopping Refugees, and it can be said that they are brought about by changes in social structure resulting from quickly advancing low birthrate and elderly longevity and from changes to the food delivery system.

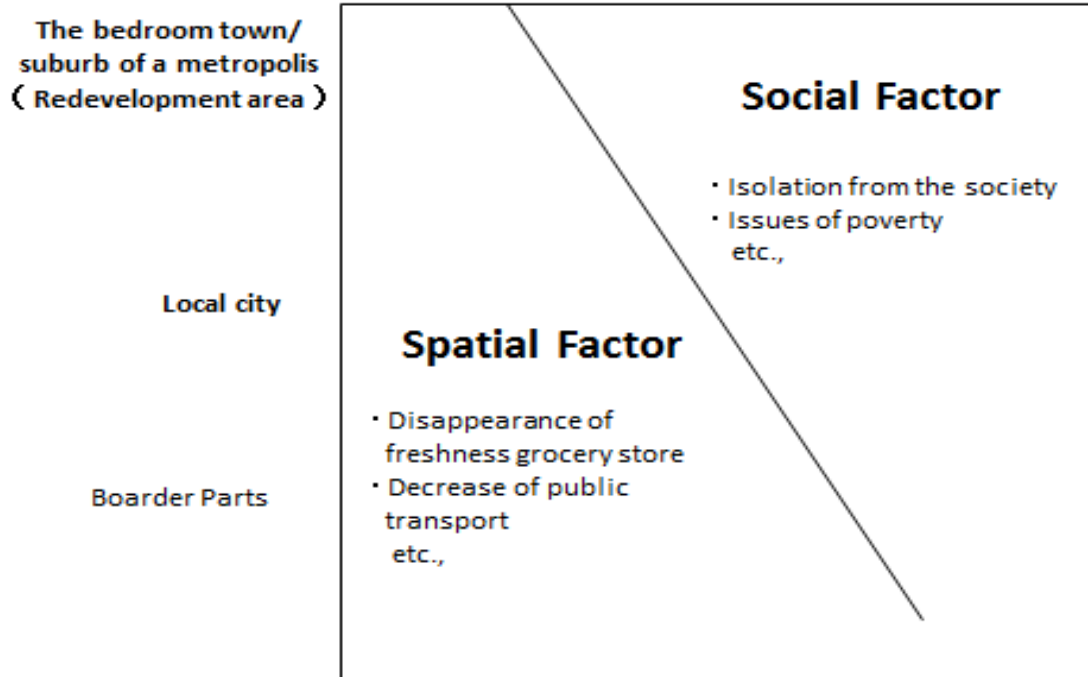


Figure1. Outbreak factor of the Food Desert by area

Source: Nobuyuki Iwata (2011), "Food Desert Issues" Agriculture-and-forestry statistics publication

Low birthrate and longevity

The population of Japan is ageing quickly. The population aged 60 and over is projected to be 44,850,000 in 2020. This is about 40% of the Japan's population.

Shopping Refugees are mostly elderly people. The following reasons are cited.

1. The abolition of public transportation facilities, such as public buses, in provincial towns, depopulated districts, etc.
2. So-called "Shuttered-shopping-streets" appeared when small grocery stores closed one after another due to the suburbanization of large stores, and also with withdrawal of large stores from residential sections of the suburbs with decreased populations
3. Elderly people have trouble going out (they cannot drive cars, public transportation facilities have been abolished, etc.).

The measures against Food Desert issues by companies, local governments, and NPOs

The solution to the source of Food Desert issues

The shopping Refugees problems is a matter of elderly people who have limited access to transportation, the blockage of the distribution system, in the suburbanization of large stores Necessitating long-distance travel to shop, and the appearance of "shuttered shopping streets"

Such shopping impaired people are a phenomenon seen not only in depopulated districts but also in city centers where the solitude of elderly people is increasing, due to the trend toward the nuclear family. Central and local government, NPOs, companies, and all citizens need to be united, and tackle the Shopping Refugees problem. The government has to implement measures to tackle the low birthrate and longevity situation. Local governments need to organize to support the measures of companies. Companies must change management strategies and adopt measures to aid the Shopping Refugees. Citizens needs to improve the state of their communities and regain the spirit of mutual help. As a possible solution, two points are mentioned,; the Guarantee of transportation devices " and "activation food delivery system and redesign of food supply chain".

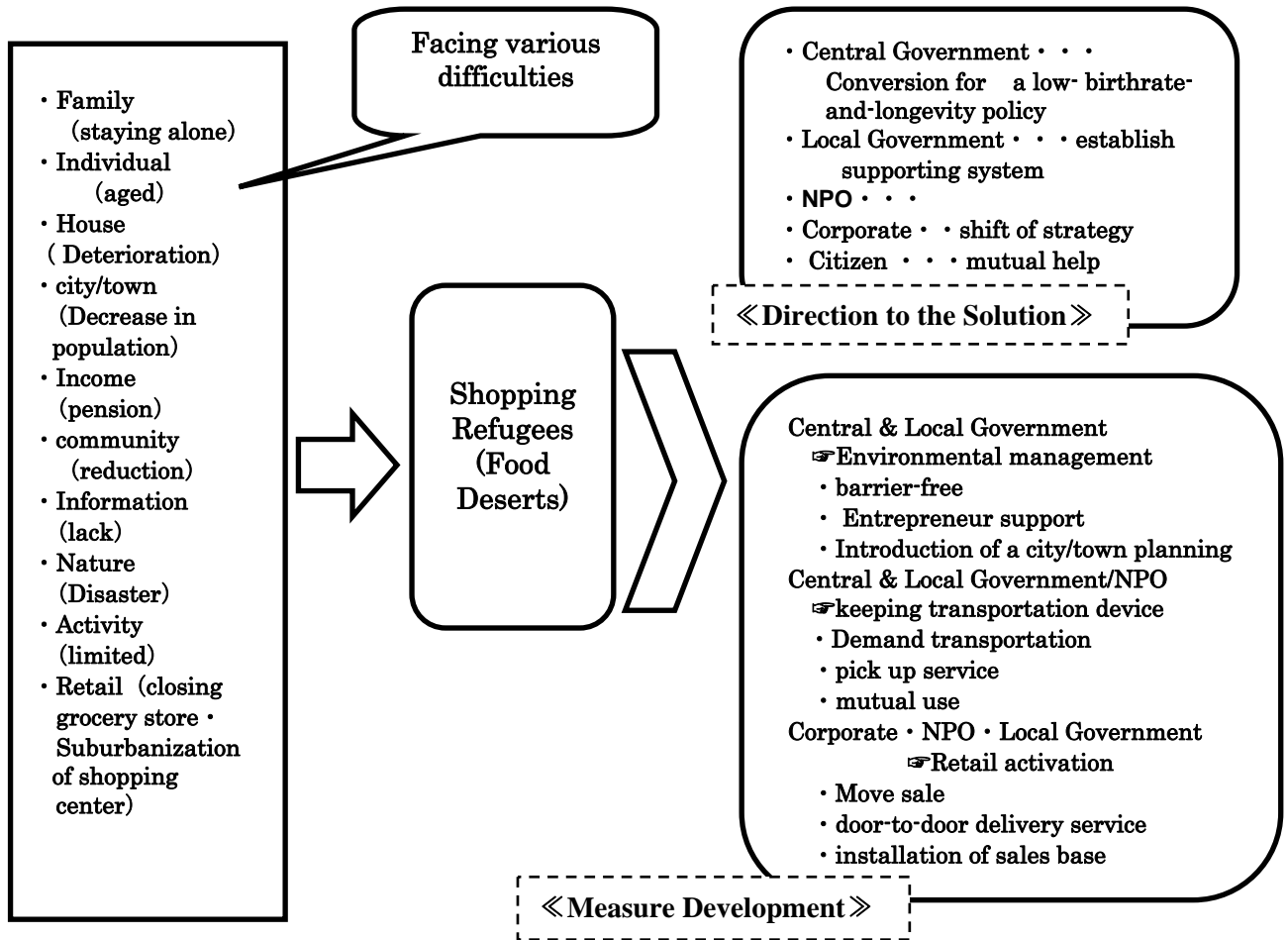


Figure2. Mechanism of the shopping Refugees outbreak and action for solution

The measure by companies, local governments and NPO

There are three types of measures against the Shopping Refugee problems; “meal offer”, “delivery”, and “improvement of access/transportation”. Meal offer are luncheons several times per month. Delivery is a door-to-door delivery service, especially for lunch and supper. Recently, supermarkets have started this service with any kind of daily goods as well as meals. Delivery can then be broken into three categories; “meal delivery service”, “Shopping Representation”, and “Door-to-door delivery service”. “Improvement of access” consists of three categories as well, “establishing shopping place”, “move sales”, and “Shopping bus”. Moreover, another type of access improvement is seen in new public traffic services which offer door-to-door transportation, called “demand traffic”, with low-price options, like public buses, and convenience options, like taxis.

The parties pushing measures to aid Shopping Refugees are Individual persons, local government, NPOs, supermarkets, and CVS, who usually manage by themselves, but sometimes, there are cases where two or more players cooperate and tackle the issue, in which case it is because of profit difficulties.

Type	measure	subjects
meal offer	Luncheons	NPOs, JA*, Local government
delivery	Meal delivery service	Local government, NPOs, co-op, Private Company
	Shopping representation	NPOs, Local government
	Door-to-door delivery service	Logistics Company, CVS*, Supermarket, Local government
improvement of access	Establishing shopping place	Citizen, local Association of store, JA, Local government, Local Supermarket
	Move sales	Supermarket, Local government, Local store, move sales
	Shopping busses	NPOs, Local government

Table1. Three types of the measure for Shopping Refugees

Source: Nobuyuki Iwata (2011), "Food Desert Issues" Agriculture-and-forestry statistics publication pp117-122 etc. *JA; Agricultural cooperative association, *CVS; Convenience store

The measure against Food Deserts, and corporate strategy

Market of door-to-door food delivery service

The size of the door-to-door food delivery market was 1,584 billion yen (US\$20 billion) in 2008. This was a 4% expansion from the previous year. It is expected to grow to 1,792 billion yen (US\$22.5 billion) in 2013. Within the door-to-door food delivery market, 970 billion yen (US\$12) comes from co-ops. 46.8 billion yen (US\$0.6 billion) comes from CVS and net supermarket. While the consumption market declines, the door-to-door delivery market is expanded.

Yamaguchi Co-op began door-to-door food delivery first in 2007. It expanded to 33 co-ops in March, 2011. Today, there is a demand of 40,000 deliveries per day. In Japan, 27 million partners have joined 138 co-ops throughout the whole country, and industry is worth 2,684 billion yen (an increase of 1.5% compared with last year). While the store business had a 1.8% decrease in income, the door-to-door food delivery service was in the black with a 3.2% increase of income for the whole co-op business in Japan.

Strategy of the Retail Industry

Each retail industry, like super market chain stores and CVS, has also set forth strategies which target Shopping Refugees. AEON will aim to establish a door-to-door delivery service network throughout Japan by 2014. Through this service, orders are received on the internet and the goods are delivered. Delivery depends on existing Yamato and Japan Post networks.

Seven-Eleven leads the convenience store industry, with "Seven Meal", the company's specialized delivery of lunch and other prepared meals with free delivery for order of 500 yen or more (with a 120 yen charge for orders of less than 500 yen). The staffs at 10,000 shops are responsible for delivery. Lawson and Family Mart are also following Seven-Eleven's lead.

The shift in strategy of retail industry, and reconstruction of a Supply Chain

So-called "net supermarkets" are more important than internet business in the "door-to-door" service. Regarding this business, reconstruction of the supply chain is an important matter. In other words, it appears the Shopping Refugees, or elderly people, are a new sales target. Until now, the main customers were the younger generations, and these were the main targets of CVS. That is, CVS has been located in a convenient place near stations, is 100-square-meters in scale, and has developed a strategy which made the younger generation the main customer. Making Shopping Refugees the main customers means changing the management strategy of CVS. To solve the issue, stores will need to operate in depopulated districts, develop elderly-oriented product subdivide goods, open smaller shop (50-square meter scale), and so on. To support shop operation under this new strategy, it is essential to reconstruct supply chain.

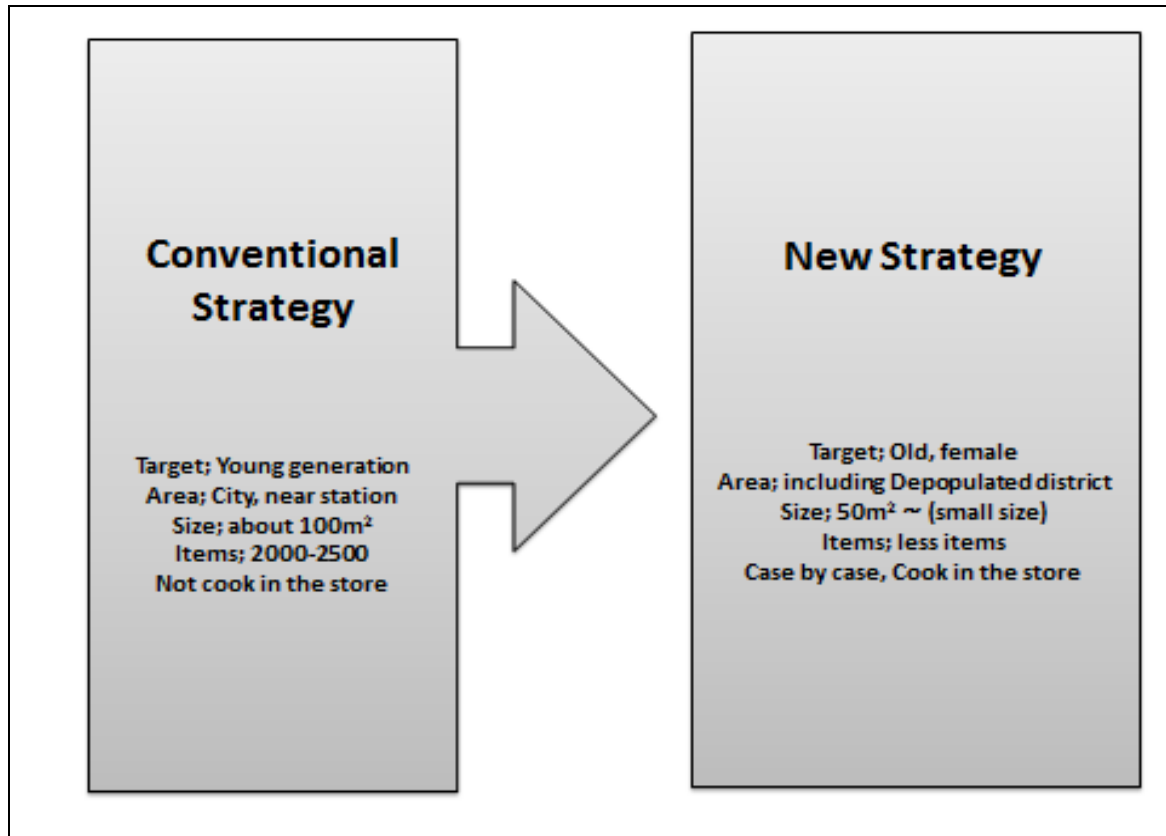


Figure3 Strategy Shift of CVS

Type of service	Player	Service
Door to door delivery service	Izumiya Supermarket	Meal delivery (supper)
	Coop Sapporo	Meal delivery(supper) to old
	Coop Kobe	Meal delivery (supper)
	Nisshin Iryoshokuhin	Meal delivery(lunch) to old
	Osaka Pal Coop	Meal delivery (supper)
	Max Value Nishi Nihon	Meal delivery by order
	AEON	Delivery service by net 28 provinces, by 2014 all provinces
Move sales	Moss Burger	Delivery (target; old) 260 stores
	Osaka Izumi Coop	Using Modified truck
	Coop Kobe	Using Modified truck
	Coop Sapporo	Specialized trucks, 100 unit
	Mikawayaya	Move sale of the clothing for old
Shopping representation	Seven Eleven Japan	Using Modified truck
	Heiwado	Shopping representation service at Shiga Province
Shopping Bus	Matsugen Supermarket	Operation of free round buses for shopping

Table2. The examples of shopping Refugees support services
Source: Nihon Keizashinbun 2012.9.11, Nikkei MJ 2012.8.13 etc.

AEON has used existing networks, such as Yamato Transport and Japan Post, while Seven- Eleven established its own networks, and Lawson and Family Mart are establishing networks with the M&A door-to-door food delivery company. Although the method, vary, each company has worked to reconstruct their supply chain. That is, a keyword here is “supply chain”. For the net supermarket, the method of delivery is important.

In that sense, the net supermarket can be placed at same rank of Yahoo, Askul, Amazon, and Rakuten. The movement of such companies toward strengthening distribution functions and services is remarkable.

Conclusion

The clothing/apparel and fast foods businesses, such as McDonald's and MOSS Burger, have expanded to include Shopping Refugees as targets. Amidst the elderly longevity and low birthrate, Shopping Refugees focused business is an effective management strategy for survival and continued growth. Survival will be difficult, if the conventional strategy is not shifted to target senior citizens.

According to the age-based statistics of visitors to Seven-Eleven per day per shop, the percentage of visitors 50-and –over, which was 9% in 1989, has increased to 28%. On the other hand, the percentage of visitors 20-and -under decreased greatly, from 28% to 10%. The middle-aged and the elderly (40-and –over) composed 40% of the customers in 2009, making them the new main customer segments for convenience stores, and signalling that a shift in strategy is necessary.

As the consumption market of Japan reduced as a whole, the door-to-door food delivery service market expanded. Although there has been a lot of new entry in the door-to-door delivery market, it is not easy to gain profits, except in some urban areas where there is great demand. There are also cased in depopulated districts where companies are forced to withdraw.

While deflation continues in Japan, it is difficult for enterprises to continue, if they do not successfully save costs while providing low-cost products. In this situation, a proper supply chain is necessary in new business models to ensure profit while prices are not expected to increase.

The measure for Shopping Refugees business, in other words, the new business model which focuses on elderly people, connect improvements in corporate earnings simultaneously with improvements in elderly people's life. That is to say, the interests of the elderly consumers and retail enterprises are well aligned.

For the retail industry, it is key to supply goods oriented toward the elder while maintaining low development cost, and, for that purpose, the reconstruction of Supply Chain is indispensable.

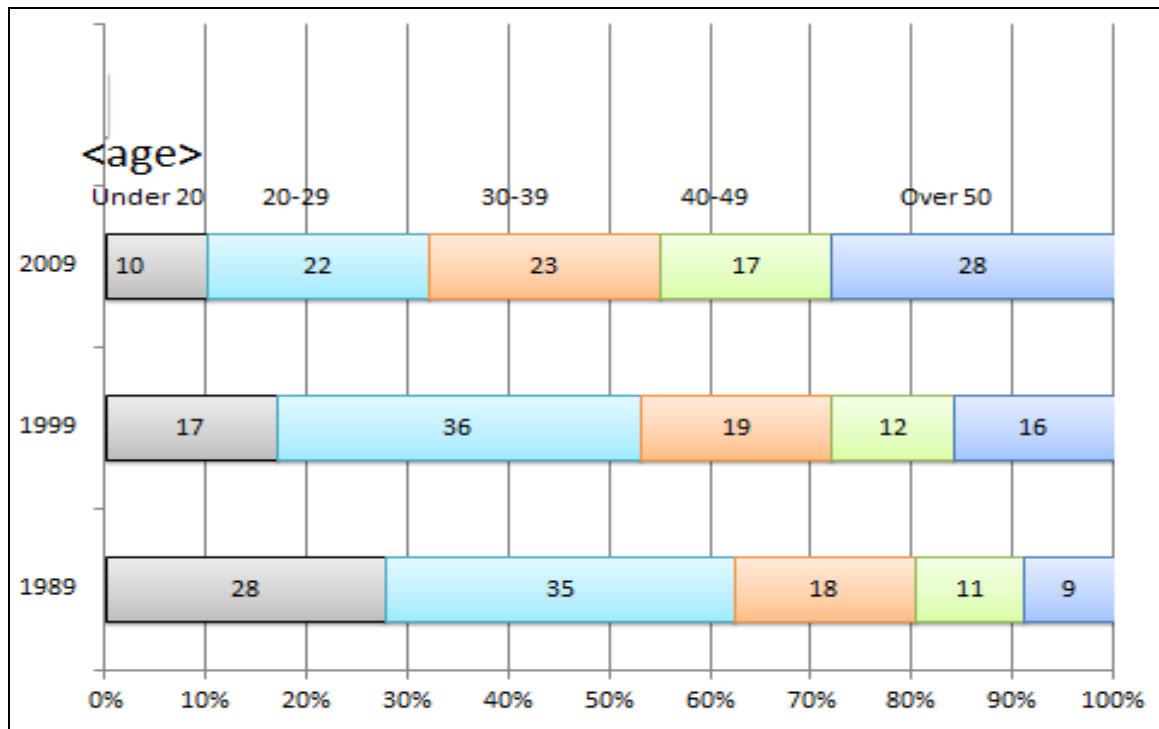


Figure4. The number of average visitors classified by age of Seven-Eleven Japan per day per store
Source: Investigation by Seven Eleven Japan

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STREET TURN STRATEGY: THE EFFECTIVENESS AS A GREEN LOGISTIC TOOL FOR THE MANAGEMENT OF EMPTY CONTAINERS FOR ROAD HAULAGE IN MALAYSIA

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ABSTRACT

Purpose: This author seeks to determine whether there is a cost saving and environmental benefits if there is implementation of a new strategy like 'Street Turn' in Malaysia for container haulage operations. Design/Methodology - The sample for this study consists of companies that are involved with the haulage of containers in Shah Alam and Klang, Selangor and questionnaires were distributed to 162 road haulage company.

Findings: The effectiveness of 'Street Turn' strategy will be measured systematically looking at the cost of operation gathering after implementation and simple estimation of percentage carbon emission reduction. In addition, Statistical Package for the Social Science (SPSS 19.0) software also had used to analyse the haulage perception.

Research Limitation: The study is still new, therefore is being a lack of information supported in Malaysia and people still lack of awareness and knowledge about green logistic.

Practical Implications: The results provide insights on how Malaysia government can reduce the carbon emission and support green logistics from the road haulage industry.

Keywords: Street Turn, Depot Direct, Green Logistic, Carbon dioxide (CO₂), Prime mover, Containers

Paper type : Research Paper

Introduction

In recent years, the logistics industry in Malaysia has expanded very quickly in response to the pressures of globalization. As one of the biggest industries in Malaysia, the logistics and transportation sector has the sheer size of being large enough to have a significant impact on the environment. As such, reducing harm to nature can be done by implementing a logistics and transportation strategy that is friendlier to the environment. This is a point established in a study conducted by Rodrigue, J.P., (2011), the logistics and transport industry are a major contributor to environmental issues through its various modes and infrastructures. As a developing industry, logistics and transport were seen as a golden opportunity for the adoption of more environmentally friendly practices and present a more environmentally friendly face to the world at large.

At the forefront of this development in the logistics industry is the humble container. However, transporting a container is not an environmentally friendly process. For example, in Europe prime-movers contribute up to 10 percent (10%) of the carbon dioxide emissions (CESER, 2009). As similar vehicles are used here in Malaysia for the transportation of containers, emission figures should not be largely dissimilar. Hence, "green" practices such as minimizing the movement of empty containers should be practiced in Malaysia. The industry practice of container movement in Europe largely uses two strategies which called 'Depot Direct' and 'Street Turn', these strategies are looked upon as suitable tools for the management of containers that is hauled by the prime-movers. However in Malaysia, logistics practitioners still have not implemented a similar strategy that will be the foundation of green logistics thus helping in reducing carbon emissions in Malaysia. If Malaysia truly desires to implement similar strategies

like those found in Europe there is no need to implement a change in the logistics network structure—that may be costly. A mere change in management can generate efficiency and effectiveness gains over a longer period of time, (Association of Malaysia Haulier, 2011). Therefore, this study is a suggestion to the government and the logistics industry to clarify which is the best strategy for implementation in order to manage the movement of empty containers.

Problem Statement

Normal operations involving the movement of empty containers, is usually identified with inefficiency, as there is a failure to maximise utilisation of both fuel and the vehicle. A study by Dam Hanh, P.I.L (2003), had found that for inbound and outbound cargo, loaded containers are picked up by haulier companies from the carrier’s terminal and are delivered to the consignee for unloading. The containers then return to the carrier’s terminal, usually by the same haulier company. The same practices are in place for outbound cargo. Haulier companies pick up empty containers required by an exporter from a carrier’s terminal and deliver these empty containers to the exporter for loading. After a container has been loaded, a haulier company will transport the loaded container to the carrier’s terminal where it will be stacked at the pier prior to loading on to a container ship. It is clear that, in the case of both export and import cargo. At least two thirds of the require container haulage trips involve empty container movements, either for empty pickup or empty return.

McKinnon, A. & Edwards. J., (2010; p. 198), said that empty journeys are not only wasteful economically, but also carry an environmental problem. They also said that, nowadays this situation is not similar because over the last 30 years the proportion of empty running by haulage in the UK has steadily declined, yielding significant economic and environmental benefits. As a conclusion, in order to solve this empty container problem, most of marine terminal companies have come out with several strategies which have been put into practices. The main thrust of these management practices is not only to reduce the problem of empty containers but also to support the principles of green logistics in managing global warming issues. One of the most popular strategy that are implemented in the United Kingdom (UK) and marine terminals in the United States of America (USA) is a combination of the “Street Turn” strategy and “Depot Direct” strategy.

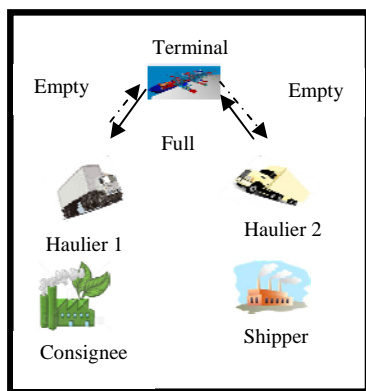


Figure 1: Depot Direct

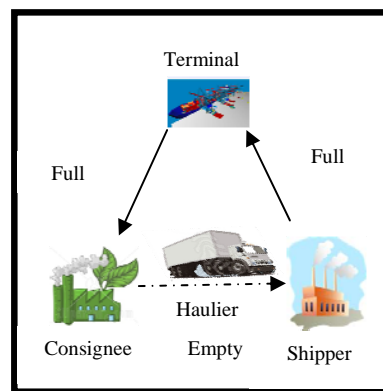


Figure 2: Street Turn

A study by Jula,H., et al., (2008), defined depot direct strategy as a normal operation of container haulage for import and export goods from the terminal, port or depot to their consumer and this strategy is suitable for the shorter distance travel. The ‘Street turn strategy’ defined as movement full load container haulage from the beginning and until the ending of operation and the rules for this strategy is consists of using an empty import container for export loads without first returning them to marine terminals. According to International Asset Systems (IAS), 2006, this “street turn” strategy can be made more effective by running it together with information systems that automatically updates the information about the availability and location of empty containers. Based on the street turn strategy, researchers have found that by implementing the idea of reusing empty containers, substantial reduction in related haulage trips from and to the container ports, reduction in costs can be obtained. Moreover, as a result of the study conducted by

Jula, H., et al., (2008) showed that by allowing substitution between different types of empty containers, we can further decrease the number of the haulage trips and also cost related to empty containers. In other that, by implementing the idea of reusing empty containers the traffic congestion around the container terminals can be improved and as a consequence emission can also be reduced significantly.

In Malaysia, the depot direct strategy is normally used by industry players and from the general observation this strategy is not an environmentally friendly strategy if we want to support the principles of green logistics, as it truly shows wastage in terms of fuel and carbon emissions, (Association of Malaysia Haulier, 2010). However, if there is implementation of a new strategy like 'street turn' in Malaysia for container haulage operation, the question which arises is how effective is a strategy like this to a haulier company and what is the impact to the environment? This effectiveness of this street turn strategy will be measured by looking at the cost operation after implementation (to measure the commercial impact) and simple estimation of percentage carbon emission reduction (to measure environment impact).

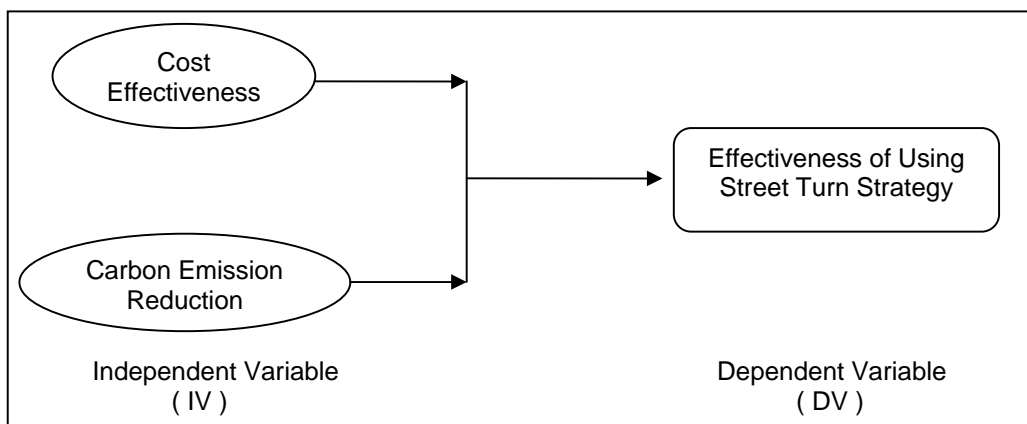
Research Framework

Measurement of the effectiveness of using the 'street turn strategy' in road haulage companies will be performed by focusing on two factors which are: Cost effectiveness and carbon emission factor. The identification of these factors has been made in previous international studies and show that these are major factors contributing to its effectiveness as tool for green logistics.

The important of cost to measure the effectiveness of Street turn strategy have been proven in studies conducted by both Dam Hanh, P.I.L (2003) and Wang, R. et al., (2008). Both conclude that, the cost control and reduction in managing empty containers have become the key aspects which influence a road haulage company's operation state. Under cost effectiveness dimension, there will be four (4) elements to support the measurement of the effectiveness of the Street turn strategy. These elements consist of vehicle impact, fuel utilization, waiting time as well as toll and road traffic.

In order to measure the effectiveness of implementing Street Turn strategy as a green logistic tool, and therefore its impact on the environment, there will be four (4) major elements that will be used in this study. The elements consist of vehicle utilisation, road traffic selection and survey, vehicle maintenance and estimation percentage carbon reduction. A selection of these elements has made by referring 'Vehicular exhaust emission modelling tree' that was included in the study conducted by Pandian et al., (2009). According to the study, Pandian and his fellow researchers noted that emission rates depend on the characteristic of traffic, vehicles and the type of road intersection. For example, engine characteristic, vehicle maintenance, condition and type of emission control equipment and age of vehicle. Based on these elements the measurement of the carbon reduction from practicing Street turn strategy is more accurate and therefore this yardstick will be used to show whether this strategy was effective as a tool to pursue the goals of green logistics in Malaysia.

Figure 3: Research Framework



Methodology

Sampling procedures

The sample for this study consists of companies that are involved with the haulage of containers in Shah Alam and Klang, Selangor. The reason for choosing this area, is because SMEs in Selangor are predominantly in the transport equipment and electrical sector (Saleh, A.L. & Ndubisi, N.O., 2006), and also there are 162 over 344 companies that involved with those activities operate here. This total number of haulage company in Klang Valley area had gathered by manually sorted after getting the list from Malaysia Logistics Directory, 2010/2011, SPAD and Association of Malaysia Haulier (AMH) for more detail, see table 3.3.

Regarding to the population, researcher will select a sample by using the stratified random sampling method, Sekaran (2003) considers this the most efficient sampling design when differentiated information is needed from the various strata within the population; purpose of using this technique is to avoid members of the population being significantly under or over represented (Hussey and Hussey, 1997). The optimum sample size was 63 determined based on the sampling table provided by Krejcie and Morgan (1970).

Table 3.3: Land Transport

Types of Company	Total Company in Klang	Total Company in Shah Alam	Total Company in Others area in Klang Valley
Container Haulier	104	21	37

Pilot testing

Once the instrument is ready pilot testing will be done to determine the appropriateness of the questionnaire. After respondents have validated the content of the questionnaire, minor changes will be incorporated into the final design of the questionnaire based upon the feedback received. To ensure consistency and reliability, a standard definition of the Street Turn system will be provided to the interviewees prior to being asked the questions in the questionnaire. Internal consistency and reliability measurement of the items will be verified by computing the Cronbach's coefficient alpha, and a minimum alpha of 0.60 will suffice in the pilot survey (Norzaiddi & Intan Salwani, 2008). Around 10 samples to represent the study population will be selected for the pilot study and feedback from pilot respondents will be used to further improve and refine the survey instruments.

Quantitative

Quantitative study is more appropriate for this research because the main research problem of this thesis involves a lot of information from the road Haulage Company that cannot be qualified such as measurement of their cost operation. Besides that, researcher will use estimation calculation to calculate percentage of carbon emission before and after implementing this strategy. This calculation will base on actual data gathering from the study that has been conducted by Hasmawati, H. (2011) about the movement of heavy vehicle in Klang Valley. In addition, researcher also will use estimation formula to measure the cost of fuel for one container haulage trips per day to compare with the profit gathering from the similar haulage on that day to identify fuel utilization result. A formula that will use will be like this:

Estimation of Carbon Emission Calculation:

Component	Emission Rate and Fuel Consumption Per Mile (Mi) 1	Calculation	Total Annual Pollution Emitted and Fuel Consumed
Carbon Monoxide	27.7 grams	$(27.7 \text{ g/mi}) \times (? \text{ mi}) \times (1 \text{ lb}/454\text{g})$	Pounds of carbon monoxide
Carbon Dioxide 2	1.15 pounds (lb)	$(1.15 \text{ lb/mi}) \times (? \text{ mi})$	Pounds of carbon dioxide

(Sources: United States Environmental Protection Agency – EPA, 2005)

Estimation of Cost Effectiveness Calculation:

$$\text{Cost Effectiveness} = \text{toll cost} + \text{maintenance cost} + \text{fuel cost}$$

(Zoetermeer, 2010).

Results

The findings indicate that the majority haulier perception in Malaysia agreed that Street Turn strategy can reduce cost operation. However they do not agree that carbon emission can reduce from this strategy based on several factors such as driver behavior. Therefore, estimation calculation had done to confirm this result. Based on the results gathered in the final stage estimation calculation analysis, it was truly showed that Street Turn strategy is more effective because the total amount of cost faced is lower (RM 35,700) compared to depot direct system RM 40,987.50. The difference for this amount is quite higher by RM 5,287.50 (12.9%) and based on this amount it was proved that by implement and practices this strategy road haulage company can reduce their operating cost and will generate more revenue for their company.

This result had supported by the previous study that's shown the effectiveness and efficiency implementation of this strategy can reduce the cost. Such as the study that had conducted by Chang et. al., (2006), the authors conclude that a cost reduction in the range of 5% to 46% is attainable, if a combination of the container types in the supply and demand nodes is found by dealing with the empty container reuse strategy. Even though, for the medium company the cost under street turn is a little bit higher than depot direct but the different amount is just RM 425 and this amount is still under consideration and can be covered by the profit gathering based on the number of trips can be run.

Besides that, the measurement of reduction carbon emission had used the formula from (EPA, 2005), the range of the total carbon monoxide and carbon dioxide for these three categories (small, medium and big company) under the street turn strategy and depot direct strategy is too small which are 0.45kg of carbon monoxide and 8.41kg of carbon dioxide. Based on literature result in carbon emission reduction by practicing the Street Turn strategy, the Tioga Group Study, (2002), provides an excellent source of reference on the logistics of empty marine container. The study covers issues such as empty container logistics and flows, the potential for empty container reuse, off-dock empty return depots and depot-direct-off-hires had shown the result of carbon emission reduction 1.04 tons per annually (12.26%) for the potential empty container reuse strategy implementation. In addition, Jula et. al., (2006) study had shown an empty container reuse will have significant environmental effects. It will reduce the traffic and congestion around the ports, which in turn reduce noise and emission.

As a conclusion, from this result it had shown that percentage of cost had reduce is quite high. In addition, there is also having a carbon emission reduction even though the percentage is too small but it still can be improved in the future. The comparison between haulier perception and simple estimation calculation indicates that the proposed tool represents a promising instrument to improve its current decision making process, yielding significant savings in cost operation by trucks. Human skills alone are not sufficient to manage such a multitude of information efficiently and, therefore, cannot ensure a rapid and effective solution for such a complex issue. Moreover, the effectiveness of this strategy will also yield benefits of the final cost of goods, while reducing traffic problems and related environmental impacts

Conclusion and Future Research

Previous studies show that the implementation of “Street Turn” system for ocean carriers, shippers, and trucking companies result in greater equipment utilization, improve operating efficiencies, and reduce empty container mileage. Other than that, terminals can alleviate congestion and its associated problems. Considerable environmental benefits are also attainable, in the form of reduced truck traffic and diesel emission. Besides that, it had significant potential to reduce congestion in port terminals, rail ramps and inland container depots, to lower ocean carriers’ and trucking companies’ costs of dispatching empty containers, and to create greater efficiency for shippers.

This current study of the “Street Turn” strategy determined how much less impact a truck operating in the Shah Alam – Port Klang area of the Klang Valley will have on the environment if the container was managed by the ‘street turn’ strategy. If the data supports what many already believe to be the case, ‘street turn’ will be a revolutionary new way to manage the transportation of empty containers in Malaysia and will have a big role to play in traffic reduction, fuel saving, expanding the life span of vehicles due to less wear and tear as well as increasing the revenue of stakeholders in the road haulage industry.

In future research, it is the suggestion of the researcher that more studies be done on an experimental design and detail calculation to determine which problem characteristics lead to the largest cost and carbon emission saving. Next, future research will focus on solution methods for larger problems and on the extension of the models presented in this study.

Since this study focuses only on one industry, future research would be useful to test this strategy to others sector of logistics and transportation such as public transport sector focuses on buses.

Acknowledgments

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ASSESSING AVAILABILITY RISKS IN HEALTH CARE SERVICE SUPPLY CHAINS

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ABSTRACT

Purpose: In many countries the demand structure for health care services is changing due to ageing population. This has led to the need to re-assess the current designs of the current service models. This paper studies health care services as service supply chains which face an availability risk largely due to the re-organisation of the service supply.

Design/methodology/approach: This paper uses a survey methodology approach in the context of the Finnish health care system. The study is based on regional health care system statistics and vast questionnaire results.

Findings: Taking customer perspective into account in planning health care services increases customer perceived availability and social acceptance of services. Geographical distance might have a great influence on availability risk, but it is context dependent and rooted in routines and habits of customer groups.

Originality/value: The availability risk of health care services is still a focal subject under research and there are clear gaps in the current scientific discussion from several perspectives. This study addresses some new research perspectives to the availability of health care services. Our contribution to earlier scientific discussion is formed through the combination of geographical availability and customer perspective.

Keywords: Availability, risk, health care, service supply chain, assessment, geographical distance, Finland.

Paper type: Research paper

Introduction

The aging population poses challenges to the health care systems in industrialised countries (Christensen et al. 2009). Functional limitations amongst aging citizens are expected to be more common, creating risks involving the availability of primary health care particularly in sparsely populated areas (Beillon et al. 2008). A decrease in the customers' mobility can have a crucial impact on the availability of the services from the customer perspective. On the supply side, the changing age structure creates pressure to develop health care service supply chains to tackle this issue. Indeed, the patient perspective is currently rather under-researched and forms a clear gap in the current scientific discussion on health care supply chains (e.g. Baltacioglu et al., 2007; Giannakis, 2011).

Even though the development of health care supply chains has been a trend in many countries and many scholars have contributed to the field, the focus in these studies has traditionally been on the upstream supply chains (e.g. pharmaceutical companies) rather than on the patient perspective and experience (e.g. Pedroso and Nakano, 2009; Motiwala et al. 2008). As many countries are issuing changes to their health care systems to decrease costs and increase efficiency, taking into account the customer perspective can give a more holistic view of how the health care supply and demand meet. In Finland, for example, the centralisation of health care services and decreasing the amount of service sites has been the prevailing trend along with the consolidation of municipalities.

In order to address this gap in the current literature, we will provide a customer perspective on the availability of health care services. This paper studies health care services as service supply chains which face an availability risk largely due to the re-organisation of the service supply. More precisely, the availability risk is viewed as a situation where the health care service supply and demand do not meet in terms of geographical distance. The availability of health care services is measured through both the absolute and perceived distance of the customers.

Literature Review

Service supply chain management

Despite the extensive focus received by supply chain management the academic contributions to the service supply chains still remains less explored. The studies on service supply chains have so far focused mainly on applications of existing SCM models to the management of service supply chains (e.g. Arlbjørn et al., 2011; Baltacioglu et al., 2007; Ellram et al., 2007). Few researchers have developed service supply chain management frameworks and have defined it 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 and Baltacioglu et al., 2007). The benefits that the service supply chain management provides can be for example better coordination of processes, improved performance through process integration and improving 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). Indeed, as identified by Cook et al. (2002) in an application of healthcare industry the traditional supply chain management is not implicit to the service sector practitioners due to lack of a systematic integration of supply chain functions. Ellram et al. (2004), lists 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. By developing the model presented by Ellram et al. with SCOR 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.

Availability and availability risk

By definition, the availability of services denotes how quickly or fluently services are accessible to a citizen when a need for services occurs. More precisely, the availability of health care services is affected by supply and demand factors, which are interconnected (Lillrank et al. 2011, Lillrank and Venesmaa 2010). The supply factors include geographic availability (including such issues as location, distance, density, means and ways of transport) and timely availability (including such issues as opening hours, response times, queues, length of time to appointment) (Kuhlthau 2011, Lillrank and Venesmaa 2010). Respectively, economical factors (e.g. conditions for public/private service provision, social insurance system) and personal factors (e.g. motivation, educational (informational) level, language, culture, attitudes) are significant on the demand side (Lillrank and Venesmaa 2010).

In a broader scope, service availability is related to service quality measures (e.g. SERVQUAL and its simplified version RATER), which overall aim to measure gaps between customer expectations and experiences about the services. Following this logic, service availability concerns failures to match demand and supply, i.e. the gap between what is made available by the service provider and what is perceived accessible by the customer. If failures occur, an availability risk is confronted. The service quality framework puts customer perceptions clearly in focus. If geographic and timely availability were purely supply side factors decided by the service provider, a large part of the problem would be

solved. In the development of service supply chains through the quality logic, customers' personal perceptions on geographic and timely availability should be taken into account.

The availability risk is connected to inequalities in health and health service delivery. The availability risk occurs when the demand and supply are imbalanced due to changes in the factors presented above.

Empirical Research

Major trends on Finnish health and social care

Demographic change is a global challenge. In Europe, Finland is the first country to face steep ageing due to the great post-war (1945–1949) increase in the birth rate. The economic consequences of ageing are fundamental. Also demand for social and health services increases dramatically. This means a need for productivity improvement in public services. One of the major challenges of the future is how to support elderly people's welfare and ability to live at home. (SOTKANet, 2012)

According to the Finnish constitution, public authorities must promote and take care of the health of the population. The provision of health care services in practice is the responsibility of municipalities and is financed primarily out of tax revenue. (The Constitution of Finland, 1999). Finnish municipalities are self-governing entities, which, under Finnish law, have the right to decide on their own matters. At the beginning of 2011, there were 336 municipalities in Finland. Municipalities control many community services, such as schools, health care, water supply, and local streets. (Ministry of Social Affairs and Health, 2008)

There is currently a heated political debate in Finland about reforming the municipality system. Essentially, a large number of small municipalities are seen as detrimental to the provision of public services. Recently, a large number of voluntary mergers have been agreed. In 2012, the government published an extensive plan aiming at merging municipalities to reach a minimum population of 20 000 per municipality. This would reduce the number of municipalities from 336 to approximately 70. However, the centralisation of services and political power also arouses opposition. A merger might immediately lead to the termination of municipal services in areas considered too remote by the majority in the new merged council. (Finnish Local and Regional Authorities, 2011a, 2011b)

Service provision in target area

The South Karelia Social and Health Care District (Eksote) provides health services, family and social welfare services, and services for senior citizens to the approximately 130 000 citizens of South Karelia in South-east Finland. Health and social services are closely integrated together in the South Karelia region. Eksote is working to deliver patient-oriented care by ensuring equal access to social and health care services to all citizens in the region, across the boundaries of municipalities. (South Karelia Social and Health Care District 2012) In South Karelia, a large number of aging people are living in sparsely populated areas from where it is often difficult to obtain transportation to urban areas where the social and health services are located. Eksote launched a Mobile Clinic in November 2010 to address these difficulties. The first duty of the Mobile Clinic (named "Mallu") was to deliver influenza vaccinations to sparsely populated areas. Since the beginning of the year 2011, the Mobile Clinic has stopped at different appointed villages in South Karelia, providing clients in sparsely populated or rural areas services closer to their home. The services offered have consisted of a nurse's consultation as well as social services in the form of service guidance for senior citizens. (South Karelia Social and Health Care District, 2012)

Sample

The empirical evidence was collected in a mail survey that was targeted to 60–90-year-old inhabitants in rural and suburban areas of South-east Finland. The target areas were defined by postal codes. The total target population was slightly over 79 000 persons. A stratified random sample of 3 000 people was drawn from the Finnish Population Register. The sample frame was based on the

population age distribution divided into five-year categories. A total of 1121 valid responses were received and the resulting age distribution was representative, indicating no statistical difference compared to the true age distribution in the population. The gender distribution was also in line with the target population; the share of female respondents was 53.8 percent (55.1 in the overall population). Due to incomplete responses, the effective sample used in the analysis was $n=1006$.

Measured concepts

Organisational mergers at municipality level often concern, in practice, the re-organisation of the geographic availability of services (e.g. in search of effectiveness, service sites in remote locations might be shut down), meanwhile preserving the availability of health care to the customer health. For this reason, the following customer related and perceived measures are proposed to help tackle the availability risk. The following measured concepts are developed based on the previous scientific literature (e.g. Kuhlthau, 2011, Lillrank et al., 2011, Lillrank and Venesmaa, 2010).

Demanded availability – the acceptable distance in kilometres to service points targeted for daily activities (e.g. groceries, pharmacies, banks and regular health care). The demanded availability is measured by group-wise means and the distribution of respondents' answers about acceptable distances to the point of service. The distance in this case describes the natural area where individuals act and carry out daily activities. The respondents were grouped by the municipalities in which they lived.

Actual availability – the distance between homes and city centres which is expected to represent the current state of Finnish service locations. Actual availability was defined by respondents' declared distances, measured in kilometres.

Perceived availability – evaluates experiences of individuals regarding actual service availability in their residential areas. The measurement consists of two scale items for the availability and acceptability of distances to services in the respondents' residential areas.

Research process

The research process of this study consists of two parts. In the first part of the empirical study, we aim to define the centralisation allowance of the local health care service supply and the customer demand for service as a geographical distance to service sites. The second part of the empirical analysis targets to test the perceived availability of regular health care services in the residential areas. The SPSS Statistics 20 was applied in the analysis.

Results

Assessing centralisation allowance of service networks

We have measured the actual service supply (i.e. locations of the service points) by the actual distance from the respondent's home to the local city centre. The mean value of the municipal specific distances (Table 1, actual dist.) is then applied as a rough estimate of the locations of service sites at present. The respondents were also asked to define the highest acceptable distance to service sites from their homes (Table 1, demanded dist.). In this aspect, respondents' entries are expected to represent the appropriate location of service sites with regard to their needs, capabilities and available logistics. Respondents were asked to consider acceptable distances from the perspective of services that are used regularly, daily or several times a week.

	N	Actual dist. [km]	Demanded dist. [km]			
		Mean	Mean	Quartile 25% upper bound	Median	Quartile 75% lower bound
Municipality 1	238	3.8	3.4	1.4	2.5	5
Municipality 2	40	5.3	4.8	0.6	2	6.3
Municipality 3	81	8.5	6.9	1	3	10
Municipality 4	79	8.7	6.6	1	3	10
Municipality 5	122	8.8	6.5	1	3	10
Municipality 6	15	8.9	7.8	1	10	18
Municipality 7	55	8.9	8.6	3	10	15
Municipality 8	214	10.5	6.1	2	4	10
Municipality 9	70	11.1	9.5	2	10	20
Municipality 10	92	12.3	10.1	2	6	15

Table 1: Actual and demanded distances to service sites

Findings support several conclusions about the centralisation allowance of the service sites. In an urban environment, the density of service site networks should be higher because customers are not willing to use distant service sites. Municipality 1 represents the demand of suburban inhabitants. There the mean values in actual and demanded distances are low and the 75% quartile of demanded distance is below the actual means of others. Findings from sparsely populated municipalities 6, 7 and 10 indicate that centralisation is less critical from the perspective of the demanded location of service sites. In these cases, the median of demanded distance is near the actual distances. The growing demanded distance is likely to be explained through the inhabitants' adjusted circle of living. The following observations from static areas support the assumption because a significant difference in the mean values of the actual and demanded distances cannot be seen in the static municipalities (3 to 7). In these cases, the service supply can be expected to fit well with the demand. The most interesting findings regard transitional areas (Municipality 8). We assume that the centralisation allowance is not available there because the 75% quartile of demanded distance is below the mean value of the actual distance to service sites. The centralisation of health and social care services during municipal mergers seems to have moved service sites outside of the inhabitants' natural circle of living in that particular area.

Analysing perceived availability

The two item measurement for perceived availability (see Table 2) describes the perceived obstacles to reaching local services. We applied the Likert scale, in which the respondent's opinion on statements varies between 1 (completely agree) to 7 (completely disagree). Thus, the higher the value is that the measurements reach, the lower the perceived availability is, and vice versa. The reliability of the measurement construct is good $\alpha=0.824$ (limit for sufficient Cronbach's alpha >0.6) and inter-item correlation was measured at 0.714, indicating no collinearity. The distribution of scale variables was visually interpreted to be normal.

Measure	Mean	SD	Alpha
<i>Perceived availability</i>	2.51	1.72	.824
Services are available near my home			
Distance to services is acceptable			

Table 2: Measure and scale items

We divided the municipalities into four general areas for analysing the perceived availability of services. The analysed areas were defined by their geographical locations, population density and whether the area is under transition or not. The following grouping was then formed:

- Area 1: Densely populated suburban area where geographical distances are short.
- Area 2: Sparsely populated areas of recent municipal mergers and service provision reform.
- Area 3: Static sparsely populated rural areas.
- Area 4: Distant rural areas of static structures.

The perceived availability of services was tested using ANOVA to find out the differences in mean values between the areas. The test statistics (F-value) illustrates the confidence level related to the existence of a difference between mean values. The statistical tests indicate that statistically significant differences in mean values (Table 3) between residential areas can be found ($F=6.087$; $p<.000$). A post hoc test was then carried out to determine which areas manifest statistically significant differences in the perceived availability of services.

Group	Municipalities	N	Measure		Post hoc ^a	
			Mean	SD	Difference to	p ^b
Area 1	1	238	2.21	1.44	2	.000
Area 2	8	214	2.85	1.76	1	.000
Area 3	2, 3, 6, 7, 9	261	2.38	1.67	2	.017
Area 4	4, 5, 10	293	2.61	1.90	1	.043

^a) Tamhane's test, equal variances between groups not assumed

^b) The difference between groups is statistically significant at $p<.05$

Table 3: Differences in perceived availability between municipalities

We did not find significantly decreased perceived availability from any analysed areas, but some indications of environmental characteristics in the availability risk were recognised. Overall, the perceived availability measured varies between good and moderately decreased. The analysis yielded several key findings that are worth discussing. Suburban areas indicate the lowest barriers to the use of services because of short distances, making the risk of unreasonably distant service locations low. Areas such as these are, however, sensitive to changes in the service provision networks due to the demand of a short distance to service sites. The transition area (Area 2) indicates a slightly lower perceived availability compared to other areas (Areas 1 and 3). The difference is a result of two major changes in the local government system of health and social care. First, large mergers of local municipalities have recently been accomplished in that particular area. Second, the health service provision responsibility has moved from municipalities to a federation of municipalities (i.e. the South Karelia Social and Health Care District) which operates as an external provider. As a sum of these trends, the centralisation of service sites from sparsely populated areas to the city centre has gained ground. Such development seems to increase the availability risks in Area 2 where three municipalities were merged a few years ago. Sparsely populated areas (Areas 3 and 4) do not differ from each other. A statistically significant difference to suburban areas and transitional areas can, however, be identified and the mean values of perceived availability in Areas 3 and 4 are between that of groups 1 and 2. The differences would indicate that geographical distance is an evident reason for the availability risk, but perceived availability seems to be strongly interlinked with the scope and speed of changes in the residential areas.

Discussion and Conclusion

Geographic distance to health care services is a pivotal issue in assessing availability risk from the customer point of view. Within the scope of this research availability risk is affected by demographic changes in population, structural changes in the municipal service system, and changes in customer needs and habits. A combined influence of these issues is likely to create imbalance between service demand and supply.

Demographic changes and availability risk

The challenge of ageing population needs to be resolved by increasing service capacity, either by increasing the capacity and effectiveness of existing modes of services or creating new service modes

and supply chains (e.g. by a stronger application of e-services). Ageing itself increases availability risk if nothing is done.. There are great differences in population dependency ratios between municipalities and regions. None of the municipalities are expected to report improved situation in the future. Smaller municipalities have the biggest challenges (The Association of Finnish Local and Regional Authorities, 2012). Remarkable net increase in service capacity (through capacity developments and efficiency gains) would be needed to balance the increasing demand. As it comes to geographic availability within our research, people would like to have services available within their circle of living in sparsely populated rural areas. For the elderly people, the circles of living become more restricted due to decreasing operational functionality by age. Further, due to constant population migration the circles of living in average are moving towards cities. Hence, at present the geographic service capacity need to be tailored to elderly, preserved in rural areas, while preparing for relatively stronger capacity increases in cities in the further future. It appears that while demographic changes occur, more flexible service supply chains are called for, like the Mobile Clinic mentioned earlier in the paper.

Structural changes in the municipal service system

Increasing size of municipalities is likely to create sparse network of service points covering large population. In such situations, the service supply would be centralized to the densely populated areas, where location of service sites does not fit to the demand of residents of rural areas. Our research showed that the centralization allowance limits have been reached in some municipalities in the sample region – a further centralization of services would conflict with the anticipated circle of living of people. Structural changes together with demographic changes might create a self-reinforcing cycle, where centralization decreases service site coverage, which in turn boosts population mitigation. As it is not self-evident that centralized service supply chains would be more cost-effective than distributed service provision, pure centralization in the cost of customer perceived availability seems to be merely increasing imbalance between service demand and supply. Actually, as mentioned earlier, one of the major challenges of the future is how to support elderly people's welfare and ability to live at home. Behind this aim is a strong economic logic that a prolonged period of independent life at home would save costs at system level. As the centralization strategy and home-centered approach exist at the same time, it inevitably shakes the demand-supply balance. More emphasis should be paid on integrated and seamless care paths, where the focus is in services, not in structural issues as such. Structural changes in the form of broader health care districts over single municipality borders might help overcome some factitious restrictions in municipality level services system. A municipality could for instance restrict the use of services from members from other municipalities, even if the underlying service site is within the circle of living of a customer. Further, some new forms of care would not be economically or operationally valid for a single municipality, but a health care district can organize the supply chain. A health care district might have a better opportunity to manage availability risk – at least in case it manages to avoid the centralization trap.

Customer perceived availability of health care services

Customer perceptions beyond actual service distances uncover deeper understanding about the geographical availability. Our findings show that suburban and transitional areas are somewhat more sensitive to the changes in the service system than the sparsely populated areas. A part of this phenomenon is explained through geographical distance, but a broader explanation is grounded in perceived availability. In static conditions, without major changes in the living conditions in residential areas, customers tend to become accustomed to the service availability within their circle of living. While the habituated balance is shaken by changes (e.g. centralization of services), it has always an effect on the perceived availability. This is, after a service site disappears from the circle of living, geographical distance might become an issue. As changes occur, it takes some time to get used to the new situation. People in sparsely populated areas accept longer distances to services, and more importantly they might not perceive longer distances a problem as much as people in suburban areas.

Scientific, managerial and social implications

The availability risk of health care services is still a focal subject under research and there are clear gaps in the current scientific discussion from several perspectives. This study addresses some new perspectives on the availability of health care services. Our contribution is formed through the combination of geographical availability and customer perspective. In earlier research geographical availability is often seen as a supply side factor, which easily limits the scope of analysis to service providers view only. Our approach enables an extension towards customer perceived availability. The implications of this research for future planning of health care services and managing availability risk can be summarized as follows:

- Customer perceptions of availability risk are a focal issue: Taking customer perspective into account in planning health care services increases customer perceived availability and social acceptance of services. Customers' perceptions and habits are important aspects in planning both volume critical services (e.g. hospital) and non-volume critical flexible services (e.g. a mobile health unit).
- There appears to be a 'habit' dimension in the availability risk: Suburban areas tend to be more sensitive to changes in the absolute distance to services than sparsely populated rural areas. Distance might have a great influence on availability risk, but it is context dependent and rooted in routines and habits of customer groups.
- The applied customer perceived availability measure indirectly accounts for both geographical and timely availability. Hence, it can be easily generalized. Actual distance and perceived availability should both be measured, but as separate items.

Limitations and further research directions

The implications of perceived availability and absolute distance are focal in reflecting the research in other contexts. The applied measure for perceived availability is technically valid, but its content should be elaborated to increase practical relevance. The results do not enable direct comparison between service availability between cities and sparsely populated rural areas. Further research should take into account a broader variety of residential areas in researching availability risk.

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SERVICE PREFERENCE IN THE SHORT SEA SHIPPING MARKET

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ABSTRACT

Purpose: This study proposed a causality model in the context of Short Sea Shipping (SSS) services to investigate the influence of purchase intention through the buyers' service preference and perceived value.

Approach: This study applies the structure equation modeling (SEM) approach to assess the empirical strength of the relationships in the proposed model. The model has been validated through empirical test that the extent of preference matching between services delivered and customer needs in each attribute influence the perceived value of customers and therefore affects the final purchase intentions.

Findings: The attributes of a service can commonly be categorized into service quality and service preference where the former represents an attitude that the more the better but the latter pertains to each one's preferred selection. The findings show that timing related services, pricing related services, warehousing services, sales services, door-to-door services, information services and advertising services have positively impact on customer preference.

Practical implications: In addition to the conventional satisfaction indicator in which the quality is perceived after using the service, we show that the perceived value can be an effective criterion for evaluating the procurement decision before the consumption of transportation service

Originality/value: Although existing studies have addressed the importance of service quality and perceived value, the service preference of customers and its relationship to perceived value and Purchase Intentions remain unexplored.

Key Words: service preference, perceived value, purchase intention, Short Sea Shipping (SSS)

Introduction

The shift of freight from road to sea is due to shipping by water is more cost-effective than by road. The short sea shipping (SSS) is as a transport alternative to road and has received considerable attention in the shipping industry over the past decade. The purpose of SSS can be a leg of transshipment or a replacement to road transport. SSS has numerous advantages such as decrease of air pollution and overall cost savings to the operators. It is also considered as a special mode favored to alleviate road congestion (Paixão & Marlow, 2002; Douet & Cappuccilli, 2011). In the trend in persuading scale economies, some used-to-be large vessels now become regional feeders. This change threatens the existing market structure of SSS. Although SSS is growing popularity, academic marketing research about service preference and perceived value of customers in the SSS market is still scarce. The service preference pertains to each one's preferred selection (O'Cass & Lim, 2001). For example, every one favors low price and good product quality but not necessarily everyone needs dedicate transport service. Prior research have identified several attributes of service for maritime firms (Paixão & Marlow, 2005, 2009; Lu & Marlow, 1999; Lu, 1999, 2000, 2003), such as reliability of sailing, availability of cargo space, on-time pick-up, etc., and their influence on the selection of carriers (Lu, 2003). However, few have specifically explored the influence of service attributes on preference of customer in the SSS context. While preferential decision has been an ongoing research topic in other social science disciplines for the past three decades (Muthitacharoen et al., 2006), very little effort has been made to incorporate preference in shipping service research. Thus, this research attempts to recognize what kind of services is preferred to shippers in short sea shipping.

The customer may cognitively perceive what they get and what they have to hand over for receiving services (Zeithaml, 1988; Gronroos, 1984). The service providers should design, develop and deliver the service offering on the basis of perceived value which is also an influential factor for selection of providers. Prior research summarized the response of the carriers, shipping agencies and freight forwarders concerning their level of satisfaction with the component aspects of service (Lu & Marlow, 1999). However, there is few literature that deals with perceived value from shipper's perspective in the SSS setting. The purposes of this paper are to: (1) investigate what service attributes are shipper's preferred services, (2) gain insights into the relationship between service preference and perceived value, and (3) examine the impact between perceived value and purchase intentions. Therefore, the hypotheses presented and tested seek to provide answers to the following research question: What service attributes will influence shipper's service preference? Is perceived value a significant determinant of purchase intentions in SSS context? Is service preference a significant determinant of perceived value and purchase intentions in SSS context?

Theoretical Background and Hypotheses Development

Short Sea Shipping (SSS)

Several different definitions of SSS are found in the studies, which show the complexity of the concept. From marketing, logistics or regulatory perspectives, some authors stated that SSS can embrace different ships, from conventional to innovative ones such as fast ships, with a variety of cargo handling techniques (horizontal, vertical or a mixture of both), ports, networks and information systems, which when studied. Crilley and Dean (1993) define short sea ships as ships, employed in the movement of goods and passengers, between 100 gross tonnage (GT) and 5000GT. Since SSS carriers can either own and operate a number of ships or own and run only one or a very small number of ships, service providers of different types may offer a variety of different services to their customers (Paixão & Marlow, 2002). The service attributes related to SSS have discussed by numerous of studies. Brooks (1983, 1984, and 1985) examined the determinants affecting the shipper's choice of a container carrier. Lu (1999) investigated the logistics service attributes and compared the satisfaction level with regard to performance between two logistics firms in Taiwan. Lu (2003) identifies four generic carriers' service factors from shippers' perspective. These factors lie in the category of quality attributes also. Cariou (2008) alleges that the industrial trends have shifted to that vertical and horizontal integration prevails and colossal vessels dominate regarding to the recent development of liner shipping market. As a result of pursuing scale economies, oversized vessels increasingly rely on spoke-and-hub configuration so that the role of regional feeders becomes important and this part of freight cost becomes significant. Paixão & Marlow (2005) identified eight service attributes for short sea shipping in the multimodal transport of an integrated service. They concentrate more on the attributes in quality dimension, leaving other preference issues untouched. Since not all service attributes are critical to every firm, the service is important to one firm may not be to another (Lu & Marlow, 1999). Thus, the key to creating competitive advantage is to understand the service preference of customer. Paixão and Marlow (2007) characterize the market of short sea shipping through assessing the impact of the Trans-European Transport Networks. They have classified three types of services including dedicated, systems, and standard operation, which reflecting the extent of customer preference attached to the carrier. In addition, Paixão and Marlow (2009) select eight directions of logistics strategies out of thirteen factors through summarizing 75 best-practices for the operators of short sea shipping. Their findings lay in the attitude of the more the better, lacking the consideration of requirement matching. Most service attributes identified reflect the more the better nature instead of a view of needs matching.

Service Preference

Preference is also defined as "the setting by an individual of one thing before or above another thing because of a notion of bitterness" (Brown, 1984). It has also been suggested that consumers have greater preference for services that are congruent with the consumer's actual self-concept which is how they would really like to be (O'Cass & Lim, 2001). The importance of service preference to other psychological variables has been observed in prior studies, such as beliefs and intentions (Anderson, 1982; Chandrashekar, 1994). According to Hsu and Lu (2007), customer preference is defined as "the degree of users' positive feelings about participating in online game communities". Similarly, Muthitachoen et al. (2006), the "service preference" stresses the that to satisfy customers' various needs.

Previous studies have addressed the importance of service quality in consumer marketing; however, few studies have empirically developed a framework to measure service preference of empirical marketing. However, researchers still lack research exploration on service attributes and service preference. Lu (2003) investigated the impact of carriers' service factor on shippers' satisfaction from shipper-carrier partnering relationships. An evaluation of aggregated shippers' perceptions of carriers' service attributes showed all 30 service attributes to be satisfactory. According to the factor analysis technique, Lu (2003) identified six service attributes or key dimensions, from shippers' perspective, were: timing related factor, pricing related factor, warehousing service factor, sales services factor, door-to-door factor, information factor and advertising factor. This study attempts to examine the relationship of service attributes with customer preference. Thus, borrowing from Lu (2003)'s six service attributes; we will validate how many service attributes have the impact on customer's preference. Thus, we may have following hypotheses.

- H1: The service attributes are positively related to service preference.
- H1a: The timing related services are positively related to service preference.
- H1b: The pricing related services are positively related to service preference.
- H1c: The warehousing services are positively related to service preference.
- H1d: The sales services are positively related to service preference.
- H1e: The door-to-door services are positively related to service preference.
- H1f: The information services are positively related to service preference.
- H1g: The advertising services are positively related to service preference.

Perceived Value

According to Christopher (1992), logistics service is explored to seek out an advantageous position based upon value advantage, and the view that relative value can help a firm gains an additional competitive advantage (Ernst, 1988). To our knowledge, the perceived value construct has not received as much attention in the transportation literature as other constructs. Unlike other industries, customers directly pay for service rendered, the SSS has third party providers that may pay for all or a part of service provided. The coverage by the third party provider may impact the customers' understanding of price and perceived value. It is complicate to analysis how perceived value of services is influenced in the SSS context. A customer perceives higher value if all service attributes of provider highly meet the requirement of customer. In SSS contexts, the role of perceived value is essential to examine since shipper might not always consume the best quality service, and they might instead purchase on the basis of their assessment of the value of a service (Cronin & Taylor, 1992). However, if the carrier provides services which are shipper preferred service, the shippers may perceive more value from a psychological evaluation of the relative payments and losses associated with the offering. This leads to the following hypothesis:

- H2: Service preference is positively related to perceived value.

Purchase Intentions

Most studies have focused on understanding the initial purchase behavior (or behavioral intention) of customers, including willingness to buy (e.g. Jarvenpaa & Tractinsky, 1999); purchase intention (e.g. McKnight et al., 2002); willingness to transaction intention (e.g. Bhattacharjee, 2001); and behavioral intention to use (e.g. Suh & Han, 2003). There are multiple behavioral intentions, including customer loyalty, positive recommending behavior and repurchase intentions (Zeithaml, 1996; Cronin et al., 2000; Oh, 1999). In addition, Zeithaml et al. (1996) proposed a multidimensional measure of these indicators that include purchase intentions, complaint behavior, price sensitivity, and word-of-mouth communication. Some studies have confirmed that customer perceived value is et al., 1991; Cronin et al., 2000). In addition, since service is intangibility, inseparability, heterogeneity, and perishability (Etzel et al., 2001), "service preference" stresses the accessibilities of service and service variety

which involves the ability to provide different kinds of service that to satisfy customers' various needs (Muthitacharoen et al., 2006). If a customer perceives a shipper's services to be of high attribute he will be more likely to generate a favorable attitude towards it, demonstrate behavioral control over it, which in turn, translates into a higher intention to purchase it (Pavlou & Fygenson, 2006). In accordance with the previous research, it is hypothesized as follows:

H3: Perceived value is positively related to purchase intentions.

H4: Service preference is positively related to purchase intentions.

Therefore, we propose a research model as Figure 1.

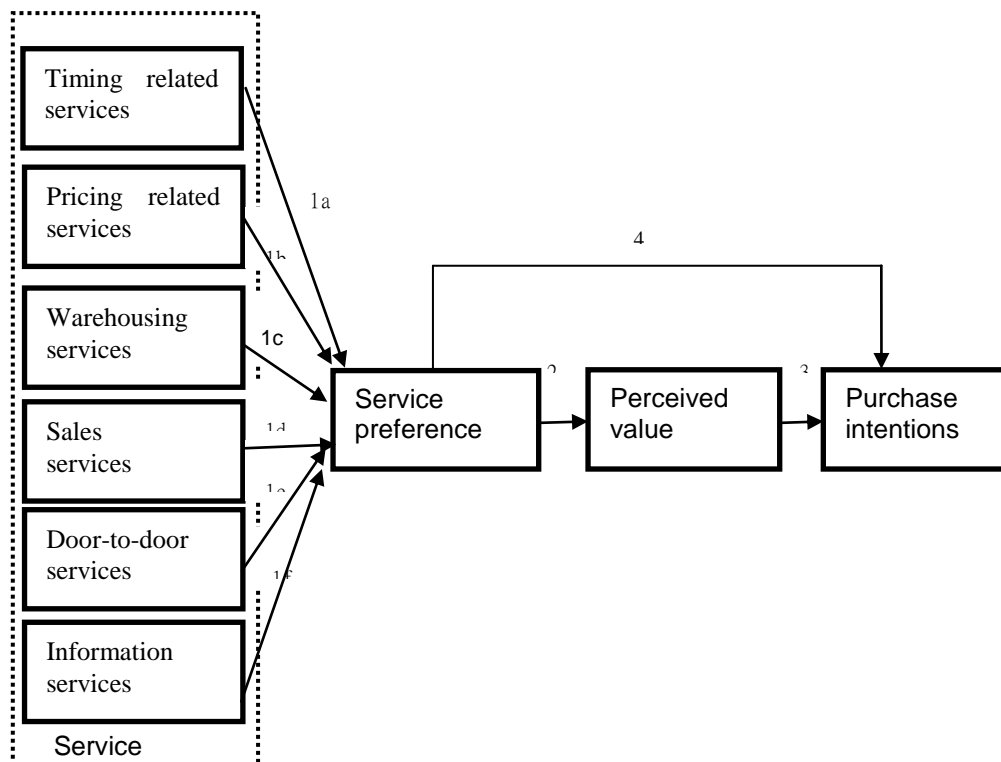


Figure 1. Research Model

Methodology

Questionnaire development and data collection

A questionnaire including 22 items was generated. All of the items were measured using 5-point Likert type scales with anchors ranging from strongly disagree (1) to strongly agree (5). For this study, all measurement items in the questionnaire were developed either by adapting measures that have been validated by other researchers or by converting the definitions of constructs into a questionnaire format. A pretest of the questionnaire was performed to ensure content validity and reliability within the target context. Five experts in the maritime area were invited to assess wording clarity, task relevance, and question item sequence adequacy. The comments collected from these experts lead to several minor modifications of the wording and the item sequence. Furthermore, a pilot study was conducted involving 30 individuals have working experience in firms of carrier or shipper. Comments and suggestions on the item content and structure of the instrument were solicited.

To investigate the research model, a survey technique was used to collect data. Candidate firms randomly were selected from a list of International Ocean Freight Forwards and Logistics Association in Taiwan. 200 firms were contacted by an introductory letter, and then a follow-up phone call

describing the goal of this study and eliciting the firm's support. All respondents were required to have knowledge of logistics and transportation. At the end of this screening process, 130 questionnaires were sent to those firms willing to help. In the e-mail welcoming and thanking them for doing the survey gave some statements ensuring the participants the privacy when filling up the questionnaire. From August to September 2011, we received 105 complete questionnaires; 86 usable data were used for analysis, yielding a response rate of 82 percent.

Table 1. Questionnaire items and factor loadings

Construct	Items	Measure	Factor Loadings
Timing related services (TS)	TS1	On-time pick-up	0.92
	TS2	Short transit time	0.95
	TS3	High frequency of sailing	0.89
Pricing related services (PS)	PS1	Freight rates	0.88
	PS2	Price and discount structure	0.90
	PS3	Willingness to negotiate	0.86
Warehousing services (WS)	E1	Customs clearance service	0.75
	E2	Storage service	0.92
	E3	Packaging/labeling service	0.82
Sales services (SS)	S1	Frequency of sales representatives calls to shippers	0.79
	S2	Knowledge ability of sales personnel	0.85
	S3	Ability of sales representatives to handle problems	0.83
Door-to-door services (DS)	DS1	Door-to-door service and good condition of containers	0.78
	DS2	Door-to-door service was the highest	0.80
Information services (IS)	IS1	Computer EDI interface	0.77
	IS2	Computer cargo tracing	0.91
Service Preference (SP)	SP 1	Transaction Cost Preference	0.94
	SP 2	Product Preference	0.88
	SP 3	Social Interaction Preference	0.79
Perceived value (PV)	PV1	The service would be economical	0.80
	PV2	The service is value for money compared with that of major competitors	0.88
	PV3	The choice of transacting with the firm is a right decision when price and other expenses are considered	0.82
Purchase intentions (PI)	PI1	I intend to transaction with the firm in the near future.	0.82
	PI2	I plan to purchase the service from the firm in the near future.	0.89
	PI3	I predict that I would consider purchasing service from the firm in the near future.	0.92

Data analysis procedure and methods

Three main statistical analyses were described as followed. (1) Descriptive Statistical Analysis: in order to summarize the characteristics of respondents and better understand each research variable, descriptive statistical analysis was used to illustrate the means, and standard deviations of each research variable. (2) Confirmatory Factor Analysis: CFA is used to test the reliability and validity. A reliability test for each construct was applied to assess the internal consistency from composite reliability. (3) Structural Equation Modeling: SEM is used to verify the goodness of fit of the research framework and to describe the relationships among the construct variables. In order to investigate the objectives of this study and test the hypotheses, PLS (partial least squares) was employed to help us analyze the collected data. The PLS software package is used to analyze the relationships in the entire research model to find out the relationships among variables in this model. PLS provides the analysis of both a measurement model and a structural model. PLS places minimal restrictions on measurement scales, sample size and residual distribution (Chin & Newsted, 1999).

Data Analysis and Results

Data analysis involves analyses of the measurement model and structural model. The adequacy of the measurement model was evaluated on the criteria of reliability, convergent validity and discriminant validity. Reliability was examined using the composite reliability (CR) values, which should be greater than the benchmark of 0.7 to be considered adequate (Fornell & Larcker, 1981). Additionally, the convergent validity of the scales was verified by using two criteria suggested by Fornell and Larcker (1981): (1) all indicator loadings should be significant and exceed 0.7 and (2)

average variance extracted (AVE) by each construct should exceed the variance due to measurement error for that construct (i.e., AVE should exceed 0.50). Most items exhibited loading higher than 0.7 on their respective construct, providing evidence of acceptable item convergence on the intended constructs.

Discriminant validity was assessed by examining the factor loadings to see if questions were loaded more highly on their intended constructs than on other constructs (Fornell & Larcker, 1981). Therefore, we conclude that the measure for each construct satisfies construct reliability and validity. In the examining of the impact of service attributes on customer preference, the empirical findings show that timing related services, pricing related services, warehousing services, sales services, door-to-door services, information services and advertising services have positively impact on customer preference. This study has found the door-to-door services and information services have the positive impact on customer preference, though the significance of these two services is weaker than the other attributes such as timing related services, pricing related services, warehousing services and sales services. Customer preference has a strong impact on perceived value ($b=-0.53$, $p<0.001$), validating H2. The higher the shipper's preference, the more likely the shipper will perceive more value from carrier's service. Customer preference also has a direct and significant impact on purchase intentions ($b=-0.18$, $p<0.01$), validating H4. In addition, perceived value has a strong impact on purchase intentions. This finding is consistent with previous research (Dodds et al., 1991; Cronin et al., 2000) indicating that customer perceived value has a significant influence on purchase intentions transactions.

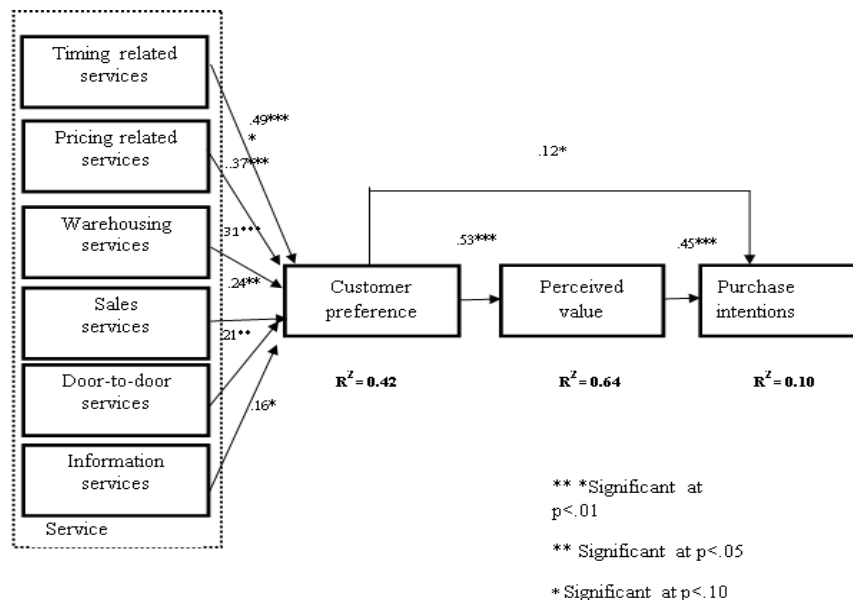


Figure 2. SEM analysis of research model

Conclusions

The development of SSS services offer a potential market (Paixão and Marlow, 2002) but researchers have paid little attention to this phenomenon in Taiwan. This study is to conduct an empirical examination of the effects of perceived value on purchase intentions within SSS context. It also contributes to identify the relationship between service attributes and customer's preference. The findings of this research should benefit both practitioners and academics by elaborating on our theoretical understanding of constructs in the model and their postulated relationship within SSS contexts in Taiwan. For practitioners, this work can significantly help managers of carrier to manage relationships with their shippers. Most of shippers focus on means of providing excellent service quality for customers. However, they may ignore the shipper's preferred services are related to customer's requirement. Thus, they should try to provide the proper services for customers. SSS service providers can use the results from the current research to identify the critical factors affecting the customers' purchase intentions and directions of improvement, and their action will increase the target customers' stickiness on them. The measuring and attaining of service useful since it is under control of SSS provider. The research also has great managerial implications as carrier' managers can use the developed questionnaire in order to assess the service preference, thus facilitating the

universal measurement based on the customer perceptions in the shipping industry. The findings of this study will contribute to the academic literature by providing clarity of consumer behavior framework in the context of SSS. The results will also be significant because they provide new information on a previously uninvestigated area – Taiwan. Therefore, the results of this research will help to begin the process of organizing a framework for understanding the link between service preference, perceived value, and important attributes of service preference within SSS contexts. In particular, the findings with respect to multi-attributes of service preference and perceived value should lead to an understanding of the broader issue of the mechanisms whereby users are attracted to purchase.

In conclusion, these findings lead carriers to understand the relationship among service attributes, perceived value and purchase intentions from shipper's perspective. Therefore, our research offers managerial and academic implications for SSS marketing. The implications of the findings may guide carrier's managers in providing the appropriate services and adopting right marketing strategy to the shippers in the future.

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GREEN AND SUSTAINABLE SUPPLY CHAIN MANAGEMENT ON OPERATIONAL PERSPECTIVE: A LITERATURE REVIEW

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ABSTRACT

Purpose: The purpose of this paper is to present a comprehensive review of the literature available that addresses Green supply chain management (GSCM) and Sustainable supply chain management (SSCM) from an operational perspective between 2007-2012, identify any research gaps and future research opportunities.

Design/methodology/approach: Content analysis was employed in this paper to analyse and classify 150 articles of GSCM and SSCM research recorded in the databases of Emerald, SpringerLink, ProQuest and Science Direct between 2007–2012.

Findings: The findings of the research work include the classification of GSCM and SSCM research. This research area can be divided into 4 categories i.e. environmental effects, strategic, operational and regulation perspective. The operational perspective has been emphasized and future studies and research opportunities have been proposed.

Research limitations/implication: the research outputs reviewed were only based on published peer-reviewed international journals; any other forms of publications (i.e. research working papers, conference papers and dissertations) have been excluded.

Practical implications: The operational perspective and new research issues are proposed as knowledge for the development of organizations more efficiently.

Originality/value: This paper summarizes available knowledge related to GSCM and SSCM, especially from the operational perspective and highlights guidelines for any future research.

Keywords: Literature review, Sustainable supply chain management (SSCM), Green supply chain management (GSCM), Operational perspective and Content analysis.

Introduction

The cross-disciplinary field of GSCM has been growing in recent years with an interest from both academic and industry (Sarkis et al., 2010). In an academic manner, scholars as well as researchers attach an importance to the approach and take the concept of GSCM being applied widely (Sarkis et al., 2011). As a result, the concept of GSCM has become a lesson for university students, the integration of research works by researchers along with the establishment of associations that are a driving force behind GSCM. Such implementation results are in most likelihood the development in academic circles (Sarkis, 2007).

From an industry perspective, enterprises are recognizing that environmental management is a key strategic issue with the potential of having a lasting impact on an organization (Diabat and Govindan, 2010). Green supply chain management (GSCM) has emerged as an important new approach for enterprises to achieve profit margins and gain market share objectives by reducing environmental risk and impact (Li et al., 2011). The inception of GSCM was marked by the attempt to reduce carbon dioxide emissions of transportation and product distribution-related activities (Mckinnon, 2010). Subsequently, attention has been extended to reverse logistics which is the adoption of reuse and the procedures to return products to be destroyed. (Srivastava, 2006; Hazen et al., 2011).

In later periods, the development of integrating diverse activities has begun within supply chain management and has coupled with the development of environmental management or what is called GSCM. (Diabat and Govindan, 2010; Shi et al., 2012). GSCM is concerned with the integration of various activities in supply chain with the environmental management purpose of reducing waste, pollution and environmental impact to a minimum. (Zhu et al, 2008; Sarkis, 2010; Srivastava, 2007). Until recently, the range of management has been developed by introducing the concept of sustainable development to be integrated with supply chain management. Sustainable supply chain management(SSCM) is to bring the concept of triple bottom line which includes the environmental, social and economic factors for integration in the supply chain management to improve the supply chain management towards sustainability (Faisal, 2010; Hall and Matos, 2009; Koplín et al., 2007) with broader scope than GSCM. This is because GSCM only considers environmental factors while SSCM extends the scope to cover social and economic elements (Carter and Easton, 2010; Cetinkaya et al., 2008; Dao et al., 2011) in addition to taking into account the environmental factor. The research on GSCM and SSCM related to operation management ranges from products such as raw materials to finished products to be delivered to consumers (Styles et al., 2012) which are essential to the business, in order to find guidelines as well as opportunities to develop research in the future.

The purpose of this paper is to present a comprehensive review of the literature addressing GSCM and SSCM from operational perspectives during the period 2007-2012 and identify any research gaps and opportunities. The remaining sections of this paper cover; Design, methodology, approach, findings, discussion and conclusion.

Design /methodology/approach

The methodology employed in this paper is content analysis in order to conduct literature review. Content analysis is a qualitative research technique which comprises classification and information system arrangement with the aim of describing elements and relationships (Bernard and Ryan, 2010). Therefore, at present the researchers have brought this technique to be applied extensively to the literature review for the purpose of finding future research gaps and opportunities (Wiese et al., 2012; Seuring and Gold, 2012; Haze metal, 2012).

The authors have focused on academic peer-reviewed journals published between 2007-2012 by using the key words “GSCM” and “SSCM” utilizing four databases including Emerald, SpringerLink, ProQuest and Science Direct. MS Access was the database tool used to search such literature.

Findings

The literature review is concerned with a collection of articles and content analysis from the total of 150 articles dating back 6 years between 2007-2012. The number of articles on the A.D. year basis can be summarized as shown in Figure 1.

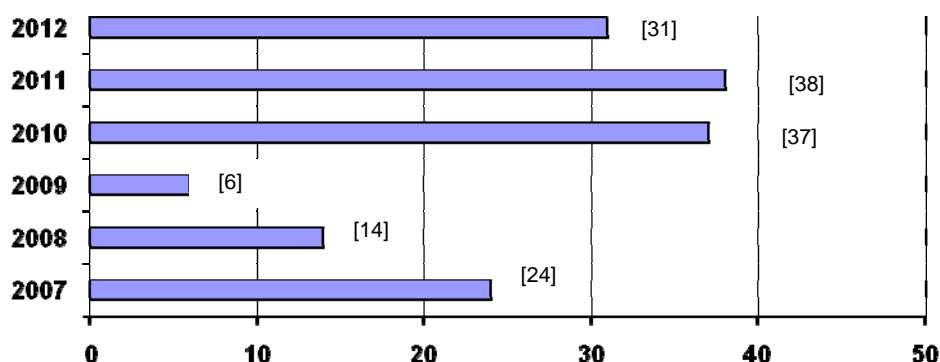


Figure 1 : Number of reviewed papers per year ([-] is the number of articles)

Most articles during the year 2007 were the articles about the concept and structure of GSCM (Sarkis, 2007), stimulating factors, operations,, as well as measuring the performance of GSCM (Zhu et al., 2007). In addition, it can be observed that the articles began to introduce the concept of sustainable development to be applied to supply chain management. However, the majority were almost entirely literature review (Ansett, 2007; Markley et al., 2007; Svensson, 2007). In the year 2008, most of the articles presented the concept of GSCM to be applied increasingly to different activities associated with supply chain management and business organization (Lee, 2008; Michelini et al., 2008; Srivastava, 2008). The research on sustainable development introduced the triple bottom line concept as key element in the development of supply chain management. Most articles were still in the form of literature review and the creation of various frameworks (Carter and Rogers, 2008; Seuring and Muller, 2008; Seuring and Sarkis, 2008; Hutchins et al., 2008). The articles for this literature review during the year 2009 were quite a small number. Most articles had similar characteristics to the research in the year 2008 with the difference that the researchers began to focus on sustainable development through furthering the research done in the past (Mark and Zhaohui, 2009; Badurdeen et al., 2009; Krause et al., 2009).

During the period 2010-2012, there was a significantly and remarkably growing number of articles that have been brought for literature review. Most of the research has focused on the interest in sustainable development in the first rank. There was an increased research development, from the literature review as preliminary framework to become concept and framework for the development of operations, increasingly measuring the performance of implementation. (Xia and Tang, 2011; Peters et al., 2011; Long et al., 2010; Lee et al., 2012; Gopalakrishnan et al., 2012). Regarding GSCM management, the research has been developed in terms of increasing the measuring of GSCM performance. (Kim and Min, 2011; Bjorklund et al., 2012; li, 2011). Based on 150 articles,with GSCM-related content the highest number represented up to 83 articles. This is followed by the SSCM – related articles. It can be said that the trend was on the increase in comparison with the past (Carter and Easton, 2011; Fabbe-Costes et al., 2011; Gupta and Palsule-Desai, 2011).

Classification of GSCM and SSCM research

It has been found that data relating to the research on GSCM and SSCM can be classified into 4 categories as show in Figure 2. These include **environmental effects perspective**, a research group that studies the impact of supply chain management which affects the environment; **strategic perspective**, a research group related to the development of different strategies as well as GSCM and SSCM – related methods to develop the organization and establish a competitive advantage; **operational perspective**, a research group concerned with the management of organizational operations, coupled with the integration related to environment and sustainable development and **regulational perspective**, a research on different rules, regulations, and policies of the organization for consideration in conjunction with the environment and sustainable development

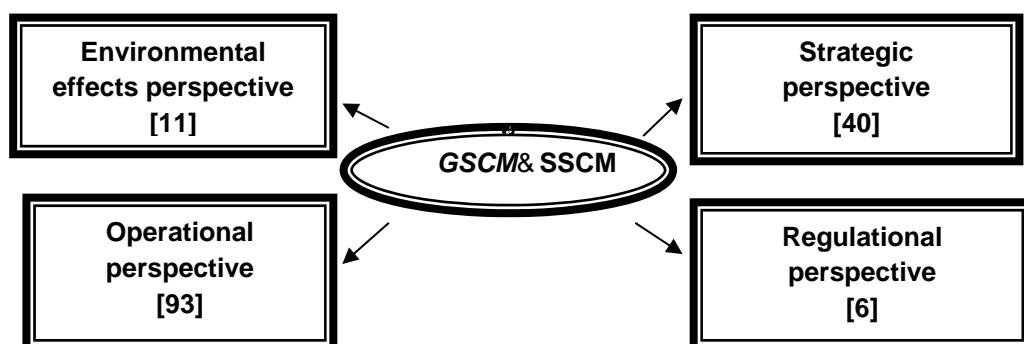


Figure 2 : Classification of GSCM and SSCM ([-] is the number of articles)

From Figure 2, it has been found that the research in operational perspective type shows the highest number. It is concerned with research on management in the acquisition of goods to be delivered to consumers with the articles that present the management of supply chain both as a whole and with separation of each individual activity (Bjorklund et al., 2012; Zhu et al., 2010), followed by the research on strategic perspectives that brought different concepts and theories related to GSCM and SSCM to be applicable in creating a competitive advantage for business organizations including a strategy of creating competition, innovation, risk management as well as decision-making. (Colicchia et al., 2011; Hojmosse et al., 2012; Chen et al., 2012). The last two ranks are research on environmental effects perspective and regulatory perspective with a rather small number of articles of research since it is about research into specific area as well as being related to various rules and regulations which vary greatly in each individual country. This results in a small number of researchers as well as the fact that the operations are conducted specifically in a particular group (Mckinnon, 2010; Arimura et al., 2011).

GSCM and SSCM on operational perspective

This paper focuses on the research from an operational perspective because the research in this category is the major issue on which the business sector attaches particular importance (Ferrell et al., 2008; Thomas and Scott, 2009). The type of research from an operational perspective can be divided into 6 subgroups. The first four subgroups are the research group with focus on logistics activities as show in Figure 3. These include the fields of Green purchase and procurement, Green manufacturing and production, Green transport and distribution and Reverse logistics. The other two subgroups focus on the management of the whole supply chain, that is to say, the research group in the areas of GSCM and SSCM.

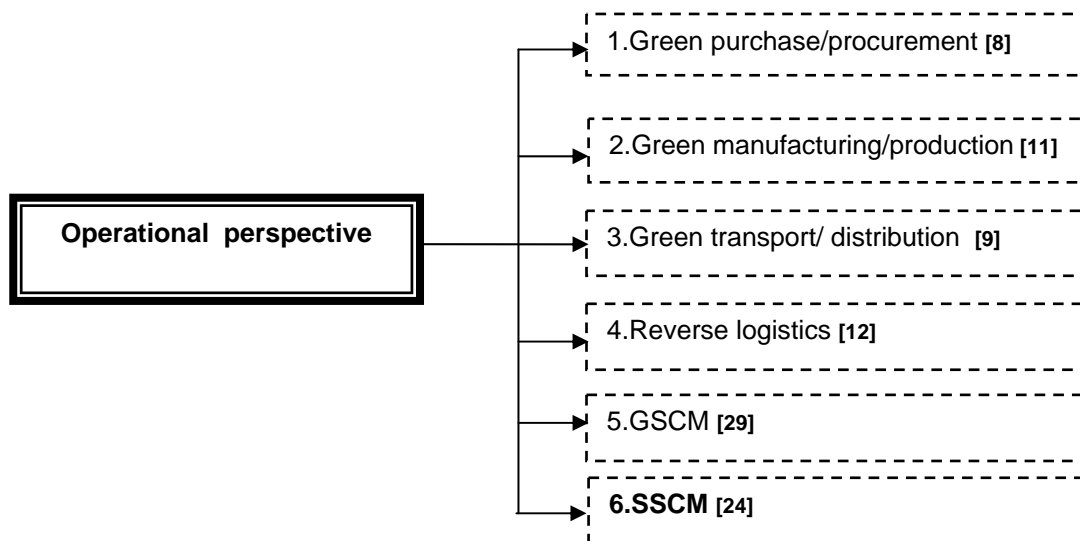


Figure 3: Classification of GSCM and SSCM from an operational perspective
([-] is the number of articles)

In terms of the first four subgroups, 1.Green purchase and procurement: is a research group related to procurement, coupled with environmental management and sustainable development(Lee, 2008). The research work in this group is the link between the organization and suppliers. 2. Green manufacturing and production is a research group associated with production of goods and services by applying the concept related to GSCM and SSCM (Zhu et al., 2010; Koplin et al., 2007). Moreover, this includes research into assessment of production performance for environment (Lai and Wong, 2011; Tseng and Chiu, 2010) 3.Green transport and distribution is research into transport development and goods distribution to minimize the environmental impact and use energy in a worthwhile manner as well as to reduce carbon dioxide emissions in transportation – related activities

and goods distribution (Mckinnon, 2010; Michelsen and Magerholm Fet, 2009) 4. Reverse logistics is a research group into the reverse process with research development that is the basis of research relevant to GSCM and SSCM. Most of the research work is concerned with network design guidelines for operations, reuse and environmentally friendly disposal (Srivastava, 2007).

With regard to the other two subgroups, a group of research into GSCM focuses on integration, linking of both supply chain and guidelines of environmental performance in the supply chain (Bjorklund et al., 2012; Kim and Min, 2011; Sarkis, 2012). Moreover, the group of research on SSCM is attracting considerable attention nowadays with broader scope than GSCM in the integration of environmental, social and economic aspects (Carter et al, 2008), making business organizations more aware of the importance of SSCM (Xia and Tang, 2011) with the study of factors, operations management, and assessment measurement of SSCM performance extensively as well (Mann et al, 2009; Badurdeen et al, 2009) as content analysis in research on SSCM to seek the opportunities for developing research in the future.

SSCM on operational perspective

Presently, the concept of sustainable development has come to play an important role in business organizations. (Fabbe-Costes et al., 2010; Xia and Tang, 2011). The concept of sustainable development has existed for a long time but has only been prevalent in environmental and social management. When business organizations recognize such importance, the concept has been applied to the development of the business organization in conjunction with supply chain management (Ansett, 2007; Gupta and Palsule-Desai, 2011; Svensson, 2007; Carter and Rogers, 2008) by integrating the entire supply chain management coupled with environmental care, business management with social responsibility together creating profitability and advances to the business (Cetinkaya et al., 2010).

Based on above, it has been determined that SSCM is an issue that is receiving much attention presently. Therefore, we have an interest reviewing the literature reviews as well as the content analysis of articles to determine issues for future research. We have brought the articles related to SSCM of the type of research into operational perspective for content analysis. In this regard, major factors of sustainable development including Economic, Social and Environmental (Theis et al., 2012) as well as the concept of operations quality management or PDCA (Durward and Art, 2011) that have been applied to the analysis and objectives of articles brought for content analysis. It can be classified SSCM on operational perspective into four main area as illustrated in Figure 4. These include Plan, Process, Control, and Improvement.

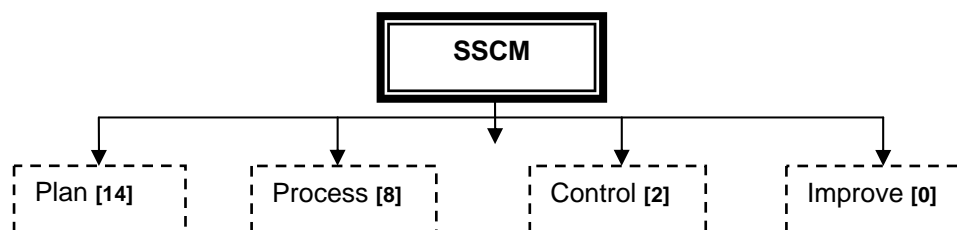


Figure 4 : Classification of SSCM on operational perspective ([-] is the number of articles)

From Figure 4; The total of twenty four articles form the study of SSCM of the research from an operational perspective. It has been found that “Plan” form the main article objectives mainly as guidelines for planning to get access to SSCM. The authors of articles use the method of literature review (Gopalakrishan et al., 2012; Ashby et al., 2012; Kang et al., 2012), followed by “Process”. Most of the articles present operations management in the field of SSCM with different methods of implementation (Keating et al., 2008; Beske et al., 2012; Walker et al., 2012). The minimal purpose of articles with the Content analysis conducted is “Control”. In this area, two articles have been found

(Carter et al., 2008; Bai et al., 2012). The article that has not been located yet is "Improvement". This article is related to SSCM development from an evaluation and control perspective.

Another view in regards to bringing articles for content analysis is by taking into consideration triple bottom line, it has been found that the articles take into account various factors including environmental factors on one side (Kang et al., 2012; Ansett et al., 2007; Dey et al., 2011) and considering two sides of factors, i.e. economic and social factors (Ashby et al., 2012; Hall, 2010; Faisal et al., 2010) as well as articles with integration of all three environmental, social, economic aspects (Mann et al., 2010; Badurdeen et al., 2009; Xia et al., 2011). Methods of research consists of three main types namely: Literature Review, Conceptual Theory and Case Study Analysis.

Discussion and conclusion

Nowadays, sustainable supply chain management (SSCM) is a new concept that has been accepted to be applied to business development in conjunction with environmental and society in an acceptable manner (Wolf, 2011; Lee et al., 2012). In this connection, three – faceted factors of the concept are applied to business process as well as supply chain management for the purpose of creating sustainable business organization and supply chain success (Faisal, 2010; Peters et al., 2011). As a result, this is the concept that we are interested in the studying more. The study has revealed that most of the research works are concerned with literature review in the fields of planning (plan) and the development of SSCM framework in terms of operations (process) only have been presented (Gupta et al., 2011; Ashby et al., 2012; Beske, 2012).

Furthermore, the articles in this area are small in number with growth in particular group, thus resulting in the need for more research. (Badurdeen et al., 2009; Mann et al., 2010; Carter and Easton, 2011). In addition, the research into control and improvement has been found to be in considerable shortage (Bai et al., 2012). These two aspects of research are crucial because they are tools to be used for performance measurement of SSCM. Moreover, they enable the business organization to be aware of getting access to SSCM and developing one's own organization truly. This is the key to the success of business organization (Walker and Jones, 2012). In this regard, the emphasis is put on the integration of all 3 factors of SSCM to generate balance (Carter and Easton, 2011). An importance is also placed on the research implementation that requires both qualitative and quantitative techniques so as to reduce errors as well as to increase the efficiency of research in the future.

The limitation of this literature review is that, we have gotten the results of this research from the literature review on the basis of four databases Emerald, SpringerLink, ProQuest and Science Direct. This may not cover the research on the basis of other databases with focus on the research in the type of operations management as well as the development of literature review by applying the technique of content analysis originated from the critical thinking of the research. This may cause potential bias in the analysis (Wiese et al., 2012; Seuring and Gold, 2012; Haze metal, 2012) as well as the lack of content analysis of articles related to three areas of research including environmental effects, strategic and regulation perspective.

The development of future research should be conducted with a review of other databases. Furthermore, it is recommended to carry out the content analysis of articles in all four aspects completely as well as include the use of a quantitative method for additional analysis. Regarding the research into GSCM and SSCM in operational perspective types, especially in regards to the research on SSCM there still needs the development of research in several areas including the implementation process, performance evaluation, control and development of performance from SSCM evaluation. In terms of taking into account social, environmental and economic factors of sustainable development, it should be tied to a way of creating balance and to be integrated into supply chain effectively.

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DEVELOPING LOGISTICS SERVICE QUALITY FRAMEWORK: MALAYSIAN PERSPECTIVE

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ABSTRACT

Purpose: The main objective of the study is to explore the logistics service quality elements that affect the Malaysian manufacturers' satisfaction level. Focus was given in assessing manufacturers view on outbound logistics service as it is the highest 3PL service used in Malaysia.

Design/methodology/approach: The research adopted qualitative approach in gathering and analysing the information from eight selected Malaysia manufacturers. In depth interview with the relevant personnel were being conducted and transcribed verbatim. Constant comparative analysis technique of data analysis was employed in analysing the data.

Findings: The study reveals that that all eight companies used 3PL services and there are four factors which are aligned with preceding LSQ empirical studies namely product condition, product delivery accuracy, quality of key contact personnel and timeliness. Subsequently, 3PL responsiveness and flexibility is an additional factor discovered in the analysis which is originally not previous LSQ studies.

Originality/value: This study provides insights on the different elements of logistics service quality from the view of 3PL users in Malaysia. This information is vital for researcher to understand the applicability of original LSQ elements and the possible element not considered in preceding studies.

Keywords: Logistics, Third Party Logistics, Malaysia, Logistics Service Quality, Manufacturers

Paper type: Conceptual paper

Introduction

In Malaysia, there are vast expansion and growth of the logistics industry (Sohal, and Millen, 1999; Frost and Sullivan, 2011). Frost and Sullivan (2011) expected that Malaysia's logistics industry to grow 10.3 % valued at RM129.93 billion by 2012. This anticipation is driven by the forecast of increase in the Malaysian trade and their foreign investments. In addition, the Malaysian government support towards the development of the logistics sector is also expected to be the main contributor to the growth (Frost and Sullivan 2011). One of the growing logistics units is 3PL services, it is a booming trend among businesses (Sohail and Sohal , 2003; Salleh , 2007; Ali, Mohamad and Jaafar, 2008). Freight forwarding transportation and warehousing services are actively outsourced, these services were claimed to be the main sources of revenue in the Malaysian logistics industry (Frost and Sullivan, 2011). Among common reasons of why businesses opted for outsourcing include gaining efficient inventory control, improvising information management and to maintain logistics service quality (Halldorsson and Larsen, 2004; Bhatnagar, Sohal, and Millen, 1999).

Logistics Service Quality

Starting from the mid 1990's, logistics capability has evolved from the traditional contribution in supporting marketing function, cost reduction and now has exalted to the capability to support or produce quality (Innis and La Londe, 1994). The quality in logistics may further enhance greater satisfaction and loyalty (Mentzer, Flint and Kent, 1999; Saura, Francés, Contrí, and Blasco, 2008). Service quality (SERVQUAL) theory was mainly established as a means to measure the difference between what a person's expectation on a service and the perception that he/she may express after experiencing the service (Parasuraman, Zeithaml, and Berry, 1988). Almost every paper examining service quality has referred to the most popular theory developed by Parasuraman *et al.*, (1985). The initial scale of SERVQUAL was developed through qualitative methods, which included focus group interviews. The model was later tested and refined through a quantitative survey. Parasuraman *et al.*, (1985) gathered the service quality information through various industries from retail consumers of appliance repair or maintenance, retail banking, long distance telephone service, securities brokers to credit card services.

Bienstock, Mentzer and Bird (1997) are among the early scholars that have integrated SERVQUAL concepts with logistics function. Bienstock *et al.*, (1997) developed a model known as physical distribution service quality (PDSQ). The construct of PDSQ is a valid reliable scale gathered from the perception of purchasing managers assessing the service quality of in-house logistics providers (Mentzer *et al.*, 1999). The PDSQ model was developed by using similar qualitative and quantitative methods conducted by Parasuraman *et al.*, (1985). The PDSQ theory consists of three variables that are timeliness, availability and condition (Stank, Goldsby and Vickery, 2003). Later, Mentzer *et al.*, (1999) expanded the PDSQ model further into logistics context by considering the need of combining both the technical and functional qualities of the logistics service. Technical quality is expressed as the service that is technically acceptable and leads to concrete results (Mentzer, Flint and Hult, 2001). On the other hand, functional quality includes the way the customer is treated during the service provision process (Mentzer *et al.*, 2001). There are nine original variables, namely personnel contact quality, order release quantities, information quality, ordering procedures, order accuracy, order condition, order quality, order discrepancy handling, and timeliness (Mentzer, *et al.*, 2001).

In addition, Mentzer *et al.*, (1999) has studied the logistics service quality (LSQ) instrument from the view of the customer instead of the providers. Whereby, the developed LSQ measurement was tested in the United States largest military logistics providers (Defence logistics America, DLA). DLA users were the sample of the study which assessed the service quality delivered by DLA. The aim is to understand the different segments of value logistics service quality across the industry. Rafiq and Jaafar (2007) tested and validated the LSQ instrument by surveying the users of third party logistics in the United Kingdom as a sample. They have made minor modification on the original constructs. Instead of assessing in-house logistics service, Rafiq and Jaafar (2007) assessed companies which used various types of the 3PL services (inbound, outbound, external 3PL providers) and different logistics providers. The results provided an overview of the level of the third party logistics service quality and its impact on the customer satisfaction. Nevertheless, as of 2012, the publication related assessment of logistics industry in Malaysia by using SERVQUAL or any other logistics service quality research related is still limited except for the work of Sohail *et al.*, (2004), Zakaria *et al.*, (2010), Ho *et al.*, (2012) and Nassiry *et al.*, (2012) (refer to table 1) which studied the general perspective of logistics service quality impact on satisfaction level and the state of quality program in logistics department among manufacturers.

Author/ Title	Sample	Constructs
Sohail, Sohal and Millen (2004) The State of Quality in Logistics: Evidence from an Emerging Southeast Asian Nation	Malaysian Manufacturers	Quality practices in logistics function, organization of the quality program, improvement measurement, quality in logistics function
Nassiry, Ghorban, and Nasiri, (2012) Supply Chain Management and Service Quality in Malaysian Hotel Industry	Hotel industry	Strategic Purchasing, Communication, Suppliers' Relationship, Service Quality
Ho, Teik, Tiffany, Kok, and Teh, (2012) Logistics Service Quality among Courier Services in Malaysia	Courier Services- Users	Timeliness, Condition/ Accuracy of Order, Information Quality, Availability / Quality of Contact Personnel
Zakaria, Zailani and Fernando (2010) Moderating role of logistics information technology on the logistics relationships and logistics service quality	Logistics Companies in Penang	Trust, satisfaction, bonding, communication, commitment, logistics information technology, logistics service quality

Table 1: Logistics Service Quality Studies in Malaysia

Research Methodology

This study employed a qualitative method. Exploratory study was carried out since there are limited related researches and publications that have been conducted in Malaysia pertaining to Logistics Service Quality assessment among manufacturers towards their 3PL providers. In depth semi structured interviews was conducted. Questions were focused on identifying problems that manufacturers usually faced in dealing with 3PL in their physical distribution activities. Total of 20

manufacturers were randomly selected from the 2011 Federation of Malaysian Manufacturers Directory listings but only 8 agreed to participate. All interviews were being audio recorded and transcribed verbatim. After Interviewing with 8 companies researchers reach a saturation point where there are no new information. Thus, decided 8 companies are sufficient for further qualitative analysis. List of interviewed manufacturers is presented in table 2. To conceal the identity of identified companies, alphabets were used to represent the respective companies.

Manufacturer	Position	Industry	Type of Companies	Length of Experience
A	Logistics Manager	Electric and Electronic – Semiconductor	Manufacturer	8 Years
B	Logistics Executive	Electric and Electronic – Camera, Printer	Manufacturer	3 Years
C	Logistics Manager	Electric and Electronic – Hard Disk	Manufacturer	7 Years
D	Logistics Manager	Food	Manufacturer	20 years
E	Logistics Manager	Dairy Product	Manufacturer	4 Years
F	Production Planner/ Logistics Manager	Beverages	Manufacturer	15 years
G	Logistics Assistant Manager	Herbs Product	Manufacturer	6 years
H	Sales Assistant	Electric Electronic	Manufacturer	5 years

Table 2: Background of Informants

Findings

Interview were analysed to identify the similarities and differences of the satisfaction level with the 3PL services or what are the attributes that they may perceive as contributing to excellent service. From the randomly selected manufacturers, all 8 manufacturers are users of 3PL services, most of them are using 3PL for their outbound or physical distribution services. Based on the analysis, five main factors were identified. These factors were believed to affect customer satisfaction in their experience of using 3PL outbound service in Malaysia. The factors identified are product condition, product delivery accuracy, quality of key contact personnel, responsiveness and timeliness.

Product Delivery Accuracy

The first factor is product delivery accuracy; it refers to how closely 3PL task executions match with manufacturer's instruction (Fleish and Tellkamp, 2005). This includes 3PL to ensure that product quantity, lot numbers, orders, date and time is tallied with documents given (Mentzer *et al.*, 2001). Accuracy of product handled is vital, this include ensuring the information and physical form of the right product, the right quantity, right location and the right documentation (Stock and Lambert, 2001; Mentzer, Flint, and Hult, 2001). From the interview, there all manufacturers are concerned with the inconsistent information accuracy of 3PL services. It is resulting from the 3PL operator, which fails to ensure that product shipped matched with the delivery instruction and document given at every task. Logistics manager of Manufacturer 'A' stated that: "*There are some cases where our end customer complaint that they receives wrong product...Although we (manufacturer) have checked the invoices and delivery order, sometimes 3PL operators might took the wrong product or quantity and send it to the customer... As it involves our end customer it has give a bad impression to our company. The inaccuracies also happen during warehousing where product kept in inventory does not tally with the record, this is due to the mistake done by 3PL personnel where they failed to check properly the quantity of the product*".

Product Condition

According to Bienstock *et al.*, (1997), product condition refers to the 3PL ability in ensuring customer's product that they deliver is not damaged along the process of physical distribution. This includes along the basic logistics activities such as warehousing and transportation. If there are any occurrence of damage to product, customers cannot use the product and must engage in correction procedures from the source of damage. This is similar with the exploratory interviews, whereby all manufacturers have pointed out about ensuring product in a good condition as a basic service quality and some manufacturers also complained about damaged product caused by 3PL during the physical distribution process (i.e.: during loading, unloading, product sorting, delivery and etc). As stressed out by a logistics manager of manufacturer 'C': "*Sometimes our logistics agents are lousy, they caused*

damage to our product during delivery to end customer. Because of that our end customer complained to us. Damages occur will waste a lot of our time and money to rectify those damages. Furthermore, it gives a bad impression about our company product care, while the problem is actually caused by the logistics agent”.

Product condition does not only refer to physically visually damaged products like dented product, scratch, broken parts. It also includes ensuring the intangible forms of product or cargo is well taken care. For instance dairies and food products required to be stored in a refrigerated below certain temperature. Whereby, failure to ensure the storage within required temperature may lead to damage of product. Manufacturer E, F and H share the same view that among the reason they choose their current 3PL is because they ability to ensure less than 5% of damage occurrence, this is as a result of the 3PL having a well trained personnel and material handling equipment.

Quality of Key Contact Personnel

According to Mentzer *et al.*, (2001) the quality of key contact personnel refers to the customer orientation of the supplier’s logistics contact people. Specifically, customers care about whether customer service personnel are knowledgeable, empathize with their situation, and help them resolve their problems (Bitner, Booms, and Mohr, 1994).

Along the process of physical distribution, the key contact personnel from the 3PL are responsible in providing reliable updated information (Mentzer *et al.*, 2001). Key contact personnel are intermediate which communicate information between supply chain members. Manufacturers B, C E, F and G gave similar comments about the quality of their 3PL key contact personnel, for example, the key contact personnel service of 3PL service are not well equipped with the knowledge of manufacturer’s product, lacking in skill to manage each task efficiently, giving unreliable information, late feedback, and sometimes having an inconsistent attendance in the state of urgency. This has cause trouble to manufacturers, because due to the incompetent key personnel there will be problems related to update of shipment status or to inform about any special instruction (i.e.: changes of location, product arrangement, etc).

This is supported by Manufacturers C statement: “ *Personnel in charge with our shipment is very important, when assign a 3PL we expect whoever responding to our calls, have to have the information about our shipment from A to Z, sometimes they pass to this fellow, to that fellow, end up at finance department which knows nothing. We don’t care about their internal communication but the person in charge must available all time, must know everything. As far as dealing with current 3PL there are sometimes when the person in charge are not around there are always backup which know what happen which for us this is very good, unlike our previous 3PL, when the person in charge nobody knows what happened to our shipment.*”

Responsiveness

In manufacturing industries, there are various levels of situations might occur. There is time where everything operating smoothly according to plan and schedule. On the other hand, there are situation where end customer of manufacturer suddenly require an urgent shipment. The willingness of 3PL providers in supporting the sudden changes requested by manufacturers is responsiveness. This is adapted from view of Parasuraman *et al.*, (1988), where “responsiveness is the willingness to help customers and provide a prompt service”. Similar to Zhang, Vonderembse, and Lim, (2005) views where the ability of a firm to feedback quickly and efficiently to changing customer needs in both inbound and outbound delivery support is termed as logistics flexibility. In Mentzer *et al.*, (2001) LSQ study, there are no responsiveness variables being associated.

Therefore, it is important to consider responsiveness as variables in this study. 3PL must be prepared at all time in any situation, as most manufacturer runs in 24 hours, they must have enough capacity and backups to support manufacturers. For example, if the manufacturer’s end customer requests for an urgent delivery, 3PL must support this activities to avoid end customer complaint (Zhang, Vonderembse, and Lim, 2005). Logistics executive of Manufacturer ‘H’ stressed that: “*We must prepare our operation 24 hours in case of urgent shipment requested by customer, but our 3PL sometimes does not prepare to support us, as manufacturer we expect that 3PL to consider themselves as part of our team, but sadly in the urgent time they are inconsistent in delivering their service*”. This view is shared with manufacturer F where he agreed that it is a convenient to manufacturers to have supportive 3PL providers which do not give excuses when there are sudden

hike up in sale or sudden requirement. Manufacturer F stated that *“Our 3PL are excellent, we are not worried if there are sudden increases of shipment, because they always prepared to support our physical distribution activities. If not I would surely have looked for other 3PL providers for long time ago (laughing)...”*

Timeliness

The most important asset of company is time (Stock and Lambert, 2001). Timeliness refers to the ability of 3PL to complete their task within a frame of time agreed between 3PL and the manufacturers. Mentzer *et al.*, (1999) stated that generally when product is unavailable, time delivery can be affected by transportation time, as well as back order time. Process must be executed fast, smooth and efficiently with the right procedure (Stock and Lambert, 2001; Bienstock, Mentzer, and Bird, 1997; Mentzer *et al.*, 1999). There are problems reported by the manufacturers related to poor timing. For instance, late deliveries were derived from to the problematic 3PL warehouse operators or drivers, where some of them were reported as unable to plan and execute work in timely manners, coming in late, wasting time on unrelated to job matters). In condition where the manufacturers do not cause the cause of poor timeliness, 3PL must ensure that the job or delivery task to be completed in timely manner. Logistics executive of Manufacturer ‘B’ stated that: *“There are a lot of cases where the driver are coming in late...as we pay our 3PL we expect that all task to complete on time without any excuses, however they failed to justify with any acceptable reason”*. Manufacturer C indicate that *“Punctuality is very important, our receiving area sometimes were cramped because this 3PL who came too early, and some of them are late, while we need them to be in sequence of their delivery location, they cannot simply come whenever they want. They must come accordingly so that the loading bays are not crowded.*

Discussion

Findings and results in this study present a number of issues worthy of discussion. Firstly, all five variables do aligned with preceding studies by Mentzer *et al.*, (2001) but with slight difference in terms of focus which is on outbound logistics activities. Responsiveness is originally not included in the Mentzer’s (2001) LSQ study, which was mentioned by interviewed manufacturer on how they value 3PL to have responsiveness as their service quality. Secondly, in Malaysian context this study provides insight to further understand about the perception of Malaysia study. Based on the exploratory, further analysis to validate the construct quantitatively is recommended. Figure 1 is the proposed conceptual framework of the outbound logistics service quality from the view of Malaysian manufacturers.

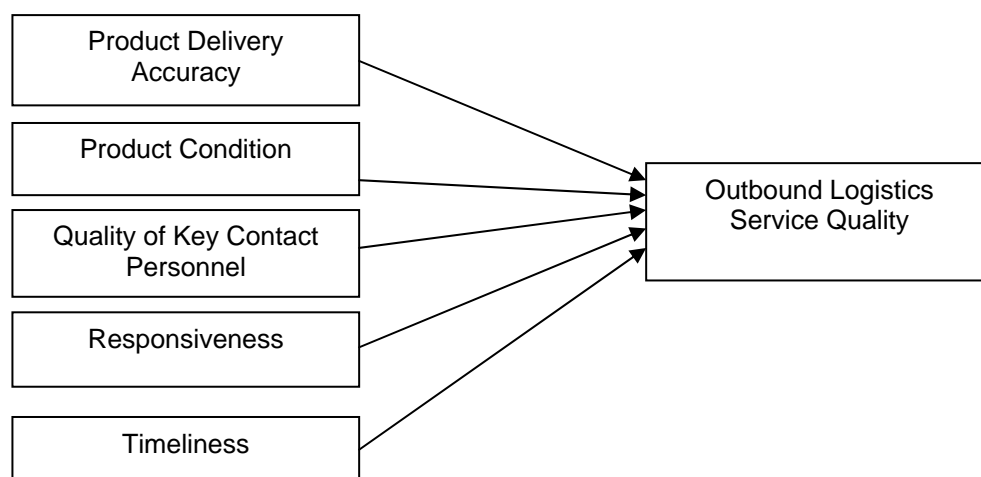


Figure 1: Outbound Logistics Service Quality Framework

Conclusion

Theoretically, the framework proposed was derived from exploratory interviews with Malaysian manufacturers. There are slight different in terms of the terminologies used and it is also different from the original LSQ instrument. Out of nine original LSQ constructs, five other original construct were not included namely information quality, ordering procedures, order discrepancy handling, order release quantities and order quality. None of the construct was identified in the interviews. Among of the reasons is probably derived from the fact that the elements are in the context of inbound logistics activities. This findings share the view of Rafiq and Jaafar (2007) where a focus assessment on either inbound or outbound logistics activities is recommended. Thus it can be concluded that there are difference in term of how manufacturers perceive logistics service quality based on the flow of the logistics activities. This study provides guidance for further investigation towards developing valid and reliable instruments to measure outbound logistics service quality.

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CURRENT CHALLENGES FACED BY LOCAL THAI COFFEE PRODUCER

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ABSTRACT

Purpose: This study explores challenges that are facing by the local producers in the coffee industry in Thailand. Moreover, there is a need to understand the supply chain systems of local producer such as the local chain and factors that are affect their businesses created by the fierce competition around. Also, there has been a paradigm shift in the coffee industry in Thailand because the consumption of the soluble coffee is transforming into the fresh brewing coffee.

Design/methodology/approach: Qualitative approached is used and semi-structured interview is conducted on the established local producer to understand their supply chain and how they sustain their businesses with an increasing competition faced by them.

Findings: This paper shows the importance of the local coffee production in Thailand that affects the local producers to meet its demand for local consumption. There are also increasing interests from the foreign investors to purchase the coffee beans at a higher price that lead to a threat to local producers.

Research limitations/implications: The limitations in data collection as the interviewers were reserved on the information and the coffee industry in Thailand is based on local producers' initiative to expand their business due to there are minimal assistance from the government. This study can provide a better understanding of important factors in the coffee supply chain risk management by the local producers that can be categorised the risks into organisational, technological, and environmental contexts.

Originality/value: This study highlights the potential benefits of this type of research to develop an understanding of the coffee supply chain and the evolution of relationships in a supply chain system as well as how the local producers can sustain their business in these increasing challenges and a fierce competition.

Keywords: Coffee Industry; Supply Chain Risk Management; Coffee Supply Chain

Paper type: Viewpoint

Introduction

The pattern of coffee drinking is not the same as they were before and transformation of consumption patterns has emerged with the fast and growing of specialty, fair trade and organic coffees (Ponte 2002). This transformation led coffee chains to mushrooms dramatically and not only that, coffee chains sell an environment and a social positioning more than just 'good' coffee. About 2.25 billion cups of coffee are consumed in the world daily (Dicum et al., 1999 cited in Daviron and Ponte, 2005). Coffee chain has transformed into a 'latte revolution', where consumers can choose from various kinds of coffee, origin, brewing and grinding methods, flavouring, packaging, 'social content', and

environment (Bacon 2005; Ponte 2002). As retail coffee prices continue to rise in the specialty market, roasters capture increasing profit margins. At the same time, some coffee farmers receive prices below the production cost. The global value chain for coffee is currently characterised by a 'coffee paradox', which categorized as 'coffee boom' in consuming countries and as 'coffee crises' in producing countries (Daviron & Ponte 2005). In the global market at present, industries have to design and manage their supply chain cost effectively and efficiently from upstream until the downstream to create and provide the product to customers. According to Simschi-Levi et al. (2003, p.1), they define that "Supply chain management is regarded a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses and stores, so that the merchandise is produced and distributed at the right quantities, to the right locations and at the same time, in order to minimise costs while satisfying service level". Supply chain management is regarded as a network that links the industry and provides needs to the consumers and it will be an important factor that local producers need to understand it (Zhao, Frese & Giardini 2010).

Hence, local producers also have their own coffee supply chain, whereby they source their "Arabica" beans from the hill tribes located at the northern Thailand. With the paradigm shift in the coffee drinking in Thailand, the consumption behaviour leads to many establishments of local coffee chain, kiosks, cafés and restaurants to serve fresh brewing coffee. According to Seranevijaikithkan (2008), there is an increase in the number of domestic coffee plants to sixty nine [in 2007], which create fierce competition amongst the industry and to survive their businesses, the local producers need to reduce costs and improve efficiency along the supply chain (Seranevijaikithkan, Parthanadee & Buddhakulsomsiri 2008). According to "The Five Competitive Forces" by Porter (1979), these forces can help local producers mirror out their position in its industry that is minimised vulnerable to risk (Porter 1979). A better understanding of these forces helps local producers increase its information of its own industry and information are, therefore, manage to withstand challenges (Gilbert 2008). This study will look at the current business challenges facing by local producers in the coffee industry in Thailand.

Background of Coffee Supply Chain

The supply chain is the sequence of activities and processes required to bring a product from its raw state to the finished goods sold to consumers. Coffee supply chain is often complex, and varies in different countries, but typically consist of growers, intermediaries, processors, government agencies, exporters, brokers or dealers, roasters and retailers. Each of them has a role to play in the supply chain (Reinhardt 2000). Figure 1 demonstrates the coffee supply chain.

Figure 1: Coffee supply chain.



(Source: Nestle, 1999. Coffee - The Supply Chain)

Growers usually cultivate on a small plot of land of just one or two hectares, and many do some primary processing [drying or hulling] themselves. Intermediaries sometimes involved in many aspects of the supply chain. They could buy a coffee at any stages between coffee cherries and green beans

and do some of the primary processing, or they could act as collectors to gather sufficient quantities of coffee from many individual farmers to transport or sell to a processor, another intermediary, or to a dealer. There could be as many as five intermediary links in the chain.

Processors can be individual farmers who have their own equipment to process coffee or a separate processor that forms a farmers' co-operative that pools resources to buy the equipment to convert 'cherries' into green coffee beans. Government agencies play their role in some countries as the government controls the coffee trade, perhaps by buying the coffee from processors at a fixed price and selling it in auctions for export (Ibrahim & Zailani 2010).

As for exporters, they buy from cooperatives or from auctions and then sell it to dealers. They have expertise and knowledge of the local area and producers generally enables them to guarantee the quality of the shipment. Dealers or brokers supply the coffee beans to the roasters in the right quantities, at the right time, at a price acceptable to the buyer and seller.

Roasters are people whose capability is to turn the green coffee beans into products people enjoy drinking. According to Ponte (2004), the coffee industry is "roaster driven" as also add value to the product through marketing, branding and packaging activities (Ponte 2004). Retailers are sellers of coffee products, which range from supermarkets to food and beverage outlets.

A supply chain is only as strong as when it is effectively linked. Each relationship exists between the supply chain involved in the separate stages of the chain whether it is in the structuring of product distribution, arrangements for payment and arrangements for handling, or in storing the product. At the heart of these relationships is the way in which people treat each other. Long-term business relationships need to be based on honesty and fairness parties to a trading agreement need to feel that they are getting a fair deal. However, the following topic discusses the research methodology used in this research.

Research Methodology

A mix research method is applied to this study. Firstly, a qualitative approach is being use to understand the local producers to understand their supply chain and how they sustain their businesses with an increasing competition faced by them (Miles & Huberman 1994; Silverman 2009). A set of semi-structured question is used in the interview to gain more insight of what kind of challenges or risk they are facing. Followed by the risk identification that is discussed with the local producer during the interview and these identify risk will then use in the future research.

In order to understand the organisational, technology and environment contexts in supply chain risk management (Tornatzky et al. 1983; Tornatzky & Fleischer 1990), a case study was used in this study (Yin 2008). Case study accept and encourage multiple methods of data collection procedures and it also provide a deeper understanding from the local producers (Hartley 2004; Yin 2008).

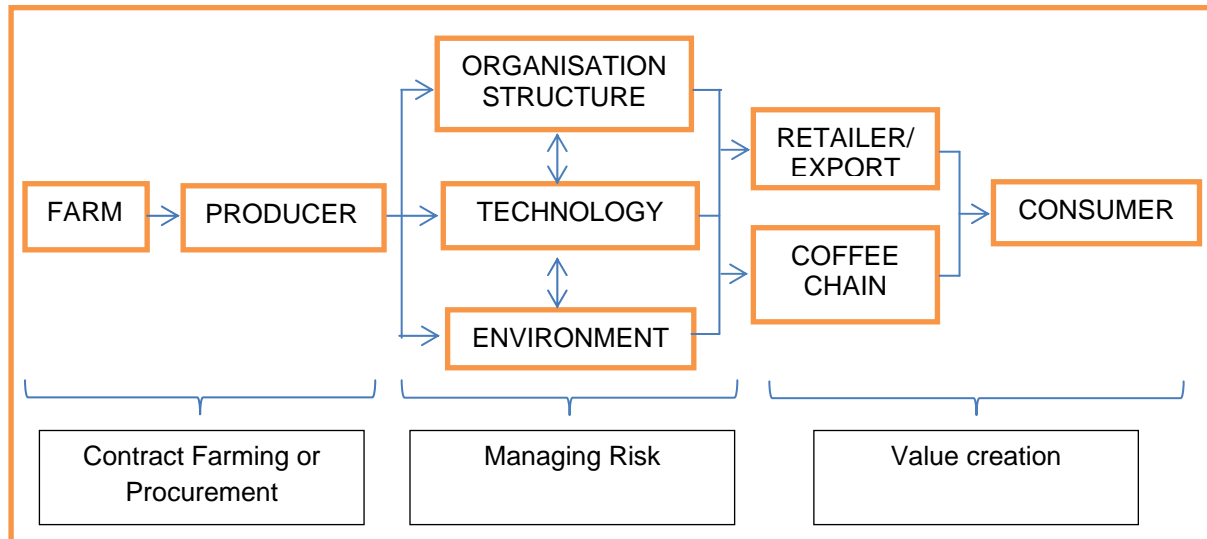
Case Study of Local Producer Coffee Supply Chain

Local Producer A is a family business, and they have been in the industry for 8 years. Their business established in 2005 at Mae Sai located in the northern region of Thailand. During the first 3 years of establishment, the business relied on the suppliers to supply the coffee beans and they had expanded the business by having their own roasting facility. They sourced the raw green beans directly from the hill tribes as their business and roasting location was located near by the source. Currently they have their own outlet to supply and also supply the coffee beans to some restaurants as well as kiosks around Chiang Rai province.

Due to price volatility in coffee, the price has led to increase of coffee price by their supplier they invested new technology by having their own roasting facility. With this technology adoption, they are more in control of their supply chain for the beans although they do not have the contract farming in place. This shows that they are proactive in managing the risk of sourcing for coffee beans and

roasting as it is the core and one of the critical success factors for a coffee supply chain. Besides, managing risks along the supply chain, they reduced costs, increase efficiency, and open up another business opportunity. They have transformed into a small medium enterprise (SMEs) by roasting the beans and supply to other outlets such as kiosk, café, restaurants and also their own outlet. Figure 2 below summarised the coffee supply chain framework by the local producers.

Figure 2: Supply Chain of Local Producer.



Source: Framework through information gathered in Interview process

Major Risk in the Coffee Supply Chain Faced by Local Producer

Local coffee supply chains in faces multiple risks. Three main categories of risks are identified through the preliminary interview, which are production risks, market risks, and other risks as shown in table 1 below. The preliminary identification is then analyse to which party that is most likely to suffer losses along the supply chain. Due to the limitation of data on coffee production and others therefore preliminary identification of risks and associated losses is a problematic so the majority of this exercise has been of qualitative, rather than quantitative nature. Table 1 summarised the risks that are identified.

Table 1: Summary of the Identify Risk

Identify Risk	Affected Party
Production Risk	
Climate	Famers
Low Yield	Famers
Market Risks	
Price volatility of coffee	Local producer
Decrease In local Consumption	Local producer
Contract Failure	Local producer
Logistics	Local producer
Cooperatives Failure	Famers & Local producer
Foreign buyers	Local producer
Other Risks	
Politics	Famers & Local producer
Labour	Famers
Land title	Famers& Local producer

Source: Information from preliminary interview.

From the identified risk, the information is then discussion on how it can be managed. Three categories of risks are explained; which are risk prevention, risk transfer, and risk coping. Firstly, the risk prevention refers to actions taken to eliminate or reduce events from occurring. Secondly, the risk transfer refers to actions that reduce exposure to existing risks. Finally, the risk coping, this refers to actions that mitigate losses caused by other factors. Table 2 summarised the risk management measure.

Table 2: Risk Management Measures Framework

Identify Risk	Risk Prevention	Risk Transfer	Risk Coping
Production Risk			
Climate			<ul style="list-style-type: none"> Forecasting information Insurance program
Low Yield	<ul style="list-style-type: none"> Biological control for pest attack Provide training for farmers 		<ul style="list-style-type: none"> Replanting
Market Risk			
Price volatility of coffee		<ul style="list-style-type: none"> Hedging 	<ul style="list-style-type: none"> Governance
Decrease In local Consumption			<ul style="list-style-type: none"> Product innovation Search Alternative market
Contract Failure	<ul style="list-style-type: none"> Proper Negotiation 		
Logistics			<ul style="list-style-type: none"> Outsourcing
Cooperatives Failure	<ul style="list-style-type: none"> Hire the right managers 		<ul style="list-style-type: none"> JV with private sectors Restructuring
Other Risk			
Politics			
Labour			<ul style="list-style-type: none"> Hire
Land title	<ul style="list-style-type: none"> Negotiation with government 		

Source: Adapted from various sources

Practical Implications of this Study

The outcomes of this study were identified some implications, where this research can provide a better understanding of important factors in the coffee supply chain risk management by the local producers, categorised the risks into organisational, technological, and environmental contexts.

Firstly, knowing organisational risk and innovation by the type of structure can assist the organisation to understand their business and drive their business competency to increase business performance more efficiently. This research has shown that organisational factors comprise of the size of organisation, culture, organisational structure and management styles, and innovation capability (Mingmalairaks 2011).

Technological risk comprises of the relative advantage, coffee recipe and available technologies, compatibility, reliability, and capacity of machines (Seranevijaitkhan, Parthanadee & Buddhakulsomsiri 2008).

Then, under environmental risks, which include information and competition (Prasad & Sounderpandian 2003). Managers or owners have to understand their business and their position in the industry and use organisational and technological factors to enhance their business capability, and their business competency to differentiate their products and business, be able to compete with, or be ahead of, their competitors (Cai et al. 2006).

The risk assessment used in this research guides the organisation to understand their business and identify their business competency, enabling them to enhance them to successfully implement the innovation in their organisation, thus resulting in improved business performance (Carter & Rogers 2008). The integration of organisational, technology and environment context and will allow an organization to achieve long-term sustainability as they are prepared for the rapidly changing business surroundings.

Limitation of Study

In this study, there are limitations in data collection as the interviewers were reserved on the information. Besides, coffee industry in Thailand is based on the local producers initiative to expand their business due to there are minimal assistance from the government.

Implications for Future Research

This research contributes to an understanding of the nature of Thai coffee industry, and specifically, managing risk at the level of organisational, technological and environment factors that lead to perceptions of improved business performance in the local industry. By enhancing the understanding of these organisational, technological and environment risks. This research contributes to potential future research in the following areas based on the current research.

Secondly, this study can be used as a basis for further research that explores in relation to other organisational, technological and environmental risks, or other industries, using a mix research method.

Policy makers and coffee association role was not discussed in this research because the interviews were conducted solely with business owners. Future research should focus on policy making perspectives, and how coffee association would come into the picture to understand and support the local producers for their sustainability in the business.

Discussion

The findings of this study could be used by traders, business owners and policy makers in the Thailand coffee industry to improve the quality, production and supply of the coffee locally and international. This should be achieved through identifying the risk and take measure of the risk. The application of this framework could also assist local producer to take a deeper understanding of their positioning and area of growth to their sustainability of business. Moreover, by managing the appropriate risks, businesses can strengthen themselves and enhance value creation from within their organisation and eligible to compete with their competitors in the coffee industry.

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FACTORS AFFECTING THE REAL-TIME TRAFFIC INFORMATION DEMAND IN BANGKOK

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ABSTRACT

Purpose – To study the factors affecting the demand of real time traffic information service and classify travelers based on the travel behavior.

Design/methodology/approach – Data from respondent are analyzed and form the basis of the generated Binary logistic model. Binary logistic regression is used for analysis used for predicting the traveler's decision that purchases the real-traffic information service or not and the equation derived from the analysis shows that the factors influencing the decision of the traveler. In addition to, the Hierarchical Cluster Analysis and the K-Mean Cluster Analysis are used for grouping of travelers.

Findings: The results will show that 5 factors affecting the traffic information demand such as traveler's needs, traffic jam experience, distance, willingness to pay for information service, and cost, respectively. The factors that influence the decision are different according to the groups (commuter and recreation). The commuter group, the traffic jam experience influences the traveler's decision. Meanwhile, the traveler in recreation group emphasized the factors of distance. In addition, the travelers are classified into three groups according to the travel behavior. Each of the group is divided into the difference of time, costs, distance and willingness to pay for service.

Research limitations/implications - This survey is specification among travelers who travel in Bangkok regularly so limits its usefulness elsewhere.

Originality/value - The results of this paper will be beneficial to the government and business in order to develop the traffic information systems for the travelers' needs.

Key words: Traveler Behavior, Real Time Traffic Information, Binary Logistic Regression

Article Type: Research paper

Real time traffic information system is the advancement of technology that facilitates information technology for solving traffic congestion (Wei-Hsun, 2008). Today, information technology and communication tools are used for traffic information systems in most of the large cities around the world. The increase of real time traffic information systems has become prevalent in many research fields related to the use of information systems such as traveler behavior (Katrin, 2007), information performance (Minoru, 2009), solving the traffic congestions and willingness to pay for traffic information service (Amalia,1997). This study seeks to investigate whether information technology can be used to benefit traveling and transportation. In addition, information system has become an attractive commercial product and enjoyed growing demand. The information service has grown together with the communication business (Rong and Erik, 2006), such as internet services and mobile phones (Lisa, et.al.2007). The purpose of this paper is to find factors that influence the selection of real time traffic information service and to create a Binary Logistic Regression Model that use forecast traveler's demand.

Travel and Real time traffic information in Bangkok

Bangkok is the capital, where the most population of Thailand and is the center of government, education, communication transportation, financial, commercial and other aspects of Thai life. Bangkok has land border contact with the other provinces. Travelling in Bangkok can be done in several ways, by express boat, automobile, motorcycle, bus, taxi, BTS sky train and by MRT subway. In Bangkok begin the main streets of Thailand's infrastructure, Phaholyothin Road leading all the way to the north of the country, Sukhumvit road which is the route to the east and Phet Kasem road going to the south. Bangkok is the center of trade and transportation, which also means it also has the worst

traffic jams in Thailand. People's expectation that the traffic jams would lessen in Bangkok once the underground and sky train opened also did not take into account the Thai obsession with the car. Owning a car has become an enormous status symbol and even the lower middle-class, who can barely afford to get through to the end of each month, are spending all their money on buying a car. This is causing an even larger congestion of Bangkok's roads, and it's expected to continue. Every year, more cars are added to the capital cities roads and less people use public transportation because of bus users took longer time than users of other transportation (Sureeporn, 2001).

The traffic report system are soon launch a web site that provides traffic information and projections to help busy Bangkok motorists save time on their daily commutes and is reaching out to smart phone users to contribute to the project to increase its accuracy. The web site, traffy.nectec.or.th, will be fully operational in the next four months and will provide a service that predicts the travel time between two points based on traffic conditions. It can currently predict journey times up to 30 minutes in advance, but that will be extended to 24 hours by launch.

A preliminary survey of travelers' behavior in Bangkok (Malai, et.al, 2010) found that motorists spend 90 minutes 56 kilometers and 150 Baht for travel expenses each day. The obtained results are rather similar to the survey by Krungthep Thanakom Co., Ltd. in 2003. In 2010, the National Electronics and Computer Technology Centre report traffic conditions on the main road and highway around Bangkok consisted of multiple channels, such as radio station, internet, call center and traffic variable messages signs or intelligent traffic signs. This system displayed information for the driver in real time to those who were actually traveling at that time by organizing a system that displays traffic conditions on the main routes in Bangkok, offering routing information for the drivers on the road. The Intelligent traffic signs are display traffic on each route at the current time and collect data processing through the detector camera over 150 units that are installed on the main roads around Bangkok measuring the traffic volume and display three line color The color indicate various level of traffic flow with green indicating traffic mobility, yellow showing slow movement but no standstill and red for heavy traffic jam and the need to be avoided (NECTEC, 2010). There are any researcher currently done that studied about the traveler's behavior and traffic information (Karin,2006), (Waadt, 2009), (David,2002).

Willingness to pay for Real time traffic information

In economics, the willingness to pay (WTP) means the maximum amount a person would be willing to pay, sacrifice or exchange in order to receive a good or to avoid something undesired. The studied the willingness to pay for advanced traffic information system or SmarTraveler, an ATIS that provides, via telephone, real-time location-specific traffic and transit information in the greater Boston area. The model is an integrated system of discrete choice and latent variable models. It predicts travelers' frequency of use and subscription under varying pricing scenarios. Two models are presented: one for current SmarTraveler users, and one for non-users. The SmarTraveler usage rate is modeled as a function of payment method and pricing, travelers' travel and socioeconomic characteristics, and their attitudes and perceptions toward ATIS. The data used in model estimation included willingness-to-pay scenarios involving two methods of payment: a flat monthly fee, and a charge per call (Amalia,1997). Similarly, the analyzed the economic valuation of traffic congestion costs in Bangkok and found that the impact of traffic congestion on travelers and their Willingness-To-Pay for improving Bangkok traffic condition was 37.64 baths per trip for auto travelers and 21.37 baths per trip for public transport users (Thanit,2001).

Binary Logistic Regressions

Logistic regression is a statistical method for analyzing a dataset in which there are one or more independent variables that determine an outcome. The outcome is measured with a dichotomous variable. The goal of logistic regression is to find the best fitting model to describe the relationship between the dichotomous characteristic of dependent variable and a set of explanatory variables. Logistic regression generates the coefficients and its standard errors and significance levels of a formula to predict a logit transformation of the probability of presence of the characteristic of interest.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p + \varepsilon \quad \text{----- (1)}$$

where Y is the categorical variable
 X_1, X_2, \dots, X_p are independent variables or categorical variable ; $p \geq 1$
 $\beta_0 - \beta_p$ are coefficients of independent variables
 ε is random Variable

Factors that make people decide in the event of any one or more alternative choice. We consider a rational basis for decision making by economic concepts called “Utility Theory” which indicate that people choose the alternative which promises greater satisfaction. The idea is to write the equation.

$$U_{in} = V_{in} + \varepsilon_{in} \quad \text{----- (2)}$$

By U_{in} is the function of satisfaction for person who prefer alternative i
 V_{in} is the independent variables that affect satisfaction
 ε_{in} is the value of the variable is not observed

The people choose alternative i instead of alternative j in the all option (Cn), when alternative i promises greater satisfaction or maximum utility. In the event that consists of two alternatives (event and no event) we are interested in the opportunity to study the event that the logit model of the basic functions follows.

$$P_{(event)} = \frac{e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p)}}{1 + e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p)}} \quad \text{----- (3)}$$

By $P_{(event)}$ is the probability that the event occurred
 $\beta_1, \beta_2, \dots, \beta_p$ are parameters on the estimated value
 X_1, X_2, \dots, X_p are the independent variables
 e is natural Logarithm (mathematical value =2.71828)

When we know the probability of occurrence, subsequently we can calculate the probability of no event that is:

$$P_{(no-event)} = 1 - P_{(event)} \quad \text{----- (4)}$$

Or
$$P_{(no-event)} = 1 - \left[\frac{e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p)}}{1 + e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p)}} \right] \quad \text{----- (5)}$$

From equation (4) and (5), we can study the ratio between the event and no event is called “Odds Ratio”. This ratio can help explain changes in factor X_1 unit will change the Odds Value which requires the interpretation of the marks and the value were calculated. The Odds Ratio is calculated from:

$$Odds\ Ratio = \frac{P_{(event)}}{1 - P_{(event)}} \quad \text{----- (6)}$$

Cluster Analyses

Cluster analysis is a class of statistical techniques that can be applied to data that exhibit “natural” groupings. Cluster analysis sorts through the raw data and groups them into clusters. A cluster is a group of relatively homogeneous cases or observations. Therefore, the selected characteristic or variable that is used to divide the case is very important. In addition, the case must be in only one group. Cluster Analysis is divided into several methods, but the most widely used techniques are the Hierarchical Cluster Analysis and the K-Mean Cluster Analysis. Hierarchical Cluster Analysis is a technique often applied in the cluster variables. This technique deals with a small amount of data or N fewer than 200 and does not know the number of group before. The K-Mean Cluster Analysis is a technique classification into subgroups based on the number of large cases. K-Mean technique uses iteration method that is included in any group of each round case. Then calculates the new median and continues to do so until the median is unchanged or completed (Kanlaya, 2010).

This research data was collected from motorists who travel in Bangkok. The questionnaire was administered to 447 respondents. The questionnaire is divided into three parts: Part 1 is general information of the respondents, part 2 is traveler’s behavior and part 3 is the willingness to pay for real time traffic information. The questions consist of both open-ended and closed questions. Data from 447 respondents are divided into two parts, part1 (412 respondents) for modeling and part 2 (65 respondents) for checking the accuracy of models. Creating Binary Logistic model in order to study the relationship between the dependent variables (Y) and independent variable (X) in this study considered variables as Y indicate the purchase of information service or not and the independent variable (X), composed of distance, travel time, congestion time, attitude and willingness to pay for service. The statistical program is used for calculated parameters and determines the parameters in the equation and validation of the model that consists of the coefficients checking, the significance checking, and the accuracy checking. The percentage accuracy of prediction is calculated from

$$\%correct = \frac{\sum_{n=1}^N A_n}{N} \times 100 \quad \text{----- (7)}$$

Classification of respondents is based on purchase information services decision. The binary Logistic model analysis shows the influence purchase decisions in real time traffic service and the clustering technique is used to divide the group of respondents.

The result of this paper

Factors that affect decision to purchase real time traffic information service.

Factors	All motorist			Commuter group			Recreation group		
	β	S.E.	Sig.	β	S.E.	Sig.	β	S.E.	Sig.
Distance	-.051	.023	.025*	-.056	.025	.027*	.005	.061	.935
Travel Time	.062	.016	.000**	.060	.019	.001**	.076	.033	.022*
Travel cost	.012	.004	.003**	.012	.005	.008**	.006	.011	.614
Congestion Time	.066	.015	.000**	.063	.016	.000**	.091	.041	.026*
Needs	2.063	.302	.000**	2.027	.348	.000**	2.561	.769	.001*
WTP per month	.036	.010	.000**	.040	.012	.001**	.031	.017	.062

Table 1: Variable in the Equation

$$Y = \beta_0 + \beta_1(DIS) + \beta_2(TT) + \beta_3(EX) + \beta_4(CT) + \beta_5(NE) + \beta_6(WTP)$$

- Y = Result of the decision (1= purchase, 0 = not purchase)
- DIS = Distance of traveling per day
- TT = Time of traveling per day
- EX = Expenses of traveling per day
- CT = Congestion time
- NE = Traveler’ needs
- WTP = Willingness to pay for service

The estimation of parameters in the function found that:

- the estimated coefficients for distance for all motorists were negative (-.051) and significant at the 95% confidence level. Besides distance, travel time, travel cost, congestion time, needs and willingness to pay for service were found to be positive and significant at the 99% confidence level.
- in the commuter group the coefficients for distance were found to be negative (-.056) and significant at the 95% confidence level. Besides distance, travel time, travel cost, congestion time, needs and willingness to pay for service were found to be positive and significant at the 99% confidence level.
- in the recreation group, factors influencing the decision were travel time, congestion time, needs and willingness to pay for service which these factors have the positive coefficients but there were differences significant level, as follow travel time factor was significant at the 95% confidence level, congestion time factor was significant at the 95% confidence level, needs factor was significant at the 99% confidence level and willingness to pay for service factor was significant at the 90% confidence level.

The study of factors influencing the decision to purchase the real time traffic information service among 412 respondents then analysis with computer software, the results show a picture choice and equation following.

$$Y = -16.075 - .051(DIS) + .062(TT) + .012(EX) + .066(CT) + 2.063(NE) + .036(WTP)$$

The model above shows the most important factors for the real time traffic information purchasing to be the real-time information facilitated for travelers in BKK and its use while on the road. The next factors are the congestion time, travel time per day, distance, willingness to pay for service and travel cost per day.

Form 412 respondents are divided into 2 group according to the purpose of the trip, such as commuter groups who travel for work or study (N=318) and recreation groups who travel for entertainment or other activities (N=94). As commuters, the models show that factors influencing the real-time traffic information services, (sort descending) such as needs, followed by travel time, the congestion time, distance, willingness to pay for service and travel cost per day.

$$Y = -15.453 - .056(DIS) + .060(TT) + .012(EX) + .063(CT) + 2.027(NE) + .040(WTP)$$

In the recreation groups, the model shows that factors influencing the real-time traffic information services are needs, followed by congestion time, travel time and willingness to pay for information service.

$$Y = -21.151 + .076(TT) + .091(CT) + 2.561(NE) + .031(WTP)$$

Accuracy and reliability of the model

The validity check for the sign of the coefficients in the model shows the direction of the relationship variables that influence the decision choice any way that sign (+) of the positive coefficient shows that factors correlated to the same direction that we interested in alternative. On the other hand, if the sign (-) of the coefficient show that factor is in opposite relationship with alternative that we are interested.

Factors	The sign of the coefficients		
	All motorist	Commuter group	Recreation group
Distance	-	-	+
Travel Time	+	+	+
Travel Cost	+	+	+
Congestion Time	+	+	+
Needs	+	+	+
Willingness to pay per month	+	+	+

Table 2: Marks show the relationship between the independent samples.

In this study, found that coefficient for distance variable is negative (-); it would mean travelers who journey much more likely to not buy the real-time traffic information services. The sign (+) before coefficients for distance variable coefficient is positive, which means if the traveler go far, they would have increasing opportunity to purchase the information services. The sign before coefficients of other variable is positive for the event which interested. There are factors that positive for purchasing traffic information service. Travel time; if takes more travel, opportunity to purchase services to increased more. Travel costs; if higher the cost to travel more, opportunity to purchase services to increased more. The congestion time; if longer traffic jam, opportunity to purchase information services to increased more. The importance level that when the data show that real-time traffic is very important the opportunity to purchase services to increased accordingly. The willingness to pay factor show that when willingness to pay is expensive, the opportunity to purchase services increased accordingly. Check the accuracy of the prediction from the sample.

Models	N	forecasting			
		Frequency Correct	Frequency Missing	% Correct	% Missing
All motorist $Y = -16.075 - .051(DIS) + .062(TT) + .012(EX) + .066(CT) + 2.063(NE) + .036(WTP)$	412	372	40	90.29	9.71
Commuter group $Y = -15.453 - .056(DIS) + .060(TT) + .012(EX) + .063(CT) + 2.027(NE) + .040(WTP)$	318	289	29	90.88	9.12
Recreation group $Y = -21.151 + .076(TT) + .091(CT) + 2.561(NE) + .031(WTP)$	94	81	13	86.17	13.83

Table 3: The accuracy of the prediction samples

Check the accuracy of the prediction from samples collected showed that the group who traveled all (412), the model can predict the decision to buy information services can be 372 people correct and 40 people be wrong that represent the accuracy per error about 90: 10. In the commuter group (318 people), the model can predict the decision to buy the information services can be 289 correct and 29 people wrong that represent accuracy per error about 91: 9. In the recreation group (94 people), the model can predict the decision to buy information services can be 81 people correct and 13 people wrong that represent the accuracy per error about 86:14.

Check the accuracy of the prediction from outside the sample population.

The most appropriate model be tested the accuracy of prediction. The questionnaire divided into 3 groups to analyze the model results in Table 4

Models	N	forecasting			
		Frequency Correct	Frequency Missing	% Correct	% Missing
All motorist $Y = -16.075 - .051(DIS) + .062(TT) + .012(EX) + .066(CT) + 2.063(NE) + .036(WTP)$	65	47	18	72.31	27.69
Commuter group $Y = -15.453 - .056(DIS) + .060(TT) + .012(EX) + .063(CT) + 2.027(NE) + .040(WTP)$	49	38	11	77.55	22.45
Recreation group $Y = -21.151 + .076(TT) + .091(CT) + 2.561(NE) + .031(WTP)$	16	10	6	62.5	37.50

Table 4: Accuracy of forecasting based on objective for travel

This tables presents the accuracy of the prediction with the total of people traveling (65 people), the model predicts demand of real time traffic information. In the commuter group, the model can predict the decision to buy information services are accuracy 77.55% and errors 27.69 %. In the recreation group, the model can predict the decision to buy information services are accuracy 62.5% and errors 37.50%.

Classification of the travelers

Clustering methods commonly used consists of Hierarchical Clustering and K-Mean clustering because the two methods have different limitations. To study the effect of the best both methods are applied using.

Factors	Group	Mean	Estimate	Meaning
Distance (Kilometers per day)	1	29.88	30	short distance
	2	54.97	55	middle-distance
	3	86.75	85	long distance
Travel Time (Minute per day)	1	51.49	50	short-time
	2	86.93	90	middle-time
	3	121.79	120	long time
Expense (Baht per day)	1	142.83	140	low expense
	2	277.98	280	Average expense
	3	507.58	500	High expense
Congestion Time (Minute per day)	1	49.23	50	Little traffic jam
	2	95.61	90	Heavy traffic
	3	184.80	180	The worst traffic jam
Traveler's needs (scale 1-10)	1	3.82	3	Little needs
	2	5.52	5	Medium needs
	3	7.00	7	The most needs
Willingness To Pay (Bath per month)	1	24.86	25	Minimum willingness to pay
	2	246.38	250	Medium willingness to pay
	3	468.18	470	Maximum willingness to pay

Table 5: The average and means of the various factors

Conclusion

Adoption of modern technology to help manage traffic and transport system has been accepted and has been developed for high performance. The next step is the integration into more commercial services. This study was to analyze travel behavior on Bangkok and to study the real time traffic information service demand for decision making on the road, including the various factors affecting the selection of information services. The results are 3 models that show the factors affecting the real time traffic information demand.

$$\text{Model 1 } Y = -16.075 - .051(DIS) + .062(TT) + .012(EX) + .066(CT) + 2.063(NE) + .036(WTP)$$

$$\text{Model 2 } Y = -15.453 - .056(DIS) + .060(TT) + .012(EX) + .063(CT) + 2.027(NE) + .040(WTP)$$

$$\text{Model 3 } Y = -21.151 + .076(TT) + .091(CT) + 2.561(NE) + .031(WTP)$$

The analysis of three models concluded that the factors impacting the demand for real time traffic information are the factors that most effective is the traveler's needs. The second factor is the congestion time and other factors, such as, travel time, distance, willingness to pay and expense, respectively. For the recreation group travel time and congestion time are prevalent in the traveler's needs and impact their willingness to pay more than commuter group. In addition, the result of clustering group travelers found that the average travel time of the short distance about 30 km with 50 minutes and lowest cost that about 140 bahts, while the travelers who travel a long haul with an average distance of 85 km and a travel time of 120 minutes, are willing to spend about 500 bahts. Finally, in regard to travelers and their willingness to pay for the real-time traffic information service the amount varies between 25 bahts per month as the lowest and 470 bahts per month as the highest to be paid.

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ELIMINATING NON-VALUE-ADDED ACTIVITY THROUGH VALUE STREAM MAPPING: A CASE STUDY OF THE THAI SUGAR INDUSTRY

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ABSTRACT

Purpose – This paper aims to analyze the Thai sugar industry supply chain and investigate the use of Value Stream Mapping (VSM) to identify waste.

Design/methodology/approach – VSM is the main tool used to identify opportunities for improvement and elimination of waste in processes. Then, this paper proposes an approach to improve the sugar supply chain.

Findings – The results of current state map found that non-value-added and necessary non-value-added activities, which are waiting times, took 735 minutes, representing 56.84% of production time. An approach sequencing and scheduling arrival of sugar cane trucks proposes to improve the sugar supply chain in the future state map. Simulation results that eliminate waiting time associated with non-value-added activity save 185 minutes, reducing non-value-added activity to 49.19% of production time.

Research limitations/implications – The findings are limited due to the focused nature of the case study.

Originality/value – This paper is a real case study showing VSM applications and simulation approach sequencing and scheduling arrival of sugar cane trucks to eliminate waste in the process. In future research, this approach will be applied to reduce non-value-added activity in the Thai sugar industry.

Keyword: Sugar industry, Value Stream Mapping, waste reduction

Introduction

The Thai sugar industry is a promising export industry. Thailand's export of sugar had been growing in the past two decades, and by 1996 the country became the world's second-largest exporter after Brazil. The export value of the Thai sugar industry grew steadily from 2007 to 2011, as shown in Figure 1. The Thai sugar industry has endeavored to create more competition, increase quality, and reduce waste in sugar manufacturing to compete with challengers. Products from the sugar industry of Thailand bring in more revenue and economic development from export than any other country in Asia. Sugar cost and farmer latency are factors supporting the growth trend in the sugar industry, as the world's sugar cost has continued to increase and farmers have the capacity to develop and improve productivity in sugar cane agriculture.

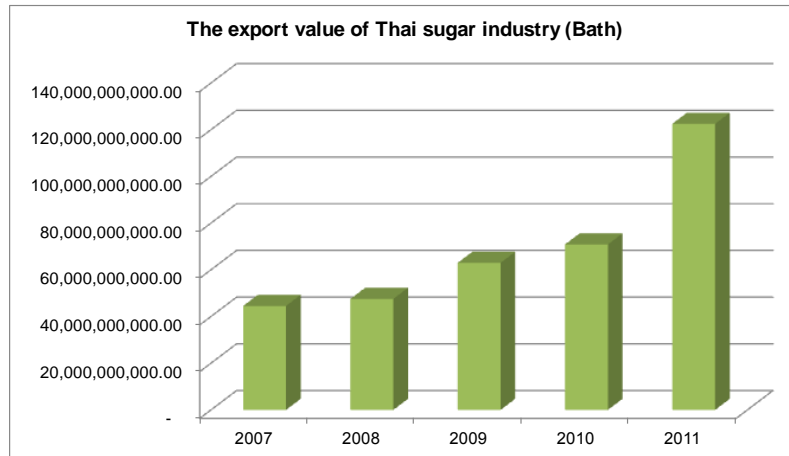


Figure 1: Export value of Thai sugar industry from 2007 to 2011
(Office of the Cane and Sugar Board, 2011)

Thailand's main competitor in the sugar industry is Brazil which leading sugar manufacturer in the world. The nature disasters or climate changes have decreased its productivity in the last four years. Thailand has enjoyed an export advantage because of these difficulties.

Currently, Thailand has competitive advantage in sugar manufacturing and exporting. It is the biggest sugar exporter in the Association of Southeast Asian Nations (ASEAN), with exports of 2.73 million tons in 2011 (Office of the Cane and Sugar Board). However, by 2015 the ASEAN member countries plan to integrate economically into the ASEAN Economic Community (AEC). This reorganization will reduce price differentials on a global level. Thailand is the biggest regional supplier of sugar, and will benefit from the AEC. The coming cross-border transport of sugar cane plants presents an opportunity to bring more revenue to our country.

Although Thailand has greater sugar export value, the sugar supply chain has several problems, the greatest of which is that trucks need to wait during the production process. This logistical problem increasingly affects costs. The study of supply chains can reduce waste, increase efficiency, and help Thailand compete with other countries. This paper studies the supply chain of the Thai sugar industry using a case study to identify waste through Value Stream Mapping (VSM). VSM was the main tool used to identify opportunities for improvement and elimination of waste in the process. The paper proposes an approach to improve the sugar supply chain using VSM in the future, (TO-BE) including suggested models to improve the supply chain in the industry. The paper is based on a case study of one of Thailand's top ten sugar exporters.

The selected company is considering using our approach to improve the supply chain from sugar cane farms to the processing factory. In the future, this approach will be applied to eliminate non-value-added activity across the Thai sugar industry.

Literature review

Several issues relating to the study are briefly reviewed as follows.

Sugar Supply Chain

Sugar, produced in more than 110 countries, is the most widely produced agricultural commodity in the world. Sugar's price is set by the world market, making it necessary to keep production costs as low as possible to ensure that there is always some profit margin. The cutting and loading of cane in the fields is a complex logistical operation at harvest time. It involves transportation by truck with a trailer to factories and unloading the cane in the factory (Diaz and Ptrez, 2000). A supply chain is concerned with planning sugar manufacturing, starting with the production of sugar cane by the farmer, through processing by millers, and finally delivery to the consumer (Masuku and Kirsten,

2004). The Thai sugar industry needs to operate as efficiently as possible to survive and compete with other countries. It is therefore important that transportation costs and selection of appropriate vehicle combinations be investigated and evaluated.

Value Stream Mapping (VSM)

VSM is a tool used to analyze and design the flow of materials and information required to bring a product or service to a consumer. It is used to create a map of both value and waste in a given process (Wanitwattanakosol and Sopadang, 2011). The map can help organizations reduce lead times and inventory, improve quality, and achieve better on-time delivery and use of resources (Goriwondo *et al.*, 2011). The goal of VSM is to identify, demonstrate, and decrease waste in the process.

VSM usually includes the physical mapping of the current flow of information and material as a product goes through the manufacturing process. The current state VSM is analyzed and unnecessary non-value-added waste eliminated. The future state VSM is drawn after assessment of the current state VSM (Teichgräber and de Bucourt, 2012). It suggests how to create a flow that reduces or eliminates waste and minimizes non-value-added activities (Goriwondo *et al.*, 2011).

Many researchers have applied VSM to reduce waste and lead time. For example, VSM was applied to the food supply chain system of cooked chicken products to Japan to identify kinds of activities that were value added (VA), necessary non-value-added (NNVA), and non-value-added (NVA) (Payongyam *et al.*, 2010). Bread manufacturing in Zimbabwe used VSM to analyze both information and material flows. Then, VSM helped to demonstrate exactly how the process operated, with detailed timing of step-by-step activities (Goriwondo *et al.*, 2011).

Reduction of Waste

Waste is a concept in the Toyota Production System (TPS). There are seven types of waste: overproduction, waiting, transportation, inappropriate processing, inventory, unnecessary movement, and defects (Teichgräber and de Bucourt, 2012). Waste can be found at any time and in any place and does not add value to the product. It is necessary to eliminate waste to add value to the product. Waste reduction is able to drive competitive advantage. It focuses on more productivity and quality. Goriwondo *et al.* (2011), using the kaizen blitz approach, obtained waste reduction through structured brainstorming sessions with shop floor employees. The elimination of all non-value-adding activities and waste from the business was a step when VSM techniques were applied to the procurement of endovascular stents in interventional radiology services (Teichgräber and de Bucourt, 2012).

These relevant papers can apply many issues to identify and analysis of process activity in the next step. Then, find an approach to improve the sugar supply chain.

Value Stream Mapping: Current State Map

The study of the Thai sugar supply chain, which was conducted by studying the sugar process and interviewing factory managers and process engineers, found that the supply chain of the Thai sugar industry, shown in Figure 2, has both material flow and information flow. Material flow originates from sugar cane farmers upstream in the supply chain. They plant sugar cane and transfer it to the sugar factory that manufactures raw sugar. After that, raw sugar is stored in warehouses and distributed to customers. Customers for this case study are both domestic and foreign. Sugar factories have a second material flow, which is transfer of raw sugar to white sugar and refined sugar factories. Then, white and refined sugar is also stored in warehouses.

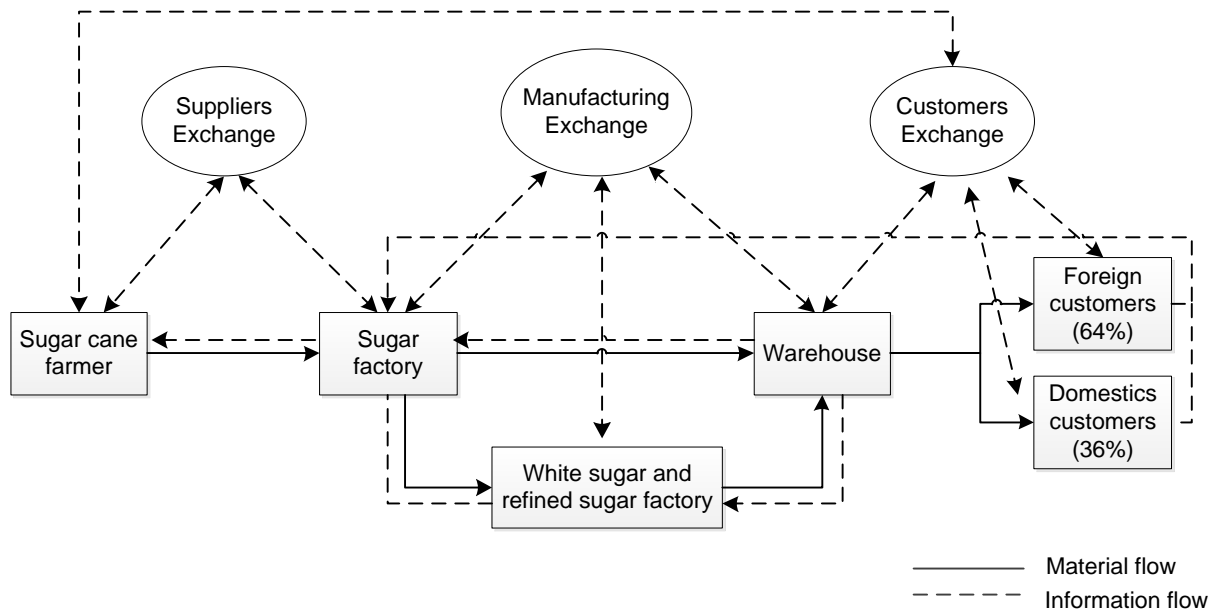


Figure 2: Flow of Thai sugar industry supply chain
(Office of the Cane and Sugar Board, 2011)

Information flow begins with the customers. They order finished goods (raw sugar, white sugar, and refined white sugar) from the sugar factory. Then, the sugar factory purchases raw materials (sugar cane) from sugar cane farmers. The sugar cane farmers deliver raw materials during approximately four months (December to March), which is the manufacturing season. Warehouses, which store finished goods, report inventory levels to the sugar factory.

The flow of the supply chain in the selected company shows direction of materials and information, typical of the sugar supply chain. We analyzed the sugar supply chain systematically by applying VSM techniques.

The VSM Current State Map shows the actual material and information flows as a product goes through the manufacturing process (Goriwondo *et al.*, 2011). The current state of the information flow is realized according to the original data from customers that purchased sugar products. This design represents the starting point to improve upon. Next, the map of material flow is shown to verify materials movement among activities. Initial conditions for the analysis of the VSM are shown in Figure 3.

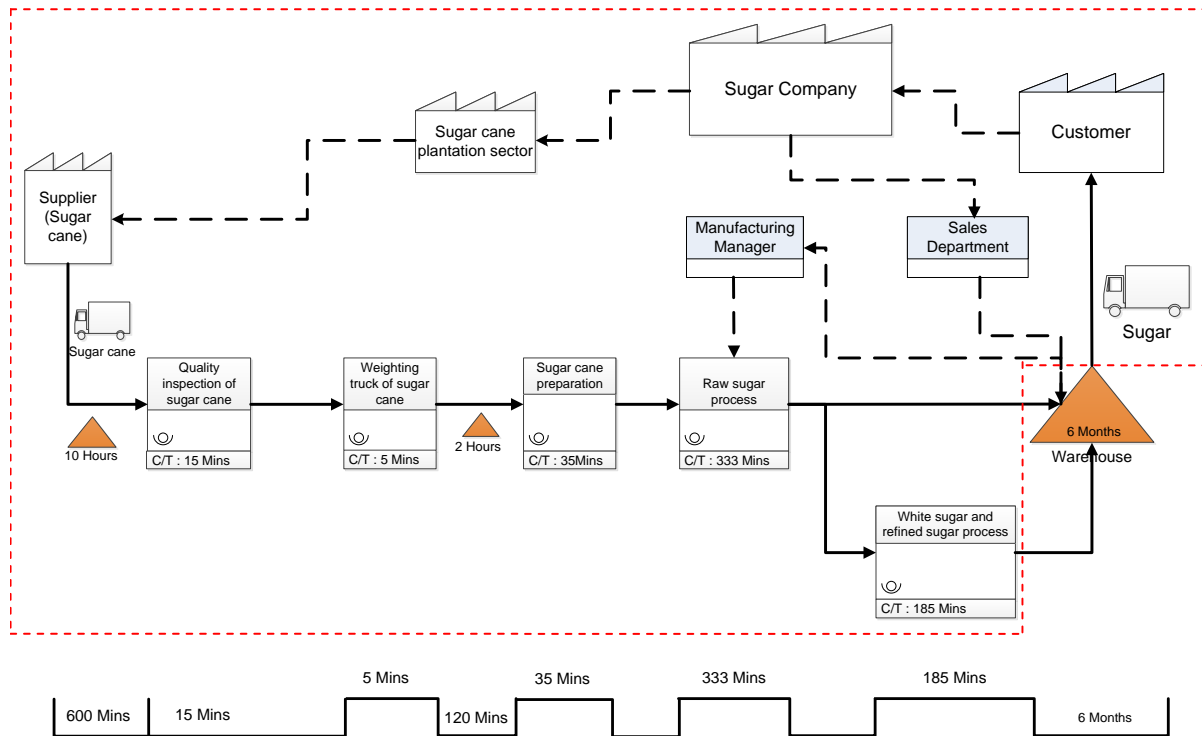


Figure 3: Value stream mapping in current state (AS-IS)

Figure 3 shows flows of information and materials in the sugar supply chain and identifies value added, necessary non-value-added, and non-value-added activities. The figure shows in dashed lines the scope of the process, except the warehouse process, which is shown in solid lines. Because sugar cane is a seasonal agricultural good, the sugar factory must store products for distribution to customers during the whole year. However, in the future, sugar warehouses will reduce storage time by extending the period of sugar manufacturing, by improved warehouse management, or other improvements that can reduce waiting time. Warehouse management can plan production of the three types of sugar, raw, white, and refined, equal to customer demands for the year for each sugar factory. The manufacturing department needs to use forecasting tools to predict consumer demand.

Results from the selected company found a total value-added activities time of 558 minutes, representing 43.16% of production time; a non-value-added activities time of 720 minutes, representing 55.68% of production time, and a necessary non-value-added activities time of 15 minutes, or 1.16% of production time. The VSM approach involves the identification of value-adding and waste activities (Hines *et al.*, 1999). Then, process activities analysis identifies waste activities in value streams and allows identification of appropriate routes to eliminate them.

This case study identified waste activities by process activities analysis, shown in Table 1. All waste activities were waiting activities. The three types of waiting activity were waiting for quality inspection of sugar cane, quality inspection of sugar cane, and waiting for sugar processing. In the sugar supply chain of the selected company, the waste of waiting occurs whenever materials or products are not moving or being worked on. Some non-value-added activities are necessary and cannot be avoided in the process. They are called necessary non-value-added activities. This case study shows the waste of sugar cane quality inspection as necessary non-value-added activity, because it is necessary to inspect and control quality of sugar cane before manufacturing.

Process Activities Analysis	VA	NNVA	NVA (Waiting Time)
	(Min)	(Min)	(Min)
Waiting for quality inspection of sugar cane			600
Quality inspection of sugar cane		15	
Weighing truck of sugar cane	5		
Waiting for sugar processing			120
Sugar cane preparation	35		
Raw sugar processing	333		
White sugar and refined sugar processing	185		

Table 1: Process activities analysis

The next step is suggesting an approach to improve the sugar supply chain of the selected company.

Suggestion for process improvement

The previous step identified process activities and classified types of waste activities that can be eliminated. It found that if the process could reduce waiting time it would increase sugar cane quality since time affecting the sweetness of sugar cane. Good quality sugar cane has more than 10% commercial cane sugar (CCS), which is calculated by the sweetness in the cane's first expressed juice. After harvesting the sugar cane, raw sugar must be produced immediately to avoid a decrease in quality. Therefore, reduction of waiting time in the process is important because it affects sugar cane quality.

Mathematical optimization is one approach to reducing waiting time in the process through considering sequencing and scheduling the arrival of sugar cane. Study of variables associated with the sugar supply chain has led to development of a mathematical model that consists of an objective function (main problem) and a subjective function (constraint of problem). Then, an algorithm is used to find solutions to the main problem. The optimal solution to this problem, which is sequencing and scheduling sugar cane coming from plantations to the sugar factory, can reduce time spent waiting for quality inspection and for sugar processing.

Time wasted waiting for quality inspection, a necessary non-value-added activity, can be reduced by inspecting at the same time as the sugar cane trucks are weighed.

Simulation of some situations in the Future State Map can verify the model. Simulation can compare outputs to evaluate and validate the model (Abdulmalek and Rajgopal, 2007). For this case study, Arena simulation software version 11.00 was used to verify the VSM Future State Map. The result found that total waiting time decreased 23.73% when scheduling the arrival of sugar cane.

The Future State Map is a chart that suggests how to create future process improvements that address waste and associated problems identified by means of the Current State Map. The Future State Map addresses the waste of waiting, as shown in Figure 4. Simulation shows that the Future State Map can eliminate 170 minutes of non-value-added waiting time. To accomplish this, the quality inspection process is combined with the truck weighing process, which is a value-added activity. Finally, non-value-added activities in this case study decreased 185 minutes. This means non-valued-added activities eliminated by reducing waiting time represent reduction from 55.68% to 49.19% of process time. This has the effect of increasing productivity.

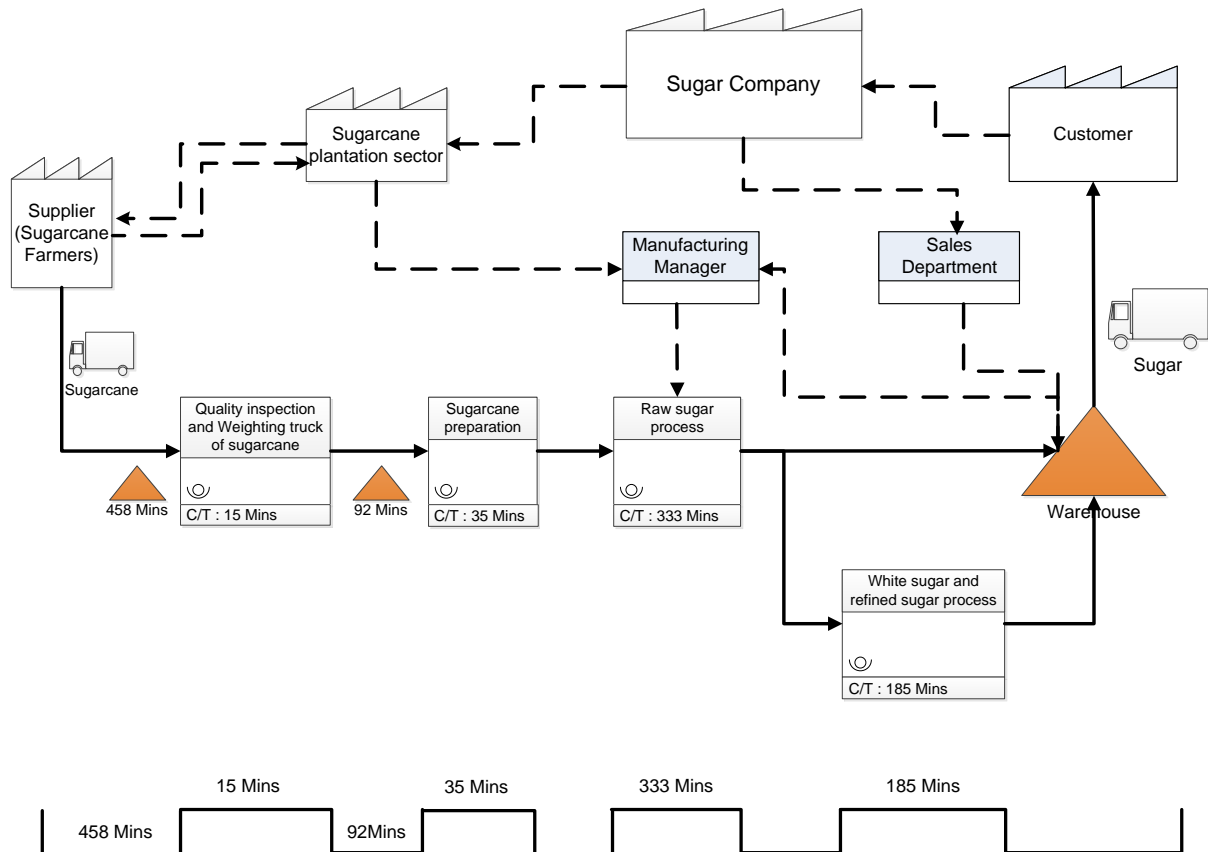


Figure 4: Value stream mapping in future state (To-Be)

Conclusion

This study applied the Value Stream Mapping tool to the sugar supply chain. The results of this case study identified waste and analyzed opportunities to eliminate it, thus improving the sugar supply chain. VSM can identify value-added activities, non-value-added activities, and necessary non-value-added activities. The waste of non-value-added activities and necessary non-value-added activities consist of waiting time, specifically waiting for quality inspection of sugar cane, waiting for sugar processing, and waiting during quality inspection of sugar cane. An approach to reduce waiting time, which decreases sugar cane quality, is mathematical optimization to sequencing and scheduling the arrival of sugar cane. This consists of performing quality inspection of sugar cane at the same time as weighing sugar cane trucks.

Future research will study factors that affect reducing wait time in this process. Then, mathematical optimization will be applied to sequencing and scheduling arrival of sugar cane trucks. This can eliminate more non-value-added activity, increasing both productivity and sugar quality.

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ORGANIC FOOD SUPPLY CHAIN RESTRUCTURING AND MARKETING DEVELOPMENT: THE ROLE OF SMALLHOLDERS AND MODERN SUPPLY CHAINS IN THAILAND

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ABSTRACT

Purpose: There have been many changes in agri-food systems in the last two decades, both in developed and developing countries. These changes were driven by forces, such as agricultural industrialization, globalization, trade liberalization, consumer's demands, safety and environmental concerns, and increasing role of information and logistics management. The food sector in Thailand undergoes two major transformations: "supermarketization" and the demand for organic and low-chemical products both from local and international markets. This presents threats as well as opportunities for smallholders. The standard set by buyers requires farmers to adjust their production and marketing systems. Assistance for farmers are derived from social enterprise and government and collaborations amongst these two parties.

Design/methodology/approach: A supply chain restructuring framework is used to analyze the participation of small-scale producers in schemes run by the social enterprises to assist smallholders with production and marketing.

Findings: This study, consequently, intends to explore empirically the pattern of agri-food (organic) supply chain restructuring and the role of social enterprises. The patterns of supply chain found in this study are substantiated and linked with the existing social enterprise and modern trade schemes to see whether there are inconsistencies in the policies and actual implementations.

Research limitations/implications: Focuses on the modern trade as the fastest growing segment in Thailand.

Originality/value: An enhancement of smallholders towards an integration of modern supply chain

Keywords: Organic food; Supply chain; Social enterprise; Smallholder

Paper type: Research Paper

Introduction

Agri-food systems (food chains)¹ have faced dramatic changes over the past two decades (Blandon, 2006). Scholars who are interested in these changes agree that forces and driving factors of these changes include agro-industrialization, globalization and multinationalization, advances in technology,

¹The definition of agri-food systems is adapted from Hobbs *et al.* (2000) with regards to the scope of the present study. Hobbs *et al.* (2000: 9) stated that agri-food systems can be viewed in terms of local as well as global "supply chains" or "value chains", which include "the entire vertical chain of activities: from production on the farm, through processing, distribution, and retailing to the consumer – in other words, the entire spectrum, from [farm] gate to [consumer's] plate".

trade liberalization and policies as well as changes in consumer demand, and growing influences of modern trade chains² (Saxowsky and Duncan, 1998; Brester and Penn, 1999; Reardon and Swinnen, 2004; Reardon and Berdegué, 2002; Blandon, 2006; Onumah *et al.*, 2007).

Agri-food systems that were based on traditional markets are now increasingly channeled through modern trade chains with new requirements on farmers, which result in alterations to traditional marketing relationships (Reardon and Barrett, 2000; Peterson *et al.*, 2001; Blandon, 2006). The development of modern trade chains in modern trade markets rely heavily on the successful management of their supply chains. Large firms with higher power in the supply chain usually have more negotiating power with their producers and suppliers, so they are able to cut cost and minimize risks in the supply chain than smaller firms (Brown, 2005). New business models have emerged to increase profits for shareholders and maintain an effective cost structure while consumers' demands have led to the emergence of measures to improve "flexibility through 'just-in-time' delivery, tighter control over inputs and standards, and ever-lower prices" (Brown, 2005). Modern trade markets can achieve competitive advantage due to their proper management of supply chains and their marketing strategies by means of market positioning, promotional activities and pricing strategies (Brown, 2005; McCullough *et al.*, 2008b; Singh, 2008). In addition, modern trade markets often demand greater flexibility and reliability of supply. They are likely to avoid storing large inventories of perishable products; at the same time, they need to make sure that store shelves are always fully stocked. For these reasons, modern trade markets are close attention to quality improvement and supply chain reliability; quantity, delivery and cost reduction are carefully managed and controlled. The modern trade markets have to constantly increase the efficiency of their supply chains to cope more efficiently with the intensified competitive environments in the industry (Neven *et al.*, 2004; Neven *et al.*, 2006).

In the case of Thailand, its rapid growth of the economy over the last few decades has led to a strong expansion of modern trade chains (Wiboonpongse and Sriboonchitta, 2004; Shepherd, 2005; Mingmalairaks, 2011). The role of social enterprises, in integrating small-scale farmers into modern trade chains in Thailand, has been a trend towards 'supermarketization'³. In addition, the growth of organic farming due to increasing consumer awareness of food safety was observed. The purpose of this study aimed to explain the current situation and development in agri-food systems and presenting the development of farmers' organizations and a modern trade, thus discussing the integration of small-scale farmers in modern supply chains in Thailand and how smallholders cope with the transformation of the food sector in Thailand. The study considered contract farming within the context of the value chain analysis framework. It employed in-depth case studies of social enterprises supplying produce to modern trade markets and small-scale producers under contract farming (social enterprise schemes).

Research Methodology

This study adopted mixed-method approach, which combines both qualitative and quantitative approaches. However, information presented in this paper was designed to utilise a qualitative approach to prepare information for the quantitative approach.

Qualitative data was adopted to develop a general mapping and characteristics of the agri-food value chain and the role of social enterprises in integrating small-scale farmers with modern supply chains in Thailand (Miles and Huberman, 1994; Silverman, 2009). A set of semi-structured question is used in the focus groups and in-depth interviews with key informants to gain more insight of what supply chain systems and kind of challenges or risk they are facing in supplying produces for modern trade chain. This information provided an essential input to design a survey for collecting quantitative data in a second phase.

In order to understand the farming and marketing systems, technology and environment context in supply chain management, a case study of organic rice producer under social enterprise scheme (Green Net Cooperative) was used in this study. A case study accepts and encourages multiple methods of data collection procedures, and it also provides a deeper understanding from the

²Modern trade chains can be grouped as supermarkets, hypermarkets, convenience stores, discount convenience stores, green/special shops, as well as export companies. This study refers to modern trade chains as supermarket chains to fit the context of Thailand.

³ "Supermarketization": Technical term to describe the evolution of modern trade

smallholders coping with food sector transformation. Furthermore, the information derived from qualitative approach was used to support and complement the quantitative results in the later phase.

The Retail Food Sector’s Transformation and Development in Thailand

The Thai retail food industry has changed drastically in recent years. Those changes have spread across developed as well as developing economies thanks to changes in consumer behaviour, evolving food safety and environmental concerns, increased importance of food quality, and the increasing role of information and logistics management (Reardon and Berdegue, 2002; Reardon et al., 2003; Brown, 2005; Shepherd, 2005; McCullough et al., 2008). It has experienced many of the same changes as those by some other countries. In past decades, Thai people bought food for their daily consumption from traditional markets such wet markets (fresh markets) and the local grocery store. The development of the retail food sector in Thailand can be classified into 7 periods as shown in Table 1.

Table 1: “Supermarketization” Timeline

Event	Year											
	1950	1964	1982	1983	1988	1989	1996	1997	2002	2003	2008	2011
Traditional Food Retail	■	■	■									
Development of Department Store		■	■	■								
Expansion Of Department Store to Suburbs				■	■	■						
Over-Investment in Modern Food Retail						■	■	■				
Economic Crisis Lead to Acquisition by Foreign Caompanies								■	■	■		
Development of Smaller Stores										■	■	■
Expansion Of Smaller Store to Suburbs												■

Source: By Authors

In addition, a close examination of the patterns of sales of foods in both traditional markets and modern trade chains between 2002 and 2010 shows that the proportion of food sold in the modern markets have been on the increase while that in the traditional markets have been in decline (Wiboonponse and Sriboonchitta, 2004; TDRl, 2002; Shannon,2009). For example, the percentage of foods sold in the modern markets rose from 35 percent in 2002 to 40 percent in 2007 and rose again to about 50 percent in 2010 while that of traditional markets dropped from 65 percent to 60 percent and about 50 percent in corresponding years respectively (Research Institute for Developing Thailand (2002); Wiboonponse and Sriboonchitta, 2004; Shannon (2009))

The accelerating rate of change and competitiveness in the retail food sector will drive the evolution of the retail food value chain over the next decade. Modern retail businesses have accelerated their expansion scheme to open more branches and new (mini) formats in an effort to obtain a larger market share. Most retail businesses follow a similar model of focusing on low prices, providing and a wider selection of products while meeting higher standards of quality. To achieve these goals, they have had to change their supply chain management systems. These changes affect both suppliers and producers, especially in agri-food supply chains where they must achieve higher standards and requirements which have become part of the modern trade market. The trends in retail food supply chain requirements in Thailand are summarized in Table 2.

Table 2: Trends in retail food supply chain requirements in Thailand

	Traditional Markets	Modern Trade Markets
Product - Production	<ul style="list-style-type: none"> - do not require contracts/agreements - prefer a short-run production and usually unplanned - do not have any specifications on diversification or intensive chemical/input use - do not require traceability and/or chemical residue check 	<ul style="list-style-type: none"> - require agreement or contract (can be formal or informal contract). - prefer long-run production under suppliers/organizations plan - have some specifications on farming systems and chemical/input used. - require product traceability and/or chemical residue (safety standard) check in most markets
Purchasing	<ul style="list-style-type: none"> - do not have regular order system 	<ul style="list-style-type: none"> - use regular order systems in advance
Purchasing Price	<ul style="list-style-type: none"> - use market price 	<ul style="list-style-type: none"> - use market price and price under contract farming scheme (usually higher than market price)
Procurement systems	<ul style="list-style-type: none"> - prefer traditional chains such as wholesale markets and direct chain from producers 	<ul style="list-style-type: none"> - prefer modern supply chains such as suppliers, brokers and social enterprise companies
Coordination	<ul style="list-style-type: none"> - use relationships or informal connections 	<ul style="list-style-type: none"> - use formal connection via contract or agreement (nowadays most are informal contract) - prefer company/organization/institution relationships along the chain

Source: By Authors

This study explores the changes in the agri-food supply chain and the difficulties faced by smallholders in Thailand because of these changes. This section explains the development of the agri-food supply chain and its effects on small-scale farmers and focuses on the results of focus group and in-depth interviews.

Agri-Food Supply Chain Restructuring and Effects on Small-Scale Farmers in Thailand

The main reason that induced most of the smallholders to sell their products in traditional (local) markets was because they had an easy access to the market and most of them had business experiences with local buyers. In addition, most farmers usually sold their produces in two ways. First, the farmers delivered or transported the produce to the market on their own or rental vehicles. Second, the farmers sold their produce to intermediaries who came to pick them up by their vehicles or they came to take the whole crops during harvest. The intermediaries usually made an agreement about buying and selling the whole crop in advance. However, this study found that most farmers lacked the ability to search for buyers and negotiation ability for an appropriate price.

The growth rate of agri-food sale in modern trade market has also been increasing each year with an average increases around 10 to 20 percent per year. Modern trade markets attempted to fulfil all customers' demands with notable changes in consuming behaviours. Therefore, the patterns of farm-shop linkages between small-scale producers and modern trade supply chain have to be developed (especially the department store owned by foreigners).

The findings from this research indicated four main traditional market chains can be identified; selling through intermediaries, selling at local markets, selling at traditional wholesale markets, and selling through minor markets. Several participants stated that which market suited a farmer, and which market a farmer decided to use, depended on farming and marketing potential and anticipated transaction costs.

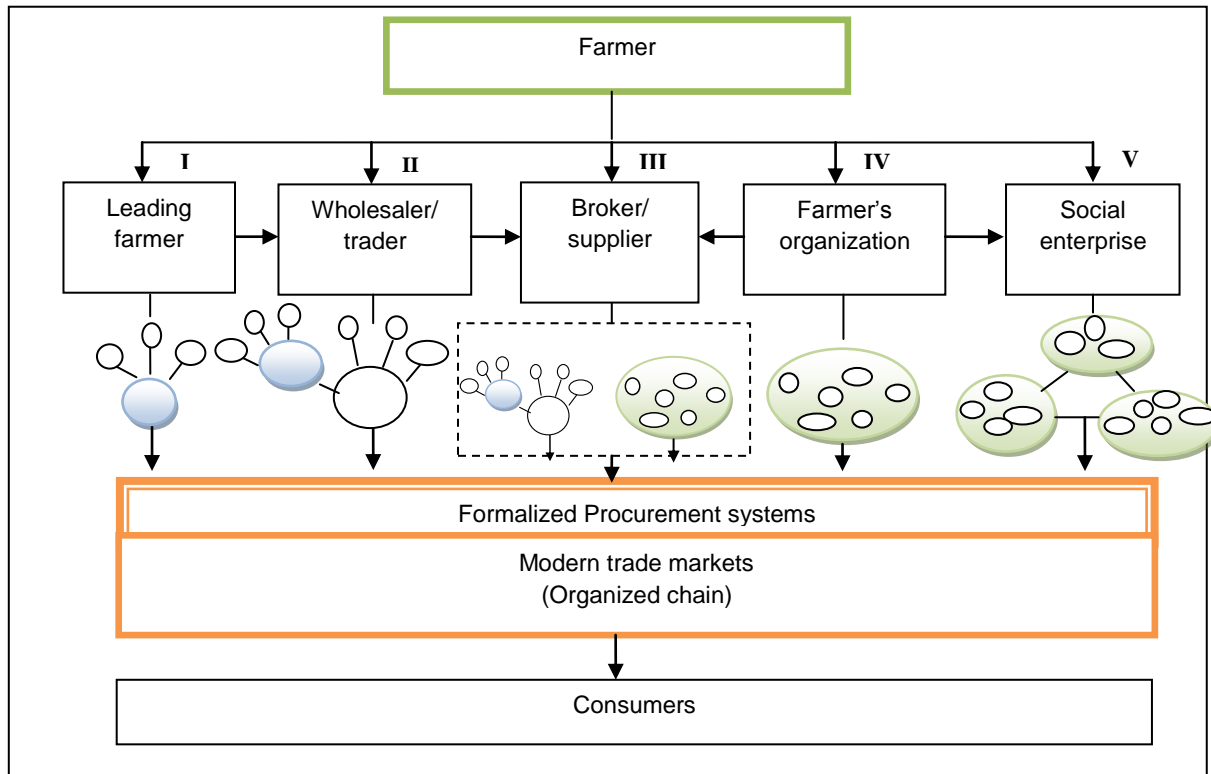
In-depth interviews with participants regarding the possible channels of small-scale farmers' participation in modern supply chains indicated that there are five potential channels; selling through lead farmers (high potential farmers/agribusiness farmers), using wholesalers/traders, using

brokers/suppliers, farmer associations/groups or social enterprises. However, the following section discusses the modern trade in forms of small scale farmer participation in the modern trade chains.

Small-scale farmer participation in the modern trade chains

This study found five channels of small-scale farmer participation in the modern trade as shown in Figure 1.

Figure 1: The channel of small-scale producer's participation in the modern trade chains



Chain V: Farmer => Social enterprise => Modern trade store or DC

There are farmers that participate in a group or farmers from the association in previous chain (V) to sell their produce to a social enterprise such as the Royal Project (pesticide-safe fruits and vegetables supplier) and Green Net (organic rice producer), who supply modern trade markets. These farmers are almost similar to the previous chain, but the farmer's association does not work individually and directly with modern trade markets. In this case, due to the lack of managerial and business management skills of farmer's associations, the farmer's associations form a group under the social enterprise organization in order to join in their production, grading, packaging, and marketing.

The study found that social enterprise helped small-scale farmers to improve their benefits in terms of profitability, stability as well as sustainability in the long-run participation. The collaboration between farmer's associations and social enterprise are more economies of scale. The farmers have higher negotiation power due to professional business management skills of social enterprise. Moreover, most social enterprises work with international organizations (for example fair trade organization) in order to join in the international and global trade systems. This cooperation helps small-scale farmers get a better price as well as increase their market opportunity.

Regarding five difference chains as mentioned previously, the study also provides a rough indication of which of these chains are relatively most crucial (largest proportion of small-scale farmers), and which ones are becoming more or less crucial over time as below.

In addition, regarding the information from interviews and group discussions with modern trade chains' representatives, currently, social enterprise has become more salient and increased its market share in organic or pesticide-safe products markets. As a result, the social enterprise has a strong supply chain management system to assure the quality of products throughout the supply chain before distributing the produce to the markets and finally to consumers. Another reason is the increasing number of organic and pesticide-safe products market share in modern trade markets. However, broker/supplier chain is still prominent in the products market.

The following table presents the advantages and five supply chains as perceived by modern trade markets in Thailand (which is based on interviews and group discussions).

Table 3: The modern trade advantage of five supply chains

Characteristics of supply channel required by modern trade		Supply channel				
		Through leading farmer	Through wholesaler/trader	Through brokers/suppliers	Through farmer's organization	Through social enterprise
Capacities	Production					
	- Control of quality and quantity of produce	✓		✓✓	✓	✓✓
	- Financial and farm managerial capacity		✓	✓✓	✓	✓✓
	- Control of farming contract violate			✓✓	✓	✓✓
Incentives	Operation Management					
	- Price plus transaction costs	✓	✓✓	✓	✓✓	✓✓
	- Delivery and logistics	✓	✓✓	✓✓	✓	✓✓
	- Reliable supply		✓✓	✓✓	✓	✓✓
	- Tractability	✓		✓		✓✓
	- Managerial cost		✓	✓		✓✓
	Business Cooperation					
	- Control of business agreements and conditions	✓		✓✓	✓	✓✓
	- Terms and conditions negotiation	✓	✓✓	✓✓	✓	✓
	- Control of farmer remuneration				✓✓	✓✓
	- Corporate social responsibility				✓✓	✓✓
- Sustainable for long-run cooperation and supports			✓✓		✓✓	

Source: By Authors

Advantages and challenges associated with the modern trade chains

The traditional market is highly uncertain, farmers are never sure if they will find a buyer of their products, and what price they will get. Whilst markets in modern trade chains are highly certain; the farmers can be confident in participating if their produces are sold. Even though the production for most modern trade chains nowadays does not use formal contract or agreement with small-scale farmers, the small-scale farmers can still be confident to participate in and keep working with their productivity and quality adjustment until it meets the standards. Most modern trade chains provide some supports such as information about products demanded, technology and farming management skills training to help farmers develop their producing and marketing systems. Thus, modern trade chains allow farmers to enhance the planning of their production and marketing activities; for example, dates of planting, harvesting, delivering, and expected cash flow. The study also found differences in principal characteristics of small-scale farmers' participation in the different market chains which affected the level of farmer's advantages.

Prices in the modern trade chains are characterized for being more stable permitting farmers to forecast expected returns, which helps them in their planning activities. Additionally, prices in modern

trade chains are usually higher than average prices paid in the traditional market (depending on grades and standards) which results in better profit margins for farmers participating in the modern trade chains.⁴ Prices in the traditional markets may be higher during a short season in a year, motivating contracted farmers to 'side-selling' their produce to this market instead of delivering to the modern trade chain as set in contracts.

Conclusions

In this paper, we observed the general overview of the retail food sector's transformation and the challenges faced by small-scale farmers in Thailand. In addition, social enterprises and their pivotal roles in integrating small-scale farmers into modern trade chains, in Thailand, are also explored. It can be concluded that though the majority of agri-food is channelled through traditional markets, modern trade chains are expected to replace them and will continue growing because of the influence exerted by the local and international retail chains in the region. As a result from these changes in the agri-food system, modern retail businesses have accelerated their expansion scheme to open more branches and new (mini) formats to try to gain a larger market shares. Modern trade chains are offering new market opportunities to farmers.

Moreover, six main channels for small-scale farmers to use to gain participation in modern trade chains in Thailand were identified; directly sell to markets, selling through lead farmers, wholesalers/traders, brokers/suppliers, farmers associations and through social enterprises. Currently, the social enterprise chain has increased its market share and is pivotal in the organic and pesticide-safe product market. Furthermore, more small-scale farmers participate in the modern trade through participation with social enterprises than with any other modern trade chain. This study also found that social enterprise schemes have several significant roles in increasing the profitability, the stability and the sustainability of small-scale farmers' production and participation in the modern supply chains.

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ANALYSIS OF THE DYNAMIC RELATION BETWEEN LOGISTICS DEVELOPMENT AND ECONOMIC GROWTH IN INDONESIA

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ABSTRACT

Purpose: This paper investigates the relationship between logistics development and economic growth in Indonesia from the data of traffic volume and GDP growth rate from 1988 to 2010.

Design/methodology/approach: The analysis of the dynamic relation will be performed by linear and logistic regression. Literature reviews have been conducted to find the most applicable statistical model. Survey data was collected, whereby data of cargo volume that travels through sea, air and rail is used as the logistics index, while GDP is used for the economic growth index.

Findings: The outcome of the study shows that development of logistics plays an important role in supporting and sustaining economic growth. The linear equation model presents a good trend, while the logistic econometric model, using the upperbound value of Indonesian GDP in 2015, shows an even a better relationship.

Research Impact: The logistic regression model is quite useful in analyzing Indonesia's logistics contribution. Even though the model is developed in the context of Indonesia, the overall statistical analysis is generic and can be generalized to other developing economies.

Originality/Value: Analyzing relationship of logistics infrastructure and economic growth that has been done in previous research in specific geographical region using various regression analysis of other statistical method can perhaps be built for understanding Indonesia's economic situation. This paper will hopefully present a strong and interesting angle of the necessity to keep the stability of Indonesian economic growth rate and be in pursuit of continuously improving the logistics infrastructure.

Keywords: Logistics, GDP, Economic Growth, Regression Analysis

Introduction

Logistics is playing an important part in a country's economy, where rapidly developing economy would intuitively support the logistics development. With this linkage, logistics would grow accordingly with the economic development, and reversibly the economic development would influence the logistics industry. Until 2012 Indonesian economy has grown in an average of 5%¹ per year since post monetary crisis in 1998, and has reached its peak growth rate of 6.5% in 2012. The latest GDP data shows that Indonesian GDP reached 1,124 billion USD in 2011, with the current forecast, it can reach GDP value of 1,542 billion in 2015². With this the current trend, the economy will keep growing for the subsequent years. An inquiry of whether logistics can meet the demand of the economic development is an issue worth investigating.

To support the Indonesian economy, logistics, as a growing service industry must improve its capacity and move away from the use of its colonial infrastructure. As a motivation, there exists a necessity to study the relation between Indonesian logistics and its the macroeconomic indicator. Then, in accordance to their relationship and rate of change, policies and action plan can be prepared reach synchronization point between logistics development and the currently rapidly growing economy. The

¹Annual percentage growth rate of GDP at market prices based on constant local currency, World Bank, available at: <http://data.worldbank.org/indicator/>. Actual growth rate 4.961% using annual GDP data from 1999 to 2011, growth rates of real GDP calculated in US dollars at constant prices.

²GDP purchasing power parity (PPP), a GDP value converted to international dollars using purchasing power parity rates. World Economic Outlook, April 2012.

findings would be useful to estimate how close is the relationship, in order to finally get something useful as a tool to plan the long-term development of Indonesian national economy. The research will hopefully present to a strong and interesting angle of the necessity to keep the stability of the regional economy in growth rate and be in pursuit of continuously improving the trade infrastructure by means of supporting the Indonesian logistics industry.

Literature Review

Several researches has been attempted to present the linkages between logistics and economic growth, as follows:

1. Liu (2010) has done research on the relationship between the Logistics Industry Development and Economic Growth of China using the grey analysis method, using GDP as dependent variable, and several logistics industry indicator, namely: logistics industry added value, total employment of logistics industry, new fixed assets investment, freight volume, freight turnover as independent variable.
2. Shao and Zheng (2011) constructed an econometrical model of the relationship between economic growth and logistics industry in Jilin province using the logistic curve model. The research concluded that the logistics industry contributes greatly to the regional economic growth by showing different trend in different stages, spotting potential saturation point, and identifying the elastic coefficient value.
3. Huang et al. (2006) performed an analysis of the relationship between Logistics Development and GDP Growth in China. Their research uses the traffic turnover volume as the index of logistics scale and GDP as the economic growth index. Their research uses time series data of both indexes, of which the correlation will be tested using statistical regression method which then the result be used for Granger causality test.
4. Shuai and Sun (2009) proposed a correlation relationship between logistics industry and national economy development using stochastic variable model, using GDP as the economic indicator and volume of freight and logistics cost as the logistics industry indicator.
5. Li (2010) carried out empirical research on effects of modern logistics the six provinces in Central China. The research used GDP as an explained variable and freight turnover as explanatory variable, of which both will then used to build a simple bivariate regression model.
6. Xie and Luo (2010) performed a similar research as Huang et al. (2006) focusing on Hunan Province in China using cointegration test and causality tests. It uses GDP as the most common economic indicator with freight volume and added value of Hunan's tertiary industry as the research indexes. The research was also extended by means of performing stability analysis using cumulative sum test and Hansen test.
7. Chen (2011) did a similar research as Shao et al. (2011) by adopting logistic growth curve model focusing on Jiangsu Province in China, and found that the logistics industry is closely related with the growth of national economy.
8. Gopal (2012) has presented his result by comparing graphical similarities between nominal GDP growth and external trade growth trends. This research is the trigger of the Author's curiosity and motivation to try to connect between the two topics.

On one hand there already exists a research on mapping the similarities of logistics growth and GDP growth; on the other hand there already exists a research on relationship between logistics infrastructure and economic growth in a region. Gopal (2012) has given an idea that there is quite a high interest of readership to make a case on developing logistics infrastructure (ports, roads, trade facilitation, etc.). While Huang et al. (2006), Chen (2011), and Liu (2010) has given an idea that a mathematical and/or economic model can be built, the model that has been built for analyzing relationship of logistics infrastructure and economic growth in China or in Chinese provinces can perhaps be built for analyzing Indonesia.

Data Selection and Method

Selection of a Representative Index

The challenge of this study is to collect the data and select representative index. With regards to the logistics index, in the beginning, it is practically difficult to get an index that can reflect the logistics volume or scale because of the broad concept of logistics. The aspect of logistics of physical items covers the field of material handling, inventory, transportation, warehousing. It perhaps can be seen that the intersecting point of all the aspect is the cargo or the goods itself. Therefore in this research, after careful consideration, Author will use selected the traffic or cargo volume as the logistics index.

GDP is used as the economic indicator index, as it is a well-accepted indicator of the national economic development. GDP is the value of all goods and services produced within a country. The GDP time series annual data has been adjusted using purchasing power parity (PPP) calculation taking into account relative costs and inflation, rather than using nominal GDP of which it uses government official exchange rates of the given year which may distort the real differences in income.

Data Selection

The original data for this research are taken from Indonesian Bureau of Statistics. Indonesian GDP is well recorded since 1967, while the logistics volume data of sea, rail, and air are recorded later, from 1988, 1987, 2003, respectively. Due to the limitation of the data available from the data collection source, there will be two types of analysis in this paper. First, the research will combine the sea and rail logistics volume starting from 1988 to 2010, and then will combine all the three logistics medium of sea, rail, and air starting from the latest available data from 2003.

Empirical Data Analysis

Linear Regression

Using the data from sea and rail logistics volume starting from 1988 to 2010 taken from the Indonesian Statistics Bureau, this paper selects GDP as dependent variable at the y axis, and the total tonnage of cargo volume as the independent variable at the x axis. The numbers used for linear regression analysis is displayed in Table 1 and scatter plot graph is displayed in Figure 1.

Table 1. Processed data of Indonesian GDP (PPP) and Logistics Volume (sea and rail)
Source: Indonesian Central Bank and Indonesian Statistics Bureau

Year	GDP (millions of \$)	Total Cargo (000 tons)
1988	208804	230734
1989	236347	246736
1990	267393	305474
1991	301163	332187
1992	329710	380508
1993	361380	404986
1994	396541	455557
1995	439836	535985
1996	481836	527455
1997	514207	518241
1998	452984	432249
1999	463262	438120
2000	496572	471365
2001	526332	511463
2002	558946	542367
2003	598002	532053
2004	645745	524317
2005	705159	541333
2006	767949	482889
2007	840352	659355
2008	910589	623695
2009	962871	794900
2010	1034307	721138

From Figure 1, although not perfectly linear in trend, we can see that y and x have a good positive correlation, which can construct a linear equation model for regression analysis:

$$\hat{y} = a + bx \quad (1)$$

After processing the data using statistical software, it yields the equation (2) below:

$$\hat{y} = -215184.69 + 1.556x \quad (2)$$

Where $R^2 = .841$, adjusted $R^2 = .833$, the goodness of fit is pretty very high. Whereby x 's t-test is 10.532, which is acceptable up to 0.009 level of significance; and F-test result is 110.91. Both the inferential statistics using t-test and F-test, result shows that the regression has a significant relationship.

From an economic sense, with a positive slope of 1.556, shows that each unit increase in cargo volume will lead to 1.556 units of the GDP growth. Statistical results also suggest, with the total sum of squares of $R^2 = .833$ is the sample regression line, of which 16.7% is not explained, so the sample regression line of the goodness of fit of sample points is quite high. Economic growth and development of the logistics industry is positively related, and the logistics industry plays a part in boosting economic growth.

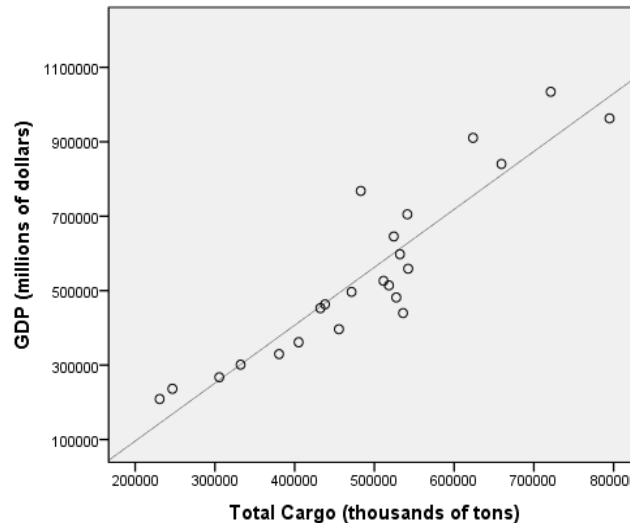


Figure 1. Scatter Graph between GDP and Logistics Volume with the estimated regression line (Data Source: Indonesian Statistics Bureau)

With the same method, using the data from air, sea and rail logistics volume starting from 2003 to 2010, it yields the equation (3) below:

$$\hat{y} = 82314.52 + 1.188x \quad (3)$$

The $R^2 = .697$, adjusted $R^2 = .647$, while variable x 's t-test is 3.717, which is acceptable up to 0.01 level of significance; and $F = 13.812$, which is quite conclusive though barely significant up to 0.01. From the statistical numbers of the test, the linear equation represents a trend, though perhaps due to limited data of only 7 samples, the result of regression equation (3) is less conclusive than equation (2).

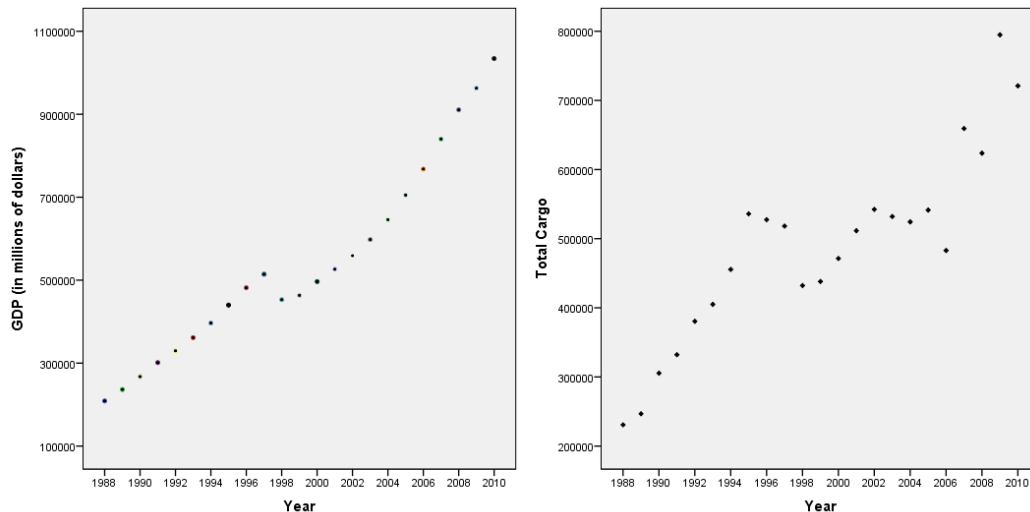


Figure 2. Scatter Graph between GDP (left) and Logistics Volume (right) annual growth
(Source: Indonesian Statistics Bureau)

Considering the lack of availability of the air cargo volume data (of only seven samples of data available), and the very low contribution of air cargo towards the overall logistics volume (average overall contribution of air cargo is 0.14%), further data analysis using logistics regression will use sea and rail logistics volume, of which it has data available since 1988.

Logistic Econometrical Model

From the GDP growth trend in Figure 2 and the relationship diagram of sea and rail cargo volume and GDP trend from 1998 to 2010 displayed in Figure 1, we can see the significant positive correlativity between cargo volume and GDP, with a potential of non-linear trend that may show an S-curve-like trend. Therefore the statistical description between the cargo volume and GDP relationship is possibly more presentable to be presented in Logistic Model. Based on the characteristic and with reference to previous research (Chen, 2011), we can try to use Logistics curve to fit the relationship. The proposed theoretical equation is presented as follows:

$$y = \frac{1}{\frac{1}{u} + ab^x} \quad (4)$$

The interesting characteristic of a Logistic curve is that the rise is primarily slow and then gradually accelerating, when it is accelerated to some point, the growth rate is gradually stagnant then finally reached a horizontal line (Shao, 2011). To use easily the parameter estimation method of the linear model, the equation (4) is transformed into equations as below:

$$\frac{1}{y} = \frac{1}{u} + ab^x \quad (5)$$

$$\frac{1}{y} - \frac{1}{u} = ab^x \quad (6)$$

$$\ln\left(\frac{1}{y} - \frac{1}{u}\right) = \ln a + x \ln b \quad (7)$$

We then transform

$y' = \ln\left(\frac{1}{y} - \frac{1}{u}\right)$ and $\ln a = a'$ and $\ln b = b'$, while u is the upperbound value where we will use Indonesia's forecasted GDP in 2015 of 1,542 billion as the constant upperbound value. When we transform equation (7), of we then have a linear equation of:

$$y' = a' + b'x \quad (8)$$

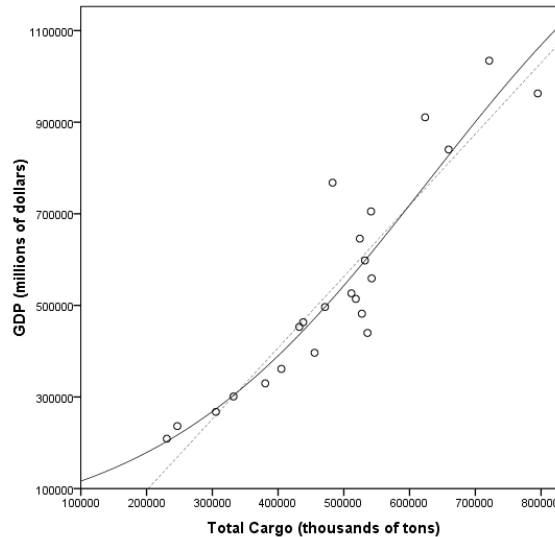


Figure 3. Scatter Graph between GDP and Logistics Volume with the estimated regression line (Solid line: Logistic regression; Dotted line: linear regression)

After running the number using statistical software, it yields an equation (10), as below:

$$y = \frac{1}{\frac{1}{1,542,300} + (0.000013) \cdot (0.999995)^x} \quad (9)$$

After running the statistical test we obtain, $R^2 = .874$, adjusted $R^2 = .868$, showing the goodness of fit is pretty very high. x and y variable t-test is 2545958.41 and 5.0332, respectively. Both t-test numbers are acceptable up to 0.0001 level of significance. While $F = 145.7793$, a highly accepted number. On the basis of coefficient of determination R^2 and inferential statistics tests, the logistic regression equation (9) fits very well, even better than the linear equation (2). Comparison of the result between linear and logistic regression is displayed in Figure 3, it can be seen, to some extent that even visually the logistic regression fits better than the linear one.

Conclusion

Based on the quantitative analysis above, it can be seen that there is a strong relationship between logistics development and economic growth. Indonesia sits between very important trade routes, of which it will take the fullest advantage of the important geographic position and seize the opportunities of the rising consumer and producer market potential to develop modern logistics industry.

Many efforts has been proposed and undertaken like creation of domestic economic corridors, national logistics integration plan, and west-east sea corridor pendulum. All those efforts have very high potential to boost traffic of domestic and international goods, and would potentially contribute towards economic growth. Indonesian government has released an Indonesian Logistics Blueprint (Indonesian Cabinet Secretariat, 2012), these plan needs to be executed as scheduled. With support of the statistical data above, there is a risk of capacity saturation of logistics services. Government, with public and private partnership, must unite to develop the logistic infrastructure and foster its logistics industry. These infrastructures does not only cover physical infrastructure of building road, bridges, port, and airports; but also implement fast logistics turnaround with support of Information Technology and educate more logistics talents and supply chain experts.

With the nature of being an archipelago country and albeit sea cargo has played a huge part in logistics services, air cargo will need to be boosted, as it still contribute less than 1% of the overall logistics. While for land cargo, providing support and facilitation in building logistics parks, distribution centers and third party logistics company licences, can potentially contribute towards connecting urban and rural areas with to support industrial competitiveness.

According to the empirical data analysis, we can conclude that the logistics industry contributes greatly to the Indonesian economic growth. The contribution of logistics industry on economic growth shows

different trend in different stages. Currently Indonesian GDP is showing a quite steady growth with strong resilience, despite the global economic slowdown which started in 2008. When relating it to logistics growth, it can be seen that there is a potential of a stagnant growth if the logistics infrastructure is not built. The tendency can be seen when the relationship of GDP and logistics volume is represented in the logistic regression. The future the development of logistics industry may risk being in a stagnant or even negative growth phase if the result of the economic growth does not translate to investments in logistics physical and supporting infrastructure.

With the mathematical model presented in the analysis, contribution of the logistics development towards the proportion of economic growth can offer quite a useful insight. However, it needs to be noted that, cargo volume, which was used as the logistics index for this paper is only one of many available potential indicator. Usage of other data such as, logistics industry added value, total employment of logistics industry, new fixed assets investment, freight turnover (in tons times kilometres) should also be taken into account, even though collecting the data for these indicators may be quite challenging, in comparison to collecting the cargo volume data. In addition, cargo volume, presented in the indicator does not cover the road cargo volume which may potentially play a quite significant part in domestic and international land border trade.

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A COMPARATIVE STUDY ON SCM PRACTICES: THAI SMALL, MEDIUM AND LARGE ENTERPRISES

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ABSTRACT

Purpose: The purpose of this paper is to present the result of a study that investigates current supply chain management (SCM) practices and performances benchmarking among Thai Small, Medium and Large Enterprises.

Design/methodology/approach: Survey data was collected from 166 companies with 50 or fewer employees, 145 companies with 51 – 200 employees, and 98 companies with more than 200 employees.

Findings: Research on SCM practices in Thai SMEs was rare indeed. The outcome of study shows that overall perception of SCM between Thai SMEs and LEs has little difference. Both of them concentrated on relationship management as the first priority. Whilst LEs focused on manufacturing flow as the next, SMEs preferred product development and commercialisation.

Research Impact: In order to investigate the effectiveness of SCM implementation between SMEs and LEs; literature reviews and semi-structure interviews have been conducted with antecedents and consequences to SCM. Then SCM practices model is conceptualised including five-dimensional constructs. Although the model is developed in the context of Thai SMEs, the overall framework is generic and can be generalized to other developing countries.

Originality/Value: The result from research offers a number of managerial implications to Thai SMEs, e.g. (1) better comprehension of perception in SCM practices and its antecedents and consequence between SMEs and LEs, (2) an appropriate framework to implement SCM practices in Thai SMEs, which may improve their competitive performance that would directly result in sustainable growth of Thai economy.

Keywords: Supply chain management, SMEs, Thailand

Paper Type: Research paper

Introduction

The supply chain management contains a concept of direct extended coordination of operations across the entire supply process (Skjott-Larsen et al., 2007, Christopher, 2011, Harrison and Hoek, 2011, Sweeney, 2009). It is acclaimed as source of competitive advantage (Mentzer, 2004). The definition of supply chain management used in this paper was developed by members of the Global Supply Chain Forum (GSCF) as: “*Supply chain management is the integration of key business processes from end user through original suppliers that provides products, services and information that add value for customers and other stakeholders (Lambert et al., 1998)*”. The supply chain encompasses all organisations and activities associated with the flow and transformation of products from the raw materials, through various stages to the consumer, along with this is effective information flows both up and down in the supply chain (Harrison and Hoek, 2011). SCM is the integration and management of supply chain organisations and activities, which have the ultimate goal to enhance customer value and satisfaction, and profitability for the supply chain member organisations (Mentzer et al., 2001).

Small and Medium Enterprises (SMEs) are core business format of the country (Stokes and Wilson, 2006, Tan et al., 2006). SMEs create jobs, contribute to Thailand economic growth, and enhance country's rural development (Thailand Business News, 2010, Office of Small and Medium Enterprises Promotion, 2009). SMEs have realised that good strategies are substantial to survive under current complex and competitive business environment with higher demanding customers to require better, cheaper and faster products and services (Thakkar et al., 2008).

Large Enterprises (LEs) have recognised that competition has been rapidly shifted from a firm versus firm perspective to a supply chain versus supply chain perspective (Christopher, 2011,(Koh et al., 2007). Supply Chain Management (SCM) has become a sweet spot for organisations (Handfield and Nichols, 2002), which look for sustainable growth and profit. The cross-functional integration of major business processes both among the members of supply chain and their internal processes are keys to achieve successful supply chain management. Then supply chain management is aimed at performance improvement and relationship management. (Lambert, 2008)

Therefore, the relationship of supply chain management practices and the firm's performance of SMEs is an issue in the practitioners' interest. Tan et.al.(2006) argued that supply chain management can help SMEs to gain the most benefits from collaboration with others in order to exchange their expertise and become strategic alliance.

The purpose of this paper is therefore to benchmarking level of supply chain management practices and performance of Thai SMEs with LEs by conducting survey research. Firstly, through literature reviews antecedents and consequences of SCM factors such as SCM drivers, facilitators, impediments and firm's performance are identified. Then the SCM practices, identified by the Global Supply Chain Forum, are selected to construct a SCM practices model by developing the relationships between the selected SCM practices and the SCM factors and the firms' performance. Secondly, semi-structured interviews are conducted with 20 Thai practitioners in Thailand to study the insight of success and hinder factors of supply chain management implementation in the large enterprises. The result from interview was used to modify survey questionnaire before send out. Conclusion from survey was analysed by using analysis of variance (ANOVA) to test for statistical difference in managerial perception among different firm size.

Literature Review

The literature on the reasons why SMEs implement supply chain management may be classified into three broad categories: SCM drivers, SCM impediments and SCM facilitators that are antecedents (Mentzer et al., 2001). As SCM may be implemented in different practices and have different impacts on firms' performance, which is consequences (Mentzer et al., 2001), this section will also review the literature related to SCM practices and firms' performance. .

Supply chain management drivers, which are the strategic factors that help to determine an appropriate level of supply chain management practices. Supply chain management drivers are omitted by daily supply chain operation while they are the critical factors to make change to a firm (Ayers, 2006) 'Supply chain management driver' is defined as the set of driving forces that will affect their ability to implement supply chain management in the firm (Fawcett et al., 2009). Ayer (2006) argues that innovation is the first force from external supply chain network to drive the whole supply chain network members to move forward to improve supply chain ability. The next three drivers – extended product design, globalisation and flexibility imperative – form the direction, scope and format of products and services, and supply chain configuration to deliver them. Process-centred management is designed for the whole network process in order to create collaboration among supply network members. Collaboration is the final driver that will loop back to create innovation to the supply chain. These drivers can be both internal and external of single company. Therefore we classify supply chain drivers into three groups based on the individual driver and its effect on the industry and the company.

Research Question 1: Does company's perception of SCM drivers is positively associated with firm size and to what extent these drivers have an impact to the company.

Supply chain management impediments that can potentially cause supply chain management practices to fail. Supply chain management impediments are defined as obstacles that prevent supply chain management practices to succeed. The following SCM impediments or inhibitors have been identified in the literature, e.g. employee resistance to change, ineffective information technology systems, lack of trust and sharing between supply chain network members and improper resources allocation, affect negatively supply chain management performance (Mentzer et al., 2000, Mentzer et al., 2001, Bayraktar et al., 2009, Goh and Pinaikul, 1998, Fawcett et al., 2008, Fawcett et al., 2009, Tan et al., 2006). According to their relationship with the firm, we classify supply chain inhibitors into two categories; internal firm supply chain impediments and external firm supply chain impediments.

Internal impediments are more related to operational efficiency or poor utilisation of organisation while external impediments are more related to collaboration among network members such as communication infrastructures (Goh, 2002). By grouping these supply chain obstacles into two categories it will give us a clearer understanding how to manage and eliminate them.

Research question 2: Does company's perception of SCM impediments is associated with firm size and how these obstacles hinder firm to success.

Facilitators can be ideas, tools, actors and organisations that usually enhance supply chain management implementation. For example, Mentzer et al. (2000) use term "enablers" as the same meaning of facilitators, which include people, organisation and technology that move supply chain management forward. However, as some factors such as organisation environment may hinder implementing supply chain management practices, we therefore extend its definition as follows: supply chain management facilitators are the structural and infrastructural factors that may affect the implementation of supply chain management practices. Structural facilitators relate to such tangibles as information system and technology, process technology and system. On the other hand, facilitators that enhance the utilisation of the structural facilitators and to control those facilitators are classified as infrastructural facilitators. These infrastructural facilitators are intangibles for instance, management, corporate culture, and organisation design.

Research Question 3: Does company's perception of SCM facilitators is positively associated with firm size and how these enablers help firm to implement SCM successfully.

Supply chain management practices, which is a set of effective activities across the supply chain network. Cooper et al., (1997) explains framework of SCM that consists of business processes, management components and the structure of supply chain. Process approach is the focus of every activity to meet customer's requirements. Supply chain management practice, which embraces process approach, is integrating process across functions to produce a specific output for a particular customer or market. The Global Supply Chain Forum (GSCF) developed a process-based supply chain management framework consisting of:

- Customer relationship management
- Supplier relationship management
- Customer services management
- Demand management
- Order fulfilment
- Manufacturing flow management
- Product development and Commercialisation
- Returns management (Cooper et al., 1997)

We proposed in this research to study the three main processes of a firm according to GSCF process framework. From semi-structured interview, the three selected processes are recognised as the significant processes to the firm's proliferation. The processes are:

1. Network relationship management, which include customer relationship management and supplier relationship management,
2. Manufacturing flow management and
3. Product development and commercialisation.

With the proposed methodology, the rest of processes can be done similarly as this research in the future. In each process, this study will examine the supply chain flows including material flow, information flow and resources flow (Mangan et al., 2008). The material flow encompasses the movement of physical products and services from a supplier to a customer and its return. The information flow embraces orders transmitting and the products delivery status. The resource flow consists of financial such as payments, credit terms, consignment and title ownership and non-financial such as people and equipment, which improve supply chain effectiveness.

Research question 4: Does level of SCM practices is positively associated with firm size and what are the major area of interest for SCM practices of the firm.

Firm's performance can be identified as the efficiency of performance measure according to the whole supply chain network members which is very difficult and, may be, not in existence (Bhanomyong and Supatn, 2011). Then internal supply chain performance, which takes into account of efficiency and effectiveness of internal firm's processes in producing its products and services such as cost, time and reliability, will be measured. Li et al., (2006) classifies organisational performance into short-term and long-term objectives. In short-term objectives of SCM are mostly to increase productivity and reduce inventory and cycle time, while long-term objectives are to increase market share and profit. In firm's financial aspect, increase market share and profit reflects asset utilisation of a firm.

For this study, firm's performances will be organised into four categories as:

- Cost dimension
- Time dimension
- Reliability dimension
- Asset utilisation dimension

Research Question 5: Are there any association between firm size and firm's performances and which is the main result of SCM practices.

Based on the above literature review and result from semi-structured interviews, we conceptualize a supply chain management practice model consisting of five dimensions: supply chain management drivers, supply chain management impediments, supply chain management facilitators, supply chain management practices and firm's performance with constructs, as shown in figure 1.

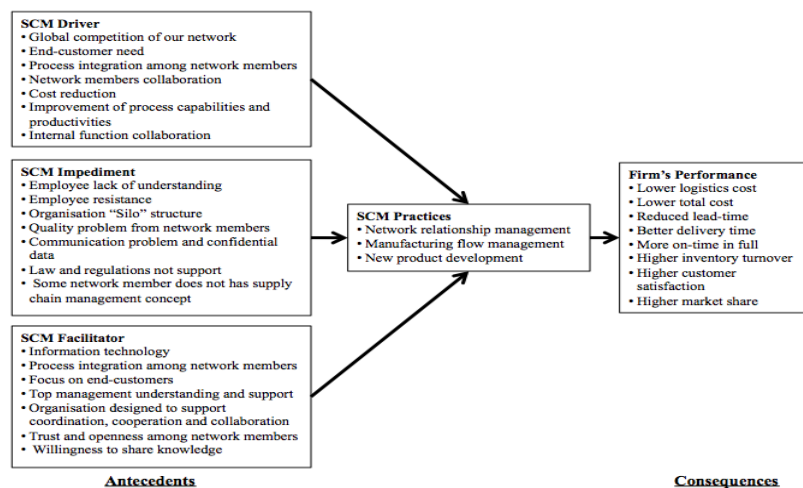


Figure 1 : A supply Chain Management practices model with constructs

Research Methodology

To achieve the research objectives, i.e. developing the supply chain management practices suitable for SMEs model, the following research methods have been used. Firstly, literature reviews both antecedents and consequences constructs that related to supply chain management practices is to be examined. Then, an empirical study of SCM implementation by using semi-structured interview has been conducted. The semi-structured interview has been widely adopted with deductive approach. It is considered as a favoured strategy in business and management research (Saunders et al., 2007). An interview guide is prepared in order to confirm that information obtained from the experts is identical. The interview examined to both SMEs and large firm to confirm that SMEs have a particular understanding of SCM similar to large firm. Resulting from interview, mapping the practices and literatures has been framed as SCM practices for Thai SMEs with construct as in figure 1.

A questionnaire of a study on Supply Chain Management Best Practices Model for Thai Small and Medium Enterprises was sent out via e-mail. The mailing list consisted of 3,700 firms who are members of The Federation of Thai Industries (FTI). We received 129 respondent answered within one month. The second and third reminding mails were sent out month later. After screening

incomplete data out of the respondents, total 409 completed surveys for a response rate of 11.1 per cent was valid. According to definition of SMEs from The Federation of Thai Industries (FTI), the size for small business (S) is typically 50 or fewer employees, the size for medium business (M) is 51 to 200 employees and more than 200 employees will be classified as large business (L). Therefore, the respondents were grouped as 166 small, 145 medium and 98 large firms. Analysis of variance (ANOVA) was used to test statistical differences in perception.

Findings and Discussion

Perceptions of SCM drivers

Questionnaire was sent out to respondents with five-point scale (1 = Unimportant, 5 = Very Important) for SCM Drivers, SCM Impediments and SCM facilitators. Table 1 shows perceptions of SCM drivers according to three firm sizes. Overall cost reduction is major driver to implement SCM then improvement of process capabilities and productivities. SCM driver composite index is calculated by averaging together individual drivers into new composited variable. We also conducted reliability analysis to determine whether from statistical point of view these individual drivers should be averaged together. SCM driver composite index alpha is 0.794 reveals high reliability value of the average SCM drivers. Mean of each firm sizes and grand mean are illustrated in column one to four respectively. Column five to eight show the exact significant value of t (p – value), and we are interested in whether these value is less than or greater than 0.05. Overall column is represent p value of difference between mean of these three groups while each pair of p value can be found in the following column. Then, the research question that company's perception of SCM drivers is positively associated with firm size is concluded by the statistically significant difference for SCM drivers composite index ($p > 0.05$) which mean that there are no significant difference between the means of three group. However, when we paired the difference of the means of two groups, managers from large firms perceived important of SCM drivers to implement supply chain to their organisation than medium firms manager. Interestingly, large firms perceived process improvement slightly more important than cost reduction while small and medium firms rank cost reduction more important than process improvement. Process improvement is statistically significant less sensitive driver to both small and medium firms when compare with large firm. For small firm, global competition is also statistically significant less sensitive when compare with large enterprises. This can be explained that small firm may only deal with local competition while LEs competed in wider geographical area.

	Mean Evaluation				Significant (p – value)			
	Small	Medium	Large	Total	Overall	S - M	S - L	M - L
SCM driver composite index ($\alpha = 0.794$)	4.15	4.13	4.29	4.18	0.051	0.731	0.055	0.031
•Global competition of our network	3.85	3.91	4.16	3.95	0.049	0.621	0.023	0.075
•End-customer need	4.31	4.24	4.43	4.31	0.242	0.489	0.255	0.088
•Process integration among network members	4.02	3.94	4.07	4.00	0.505	0.447	0.621	0.253
•Network members collaboration	3.89	3.89	4.00	3.92	0.561	0.984	0.323	0.327
•Cost reduction	4.47	4.38	4.55	4.46	0.237	0.310	0.417	0.095
•Improvement of process capabilities and productivities	4.34	4.33	4.57	4.39	0.010	0.887	0.019	0.016
•Internal function collaboration	4.17	4.20	4.26	4.20	0.728	0.790	0.451	0.615

Table 1 : Perceptions of SCM drivers

Perceptions of SCM impediments

Respondents were asked about important of SCM Impediments as similar five-points scale. Table 2 shows perceptions of seven SCM impediments construct. Embracing, employee lack of understanding, quality problem from network members and communication problem are the main barriers to implement supply chain management. From SCM impediments composite index calculation, the research question that company's perception of SCM impediments is positively associated with firm size is rejected by the statistically significant difference ($p < 0.05$). Firm size is not related to an important of SCM obstacles. Statistically significant differences are found that managers from medium firms ranked more important of communication problem and confidential data than respondents from small and large firms. This can be interpreted as small firm usually run by single owner or family member, which tends to be less communication problem. When firm grows to medium size the complexity leads to communication problem. While large firm knows this problem and solves it with established good communication channel then the problem becomes less.

	Mean Evaluation				Significant (p – value)			
	Small	Medium	Large	Total	Overall	S - M	S - L	M - L
SCM Impediment Composite Index ($\alpha = 0.818$)	3.84	3.89	3.82	3.86	0.649	0.507	0.772	0.391
•Employee lack of understanding	4.15	4.12	4.17	4.14	0.853	0.719	0.826	0.598
•Employee resistance	3.67	3.72	3.67	3.69	0.905	0.681	0.971	0.747
•Organisation “Silo” structure	3.67	3.78	3.63	3.70	0.458	0.354	0.740	0.259
•Quality problem from network members	4.05	4.06	4.07	4.06	0.980	0.892	0.839	0.936
•Communication problem and confidential data	3.85	4.10	3.82	3.93	0.020	0.017	0.776	0.019
•Law and regulations not support	3.70	3.68	3.58	3.67	0.651	0.889	0.363	0.444
•Some network member does not has supply chain management concept	3.81	3.79	3.79	3.80	0.970	0.848	0.815	0.951

Table 2 : Perceptions of SCM impediments

Perceptions of SCM facilitators

Respondents were also questioned about important of seven constructs of SCM Facilitators as similar five-points scale. Table 3 shows result of SCM facilitators' perception. Top management support, Information technology and organisation designed to support collaboration are rated important respectively. Only small business ranked focus on end-customer higher than organisation design. This can be explained as small firm has simple organisation design and flexibility. In their opinion about facilitator to support supply chain management implementation, they believe that organisation designed is not as important as focusing on end-customer need. The research question that company's perception of SCM facilitators is positively associated with firm size is again not supported by the statistically significant difference for SCM facilitators composite index ($p < 0.05$). Contradiction to SCM facilitators composite index, Information technology is perceived as important to large firm than small and medium firm with statistically significant differences. This shows that large firm supply chain management implementation is heavily relying on information technology. Another factor that shows statistically difference in the means of three groups is top management understanding and support. Large firm perceived important of top management support than small firm. This may be because of large firm has several projects to be implemented then supply chain management implementation will be chosen among other projects. Top management is a key decision maker to allocate budget and resources to support supply chain management.

	Mean Evaluation				Significant (p – value)			
	Small	Medium	Large	Total	Overall	S - M	S - L	M - L
SCM Facilitator Composite Index ($\alpha = 0.831$)	4.10	4.11	4.19	4.13	0.288	0.891	0.201	0.260
•Information technology	4.19	4.18	4.40	4.23	0.040	0.933	0.034	0.032
•Process integration among network members	4.03	3.97	4.20	4.05	0.041	0.515	0.081	0.024
•Focus on end-customers	4.16	4.06	4.04	4.10	0.444	0.293	0.256	0.847
•Top management understanding and support	4.24	4.34	4.52	4.34	0.012	0.273	0.005	0.073
•Organisation designed to support coordination, cooperation and collaboration	4.11	4.11	4.24	4.14	0.301	0.963	0.190	0.188
•Trust and openness among network members	3.98	4.08	3.97	4.01	0.427	0.275	0.903	0.286
•Willingness to share knowledge	3.99	4.03	3.98	4.00	0.884	0.725	0.893	0.663

Table 3 : Perceptions of SCM facilitators

Perceptions of SCM practices

Respondents were inquired level of current SCM practices in their company with five-points scale (1 = Not at all Implement, 5 = Fully Implement). Table 4 shows result of current SCM practices. The questionnaire grouping practices into three major processes as network relationship management, manufacturing flow management, and product development and commercialisation. Each process consists of four questions then total twelve questions were asked. The major finding is that there is no pattern of statistical difference among the three groups ($p < 0.05$) except level of implement of IT coordination among large and medium firm. Large firm has level of implement IT coordination among network partner higher than small and medium firm. This is not surprising large firm usually spend more IT budget in collaboration and coordination with network partner. Then the hypothesis for degree of SCM practices is positively associated with firm size is rejected. Despite of IT coordination in relationship management process, which is strongly implement for all the three groups, small and medium firms (SMEs) also leverage joint inventory management while large firm focuses on the clear vision of SCM. This shows that SMEs focus on day-to-day management rather than long-term vision planning. For manufacturing flow management process, both SMEs and LEs have similar implementation pattern. Customer's feedback as input to design is rated as highly executing in product development and commercialisation process.

	Mean Evaluation				Significant (p – value)			
	Small	Medium	Large	Total	Overall	S - M	S - L	M - L
SCM Practices Composite Index ($\alpha = 0.954$)	3.63	3.54	3.66	3.61	0.439	0.324	0.828	0.285
Network Relationship Management Composite Index ($\alpha = 0.891$)	3.67	3.59	3.72	3.65	0.367	0.379	0.612	0.209
• Joint inventory management	3.71	3.59	3.67	3.66	0.500	0.251	0.758	0.484
• IT Coordination	3.78	3.66	3.90	3.76	0.117	0.248	0.306	0.046
• Long-term relationship enable	3.65	3.58	3.63	3.62	0.792	0.514	0.883	0.671
• Clear vision of SCM	3.54	3.52	3.68	3.57	0.353	0.912	0.226	0.202
Manufacturing Flow Management Composite Index ($\alpha = 0.893$)	3.59	3.48	3.65	3.57	0.287	0.281	0.612	0.153
• JIT / Lean implementation	3.57	3.43	3.57	3.52	0.440	0.256	0.995	0.326
• S&OP implementation	3.58	3.50	3.71	3.58	0.275	0.524	0.302	0.119
• Benchmarking and performance measurement	3.49	3.39	3.57	3.47	0.387	0.384	0.576	0.193
• Quality policy established	3.73	3.61	3.76	3.70	0.386	0.263	0.868	0.256
Product Development and Commercialisation Composite Index ($\alpha = 0.912$)	3.64	3.55	3.59	3.60	0.731	0.426	0.705	0.746
• Material strategy alignment	3.66	3.50	3.58	3.58	0.393	0.170	0.566	0.525
• Customer requirement information sharing	3.61	3.51	3.57	3.56	0.705	0.413	0.783	0.657
• Design for supply chain concept	3.53	3.57	3.51	3.54	0.863	0.707	0.875	0.631
• Customer's feedback as input to design	3.75	3.63	3.70	3.70	0.619	0.325	0.737	0.596

Table 4 : Perceptions of SCM practices

Perceptions of Firm's performance

Finally respondents were self-evaluated level of their performance comparing with their competitors in the past year with five-points scale (1 = Definitely Worse than Competitors, 5 = Definitely Better than Competitors). The results of firm's performance in four areas including cost, time, reliability and assets utilisation are illustrated in table 5. Overall there is no association between firm size and firm's performances according to statistical difference among the three groups ($p < 0.05$). The highest achievement from SCM implementation from respondents was higher customer satisfaction and more on time in full. Better delivery time was rated as the second while both logistics cost and total cost saving were rarely fulfilled.

	Mean Evaluation				Significant (p – value)			
	Small	Medium	Large	Total	Overall	S - M	S - L	M - L
Firm's Performance Composite Index ($\alpha = 0.909$)	3.60	3.53	3.56	3.56	0.624	0.327	0.631	0.701
•Lower logistics cost	3.43	3.41	3.35	3.41	0.732	0.842	0.438	0.560
•Lower total cost	3.44	3.43	3.38	3.42	0.848	0.902	0.575	0.660
•Reduced lead-time	3.58	3.50	3.55	3.55	0.649	0.354	0.753	0.617
•Better delivery time	3.70	3.62	3.69	3.67	0.615	0.351	0.914	0.481
•More on time in full	3.75	3.60	3.72	3.69	0.234	0.112	0.828	0.242
•Higher inventory turnover	3.58	3.48	3.44	3.51	0.357	0.277	0.187	0.732
•Higher customer satisfaction	3.73	3.62	3.73	3.69	0.376	0.238	0.955	0.280
•Higher market share	3.57	3.55	3.60	3.57	0.902	0.833	0.786	0.655

Table 5 : Perceptions of firm's performance

Conclusions and Further Recommendation

This paper presented a comparative study on SCM practices in Thai small, medium and large enterprises. Through a questionnaire survey and ANOVA analysis, it is found that Thai small, medium and large enterprises have mostly similar characteristics in implementing SCM in their firms. The main driver of SCM implementation is cost reduction and the major supporting factor is top management support while the strongest obstacle is employee lack of understanding. The most common area of SCM practice is IT coordination and the main performance gain from SCM implementation is higher customer satisfaction and more on time in full delivery.

Next step of a research, the collected data will be analysed using structural equation modelling (SEM) approach including both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Further research will focus on how Thai SMEs measure their firm's performance and how it relates to SMEs' supply chain management implementation.

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A COST-BASED MODEL FOR CONTAINER FREIGHT INDEX ESTIMATION

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ABSTRACT

Purpose

The road freight index is an indicator for referencing and forecasting the price of freight transportation. This paper develops a cost-based model used for estimating container road freight index in Thailand

Design/methodology/approach

We focus on a macro-level freight index estimation using non-survey method to update the freight index quarterly. To define the freight price structure, forty-three carriers in the eastern region of Thailand are chosen ranging from small to large-sized companies. The developed freight index includes five transport routes between Industrial Estates and Laem Chabang port. The cost-based model is developed considering primarily carriers' fixed costs, running costs, and profit mark-up. The freight index is derived from the freight price using a modified Laspeyres's formulation.

Findings

The results have indicated that the transport distance and the average price per kilometer are negatively non-linear trend. This is similar to the profit mark up in which up to sixty percent of the freight price is quoted. The results have also shown that the proposed freight index follows similar patterns to the Thailand road freight index. The validation on updating freight index compared with the average freight price is 70 percent correctly estimated.

Originality/value

This paper fulfills the information of road freight index for container transport between Industrial Estates and Laem Chabang port.

Keywords: *Road freight index, Container freight price, Cost-base index*

Introduction

Several transport sectors in Thailand have attempted to formulate road freight index. The current freight index is derived from macro-level estimation and mainly used for national policy. We focus on freight index model for a container type of cargo on five specific routes between the Eastern Industrial Estates and Laem Chabang Port. We analyze factors that influence the freight price, which are: fixed cost, vehicle running costs and profit mark-up. The Gross Domestic Product (GDP), fuel price, and minimum wage rate are also used to calibrate the freight model. The objective of this paper is to develop inland container freight index in a cost effective manner with less time-consuming.

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Literature Review

Transportation cost

One of the main difficulties in land transportation companies is to determine and evaluate the actual cost of their services (Baykasoglu and Kaplanoglu, 2008). The critical issue of transport company is to gain a more accurate cost estimation in order to provide the high quality service with reasonable cost to customers (Gupta and Galloway, 2003). The overview of transportation economics and pricing are concerned with four topics; (1) the factors that drive transport costs, (2) the cost structures, (3) carrier pricing strategy, and (4) transportation rates (Bowersox et. al, 2002). In part of cost structure is concerned to the criteria used to allocate cost. Transportation costs are classified into a number of categories; variable costs, joint costs, common costs. Barns and Langworthy (2007) use various sources to estimate commercial truck vehicle operating costs in Minnesota. The study provides a linear model for estimating truck operating costs under different driving conditions. The running cost is increased by 25% under city driving conditions, and 17% on roads with poor quality pavement. Logistics Solution Builders Inc. (<http://www.logisticssolutionbuilders.com>) responds for the accuracy data of operating costs of trucks in Canada and attempts to understand comparative economics for trucking inside Canada's largest trade partner as well as for the significant commercial trucking links between the two countries. Eleven vehicle types in all regions of Canada are included to report the operating costs. Compares with operating cost freight of container in Thailand, the cost proportions are absolutely different. Even though under The regulation of land transport in Thailand by year 2006 under The Department of Land Transport (Thailand) (<http://www.dlt.go.th>) there are two methods which are considered to classify for trucking; characteristic of usability and weight of vehicle. According to characteristic of usability, containerized truck is classified in 2 types semi-trailer and trailer. Litman (1995) examines the running costs of drivers, depreciation, interest rates, fuel, tires, maintenance and repair and overhead on different types of trucks. The Transportation Research Board (1996) calculates the marginal social cost of freight traffic. Marginal social cost are defined to be the increasing full social costs of transport one more unit of freight at a certain time and along a certain segment of road. Vehicle operating cost are the large share of marginal social cost between 78% and 98% of total costs. Trimac Logistics Ltd. (2001) determines the factors of trucking costs for each of the provincial and territorial regions in Canada and developed US base trucker comparisons. They develops the estimation for ten categories semi-trucks plus smaller two-axel delivery trucks by using computer model. The data are used to set up and utilize this model derived from a number of sources including: quotes from suppliers of equipment, tires, and fuel, consulted with experts in the field and reviews of relevant published literatures. Mc Mullen (1987) studies the mostly concerned with determining the presence or absence of scale economies by estimated cost function for the regulated industry. The results are used to make inference about the potential unregulated market structure. Daganzo (2004) explains the motion costs and classified as either handling cost or transportation costs. They are very similar but the main difference being the distances transported and the size of the batches moved together. Handling cost include packaging, transportation costs include loading. Levinson et al. (2005) studies the operating cost for commercial vehicle operators in Minnesota. The commercial vehicles are calculated from the survey responses in the average operating cost per kilometer. There are different methodology and model to estimate the variable costs of operating trucks. Fuel, repair and maintenance, tire, depreciation and labor cost are estimated by the functional gave an average cost of \$0.64 per km. Water (1976) reviews the major approaches to costing the transportation. Determining costs in transportation are often difficult because of (1) the heterogeneous nature of output and (2) indivisibilities in production. He also compares the technique to estimate transportation cost within accounting, engineering and statistical method. Focusing on accounting the advantage is cheapest and most convenient method providing the data existing. In contrast to its shortcoming the historical or recorded cost of assets might not be an accurate guide to reflex the actual opportunity costs. Then that data should be adjusted for updating to estimate freight price.

Freight price and market

Carrier pricing strategies charged to shippers follows one or a combination of two strategies. The combination approached is considered trade-offs between cost of service incurred by the carrier and value of service to the shipper. Cost of service strategy is a build up approach where the carrier establishes a rate based on the cost of providing the service plus a profit margin, and value of service is alternative strategy charged a price based on value as perceived by the shipper (Bowersox et. al, 2002). Elzinga (1994) examines the relevant market for freight transportation of less-than-truckload dimensions. Deregulation had altered significantly the character of this market. From an economic perspective, a market's boundaries are large enough include the products and firms that more

constrained the price of the firm under antitrust. [Clair and Fox \(2004\)](#) develops a value-based transport pricing model for freight carriers to negotiate their customers with some specific discounts according to a competitive level and the customer relationship. [Smith et al. \(2005\)](#) demonstrates the development, test and application of statistical model to study actual net of discounts for expedited freight services the model revealed the structure of net tariffs. This research aims to develop the freight index for a container type of cargo on some specific routes. [\(Limkunatham et al., 2007\)](#) applies regression models to estimate road freight indices on three types of commodities: cement, container and petroleum. The main purposes of research are to calculate the reference price and to develop models and calculate road freight indices for Thailand. The sensibility between commodities and fuel price, petroleum index is the most elasticity price while container index is the least. [Jansson and Martinsson \(2003\)](#) points out freight price depended on a number of different and continuously changing factors. The primary factors are: freight type, customer, vehicle type and route. The freight price from thirty carriers in Sweden is used to estimate road freight indices. [Tsai et. al \(2008\)](#) studies the development of truckload options pricing model used for both shippers and carriers. They tries to estimate a reasonable model that is compatible with the given values of the minimum, average, and maximum prices for all transactions concluded during a set period. The option model of the truck load price is calculated by common stochastic process. The fluctuation in truckload may indirectly depend on the price of oil. Road Freight Transport Index (RFTI) has been responsibility of Ministry of Commerce in Thailand (www.price.moc.go.th). They have to calculate and publish index in quarterly by survey base method. RFTI is first published in the second quarter year 2007 followed by weight proportion from Input-Output Table of Thailand (I-O Table) year 2000, compared within 3 dimensions; base year, previous quarter and within the same period previous year.

Methodology

Freight price model

Of all 101 containerized freight carriers in the study area, the forty-three are chosen. They are providing transport service contracts for the movement of container on five specific routes: Eastern Seaboard-Laem Chabang, Amata Nakorn-Laem Chabang, Lad Krabang-Laem Chabang, Gateway City-Laem Chabang, and Rojana-Laem Chabang. The freight carriers are in-depth interviewed the factors as many as possible to define their strategies on their freight pricing. The primary factors to define the freight price are: costs of fuel and lubricant, maintenance and repair, tires, drivers, vehicle depreciation and interest, insurance, registration and vehicle taxes, administration, over-head and profit mark-up. The cost-based model for the freight price can be written as:

$$\tilde{V} = [FC_d + FC_i + FC_r] + [VC_f + VC_w + VC_m + VC_{dr} + VC_{ad} + VC_{oh}] + Markup \quad (1)$$

Where: \tilde{V} is freight price, FC_d is depreciation and interest cost, FC_i is insurance cost, FC_r is registration and vehicle taxes, VC_f is fuel and lubricant cost, VC_w is tire cost, VC_m is maintenance and repair cost, VC_{dr} is driver cost VC_{ad} is administration cost, VC_{oh} is overhead cost.

The freight price, \tilde{V} composes of three terms; fixed cost, variable cost, and profit mark up. In terms of cost factors; fuel, lubricant and tire costs have less deviation while administration, insurance and depreciation and interest costs are most deviated. A large deviation of administration cost is because of the carriers apply a variety of methods to estimate the freight price corresponding to business sizes. Similar to the insurance cost, carriers try to limit the insurance no more than the basis of transport regulation; however, in the situation of fatal accident, they have to compensate a lot of money for that case. In term of interest cost is concerned with how the vehicles are purchased. Used trailer imposes a more interest rate than a new trailer and also the number of years of hire purchase affect to the amount total of interest. According to the depreciation, second-hand vehicle in Thailand has several methods defined by the Federation of Accounting Professions (FAP) that allows the businesses apply them. The estimation of depreciation is concerned with repair and maintenance cost. In generally, except the vehicle's engine belt almost of all businesses have no timetable to overhaul the vehicles. According to the profit mark up, it depends on the distance, condition of route and the contract agreement of customers.

Figure 1 represents the structure of freight price. Note that, although fuel and lubricant costs are the most proportion of total operating costs, but when we calculate to the percentage of freight price the profit mark up is the main part of the value. The great number of percentage mark up is concerned with two hidden factor. Firstly, businesses want to absorb some costs which could not be recorded in freight transaction. Secondly, they want to have some discount rate for bargaining freight price. According to the perspective of business owners, container road freight index could be reflected the competition in the freight market. We also compare our structure of freight price to Canada (Trimac Logistics, 2001); two big differences of percentage are profit mark up and driver cost. In Thailand, profit mark up is the most percentage 60.82% while driver cost is only 3.46%. In contrast to Canada those cost and mark up percentage are inverse 5% and 57%. The structure is depended on characteristics of freight price in each region.

In this study, the distance in each (Origin and Destination) O-D pair is not the shortest path but it is the most common path of container transport. The drivers seldom switch the direction unless uncommonly traffic case happens. The common path is also involved with toll fee cost and related to the regulation of Department of Land transport and Highway Law (DLT). The result shows that the transport distance and profit mark up are negatively non-linear relationship (with the correlation coefficient, $r = -0.98$). Similar to the profit mark up the shortest route (38 km) is between the Eastern Seaboard and Laem Chabang but it is accounted for the highest make up 72.13%. The relationship between them is shown in Figure 2. The slope of mark up percentage represents the profit requirement of carriers. In short trip has more profit per kilometer than long trip. The carriers inform that they mark the minimum freight cost between 3,000-3,800 Baht per trip in the short trip because they want to absorb fixed cost.

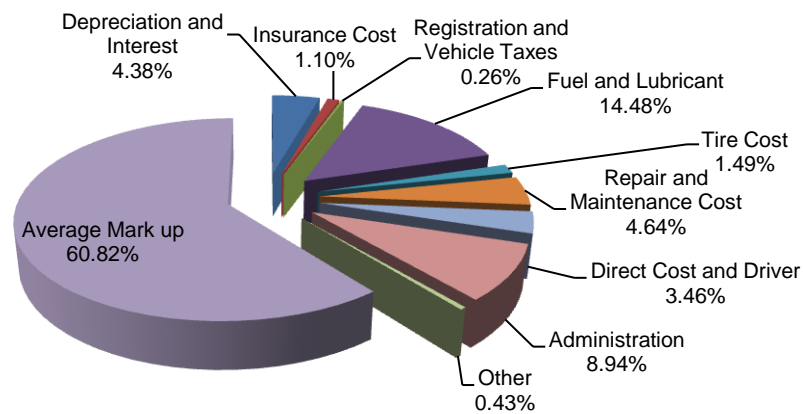


Figure 1 Structure of freight price in Thailand

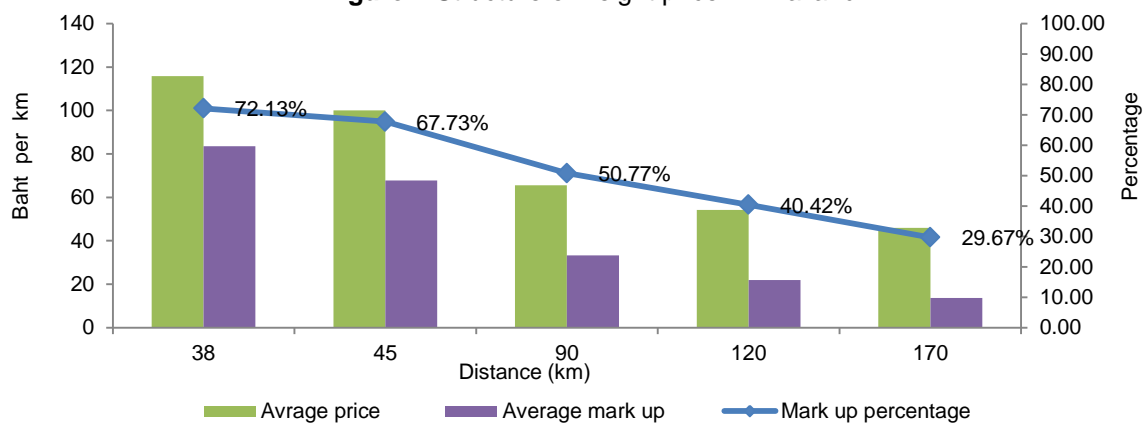


Figure 2 Relationship between container freight price and profit mark up

Road Freight Index

Our freight index is modified from Laspeyres's formulation (Roberts, 2000). There are several methods for estimating index including simple index, weighted composite index, weighted mean index and some of mathematical forms (Sin, 2000). Freight price and number of truck trips are weighted to the freight index. In generally, to initialize the freight index, weighting base price is assigned to the

transport volumes and the transport values in the calculation. The freight price for time period, i is derived from p_i and q_i on a service route as written in (2).

$$P_i = \frac{\sum_{i=1}^n (p_i q_i)}{\sum_{i=1}^n q} \quad (2)$$

Where: p_i and q_i represent freight price and number of truck trips in each business. In this study, we have some differences method. In term of assumption we defined the number of container trips and size of businesses are not concerned. Then, we start with cost-base and adjust them with GDP inland mode, diesel price index and minimum wage index to be the freight price baht per km in specific service route. Thus the price is not necessary to weighted. Laspeyres's formulation is used to estimate the freight index as shown in (3).

$$\text{Freight index} = \frac{P_i}{P_0} \quad (3)$$

Where: P_i and P_0 represent the freight prices of calculating time period and base time period.

According to estimate road freight index, the diesel price is first taken into account. Apart from the observation, we are also considered with the GDP and minimum wage index. GDP especially inland mode is usually concerned with the macro level and domestic policy. GDP and minimum wage in Thailand have been represented by Office of the National Economic and Social development Board (NESDB) and Ministry of Labour (MOL). We calibrated freight price by those three factors. The characteristic of price movements are separated range of route. The proposed of study we attend to provide the inland container freight cost base index in term of quartering within three dimensions follow by RFTI.

Figure 3 shows freight price on five transport routes based on cost-based model compared with other previous research. In container transport they had studied only one O-D trip between Lad Krabang and Leam Chabang. They calibrated estimate freight price by using the diesel price index with regression model. To formulate freight index, they compared the current estimate price with based year price (July 2006). We also compare their freight prices with ours in the figure 3. The trends are quite different during 2/2008-3/2008; then the remaining other trends are similar to our price but in the difference route Amata Nakorn and Leam Chabang. Note that the comparison is not commonly because both of them are based on the difference year but they could be shown the pattern of trend.

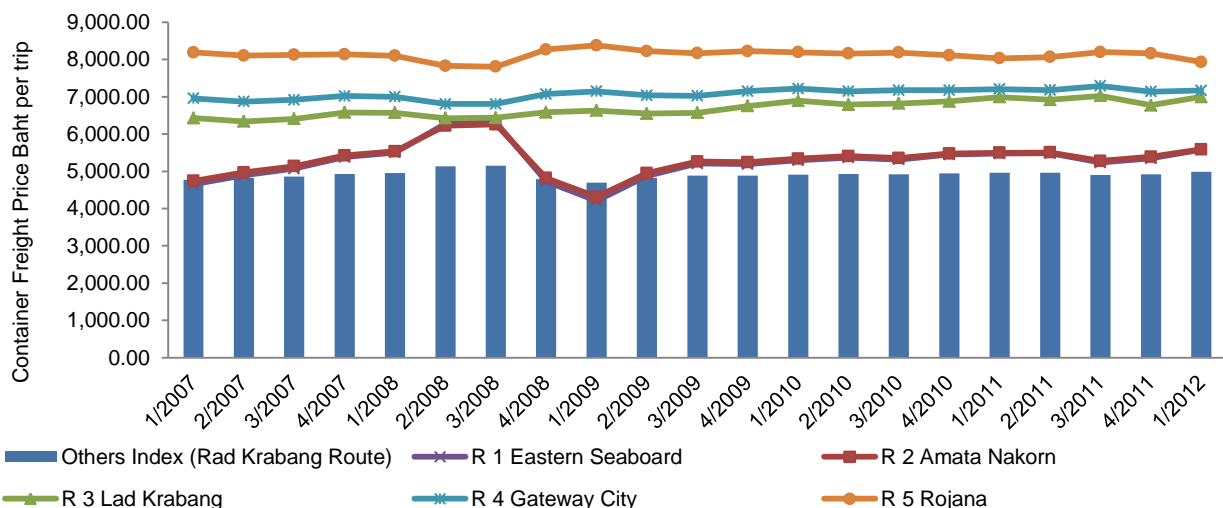


Figure 3 Estimates of container freight price

Freight Index Validation

Once the freight index has been estimated, we compare the index with Thailand Road Freight Index (RFTI) from the Ministry of Commerce. In Figure 4 we represent both freight indices base year 2005. The pattern of movement indices by cost-based model quite similar to RFTI's whereas the ranges of

trend have some variations. The widest range between both scales is during quarter 2/2008 to 3/2008 the nearest trend of RFTI is Amata Nakorn. It might be the effect of fluctuation of fuel price. The longest similar trend of RFTI has represents in 2 periods. The first period is during 3/2009 to 3/2010 in O-D trip between Rojana and Leam Chabang. Then the scale of cost-base O-D trip changes in the second period to Gateway City during 4/2010-4/2011. In the present (1/2012) the trends are quite similar to RFTI in 3 O-D trips those are trip between Eastern Seaboard, Amata Nakorn and Lad Krabang to Leam Chabang.

Note that RFTI freight index during 2/2007 to 4/2011 they based on year 2000 and then they changed to base on year 2005 follow by I-O table. In order to product classification, on base year 2005 they also adjusted from classify by transportation group into the Classification of Product by Activity (CPA). And there is no more represent containerize commodity road freight index.

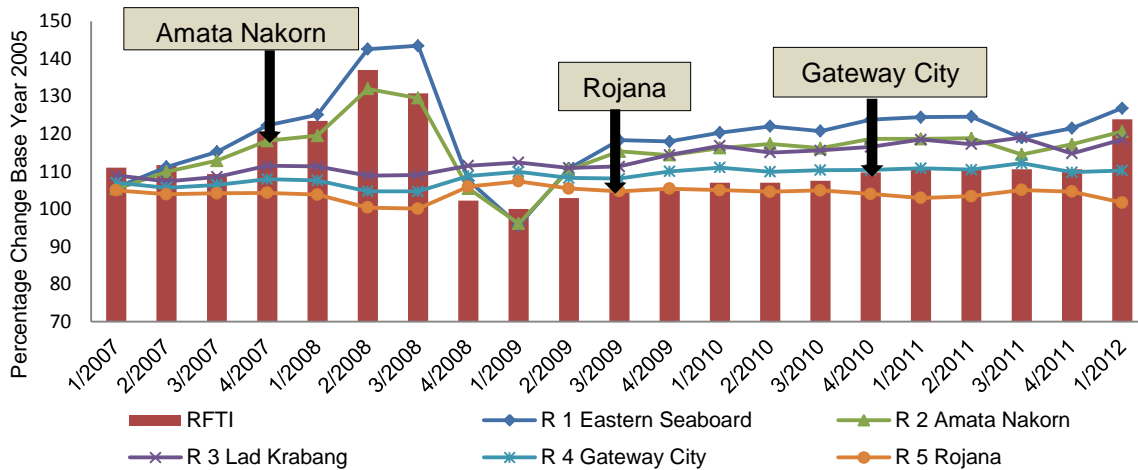


Figure 4 the proposed container freight index and RFTI (base year 2005)

Figure 5 shows freight indices between 2/2007 and 1/2012. The movement is based on previous quarter. RFTI is also plotted in the graph for validating. In term of previous quarter the 3 longest routes, Lad Krabang, Gateway City and Rojana their percentage change is quite stable especially during 4/2009-3/2011. In contrast to the 2 shortage routes the Eastern Seaboard and Amata Nakorn the trend have more dramatical. Clearly that the distance of transportation is adverse effect to the variation of freight index. When we compare cost-based index with RFTI, two routes Eastern Seaboard and Amata Nakorn, their trend are similar to that index during 3/2007 to 1/2009. After that all routes have narrow bandwidth with RFTI between 4/2009 to 1/2012.

Concerning with contain freight indices percentage changed base on the same period previous year in Figure 6, RFTI represents the first period on 1/2008. Both of RFTI and cost-base index trend are similar. In the same pattern of percentage change in figure 5 the short routes are more fluctuate than long routes. In additional, on the dramatical period the short routes are similar trend to RFTI and the long routes are close to that index in the stable period. Another reason why the trend of RFTI and cost-base index is difference is our index more specific commodity in containerize.

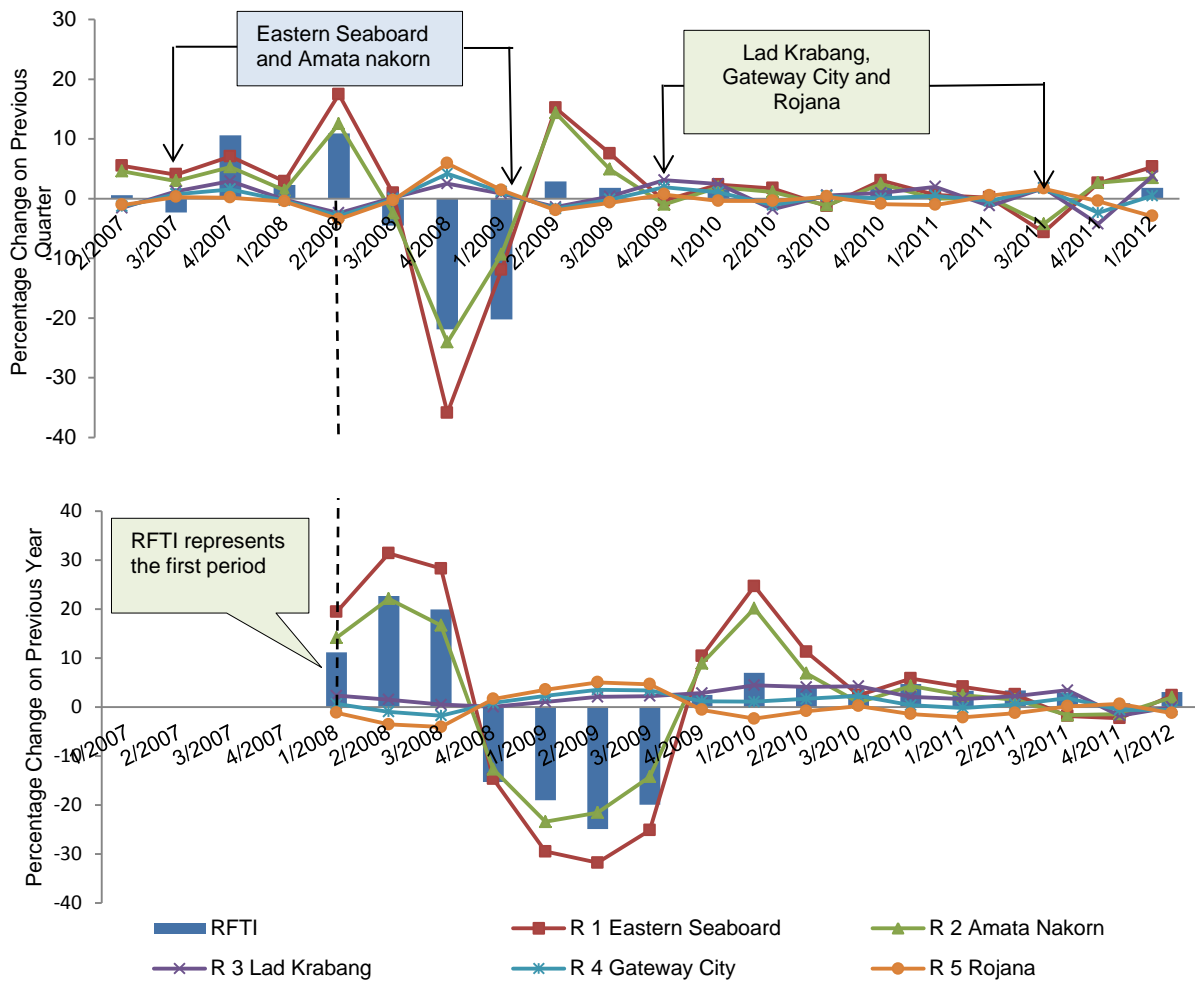


Figure 5-6 Ccontainer freight indx percentage change base on the previous quarter and the same period previous year

Conclusion

In general, it is difficult to get the real data to estimate road freight index due to the fact that carriers need to keep their operating costs and profit mark-up confidentially. However, in this study carriers are interviewed for the freight price structure and their business strategies in various scenarios. We quantify the factors influencing the freight price. Although fuel is the largest portion of the vehicle operating cost but it is an external factor. The administration cost is the main part for business strategy the carrier that has a lower administration will stand higher in a competitive market.

Due to a major problem in applying road freight index for the transport sector how to update the indices regularly in a cost-effective manner, we propose the indices that can be derived from vehicle operating cost structure for a specific type of commodity with the fuel inflation and minimum wage adjustments. The variations in service route are tuned with the transport distance included in the cost structure model. The results have shown that the proposed container freight index follows similar trends with Thailand Road Freight Index (RFTI). However, when updating the freight index for next some time periods, our cost-based index need non-survey data making possible for a frequent index update.

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GROWTH OF ASIAN INTERNATIONAL PHYSICAL DISTRIBUTION AND IMPROVEMENT OF TRANSPORT INFRASTRUCTURE

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ABSTRACT

Purpose: We analyze the international freight transport systems in Asia. Also we consider the improvement of transport infrastructure which enhances the efficiency of the international physical distribution.

Design/methodology/approach: We use the statistical methods to analyze the major international freight transport in Asia. Also we use theoretical analysis to consider the improvement of transport infrastructure which enhances the efficiency of the international physical distribution.

Findings: In Asia, the intermodal transport will become more used as an efficient international physical distribution system. To use the intermodal transport systems more widely, it needs to reduce its total cost. For that purpose, terminals must be improved and transshipment cost must be reduced. We had to improve transport infrastructures continuously to make our international physical distribution systems more efficient.

Originality/value: We statistically confirm that the major modes of international freight transport in Asia are the sea container, the air freight transport and the intermodal transport. Also we theoretically analyze the improvement of transport infrastructure which enhances the efficiency of the intermodal transport or the international physical distribution.

Keywords: Asian Economic Growth, International freight transport system, Intermodal Transport, Improvement of transport infrastructure

Paper type: Viewpoint

Preface

The growth of industrialization in Asia has rapidly been increasing the international physical distribution. The great volume of products and materials has been transported between Asian countries, also to and from all over the world.

One of the features of the international physical distribution in Asia is the growth of the sea container and the air freight transport. The highly developed industries produce various highly value added goods. They need to be transported quickly and efficiently. Also the just-in-time transport is widely introduced in the international physical distribution. The sea container transport and the air freight transport met the needs. Asian countries have increased the volume of the sea container and the air freight transport.

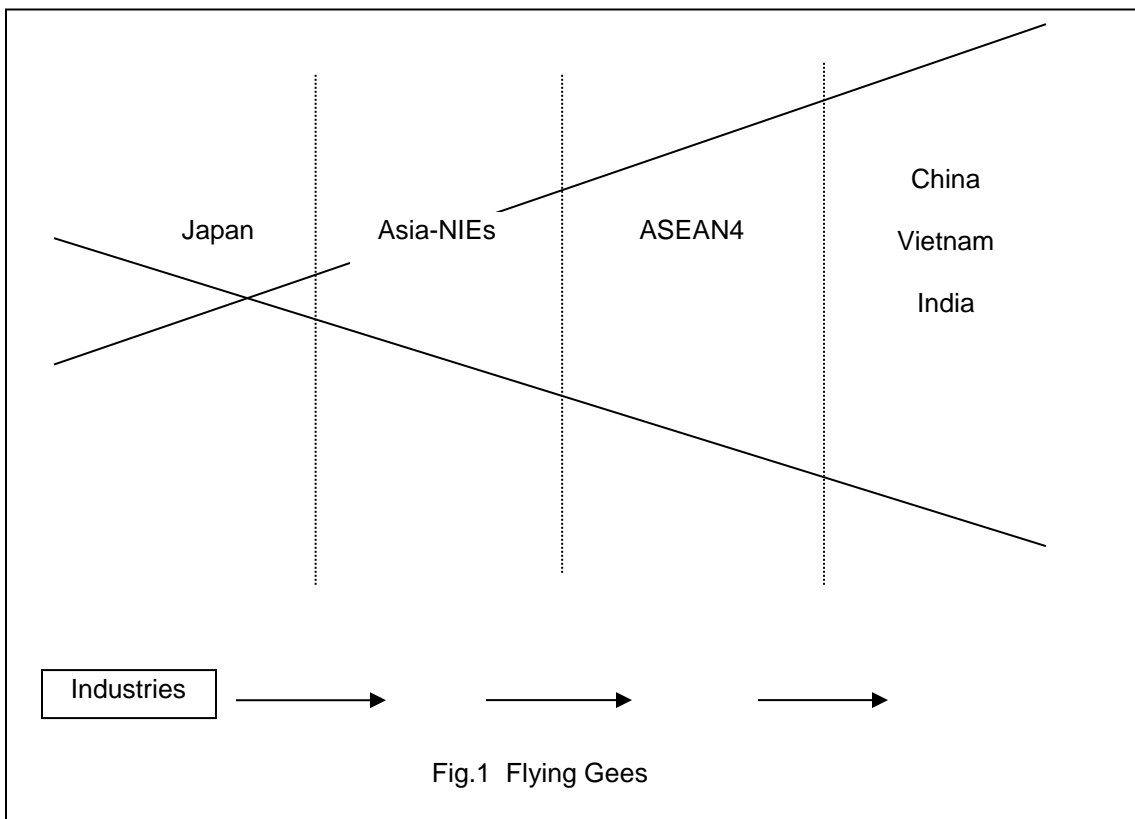
This paper analyses the international freight transport in Asia. Also we consider the improvement of transport infrastructure which enhances the efficiency of the international physical distribution.

Economic Growth and International Freight Transport System

Economic Growth Pattern of Asia

In Asia, Japan realized the industrialization firstly. Following Japan, Asia-NIEs and ASEAN countries go on industrializing continuously. In the economic growth process, the developed industries have moved from Japan to Asia-NIEs, and from Asia-NIEs to the other ASEAN countries in turn. This pattern of economic growth of Asia is called “Flying Geese” (Fig.1).

Asian countries have been making their economic relations stronger. For example, more than 25% of ASEAN trades are intra-regional. The volume is bigger than the trade between ASEAN and US, also between ASEAN and EU.



International Freight Transport System in Asia

The major modes of international freight transport in Asia are the sea container and the air freight transport. Comparing the volume of container handlings in each port, eight of the top ten ports in the world are Asian ports. And many of them are Chinese ports (Tab.1). About the volume of air freight handlings in each airport, five of the top ten airports are Asian airports (Tab.2).

Recently, Asian countries have constructed new ports and airports, or have improved old ports and airports. Asian countries needed to expand capacities of international freight transport infrastructures in order to handle their increasing freight. In other words, the higher efficiency in freight transport infrastructures attracts the more foreign industries. Their efficiency has become one of elements of economic competition with neighboring countries.

1	Singapore	25,866,400
2	Shanghai	25,002,000
3	Hong Kong	21,040,096
4	Shenzhen	18,250,100
5	Pusan	11,954,861
6	Guangzhou	11,190,000
7	Dubai	11,124,082
8	Ningbo	10,502,800
9	Qingdao	10,260,000
10	Rotterdam	9,743,390

Tab.1 Volume of Container Handlings in the Top 10 Ports (2009:TEU)

1	Hong Kong	3,627,225
2	Seoul	2,386,472
3	Tokyo	2,058,633
4	Paris	2,010,070
5	Frankfurt	1,962,706
6	Shanghai	1,915,864
7	Singapore	1,856,939
8	Dubai	1,740,575
9	Amsterdam	1,567,712
10	Miami	1,543,602

Tab.2 Volume of Air Freight Handlings in the Top 10 Airports (2007:tonnage)

Intermodal Transport

Intermodalism

Intermodal transport is the system which uses different multi-modes. An user chooses the combination of transport modes which makes his total transport cost lowest (Fig.2).

When an user sends his goods to a faraway destination, he can use any combination of modes. They are local (short-haul) truck, sea, air, rail and long-haul truck. He chooses the most efficient combination for himself.

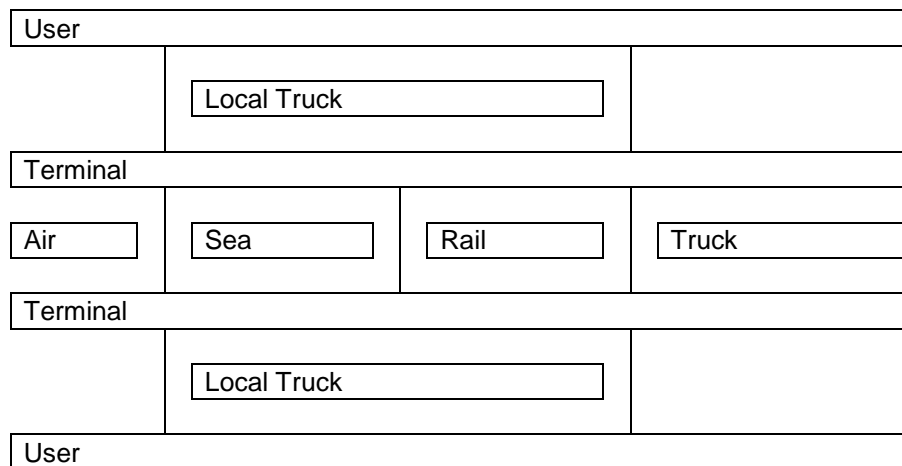


Fig.2 Intermodal Transport

Costs of Intermodal Transport

The relations between total cost and distance of intermodal transport are illustrated on Fig.3. The line AG shows the total cost when a single mode (only a truck) is used from origin to destination. Also the line ABCDEF shows the total cost of the intermodal transport. In this case, three modes are used, a local truck (AB), a long-haul mode (sea, air, rail, long-haul truck) (CD), another local truck (EF). The slope of line CD is easier than that of AG, because per-distance cost of long-haul modes is lower than that of short-haul truck. The intermodal transport needs transshipments at terminals. So transshipment costs (terminal costs) occur at terminals. The lines BC and DE are them.

On Fig.3, if the transport distance is longer than OI , the total cost of intermodal transport is lower than that of single mode transport (only a truck). Conversely, if the distance is shorter than OI , the total cost of single mode transport is cheaper than that of intermodal transport. So if the transport distance is longer than OI , a user chooses the intermodal transport. If the distance is shorter than OI , he uses the single mode transport.

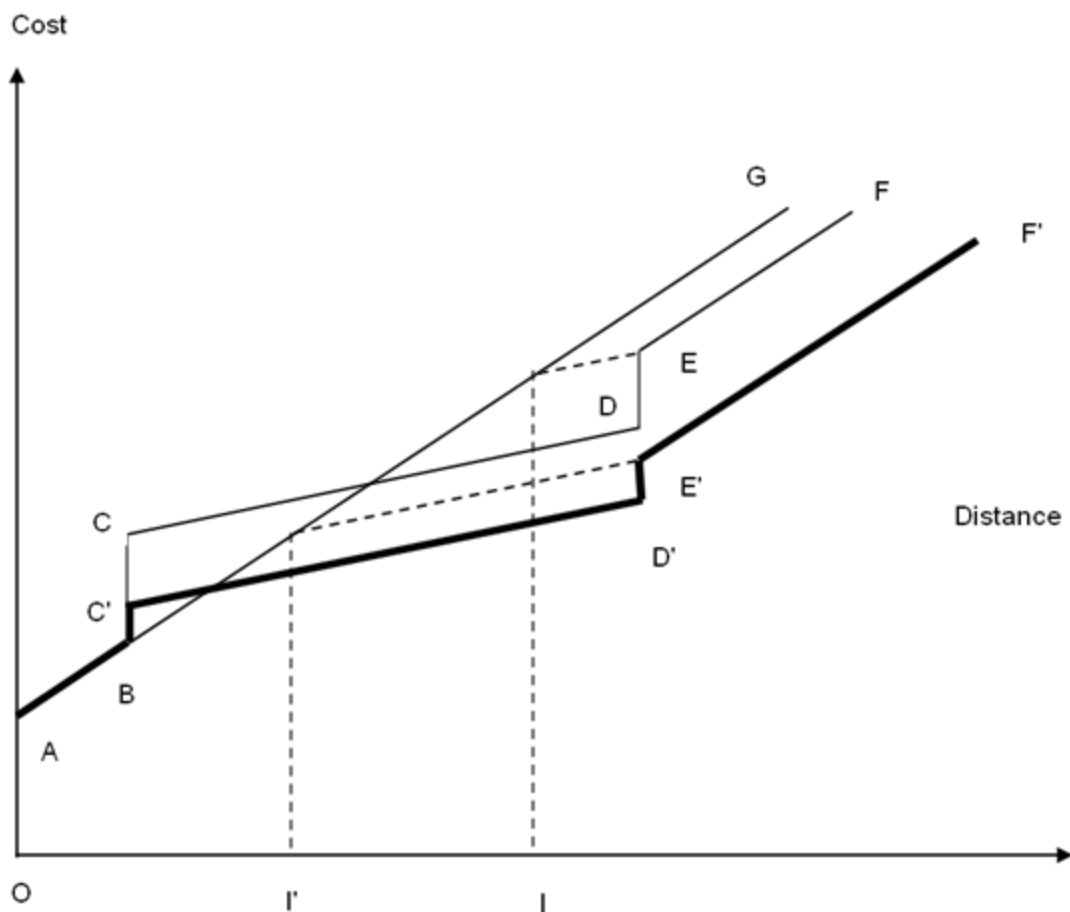


Fig.3 Costs of Intermodal Transport

Improvement of Terminals

Intermodal transport becomes more widely used if its total cost becomes lower. One of the policies is to improve terminals and reduce transshipment costs. If terminal costs are reduced, the total cost of intermodal transport becomes cheaper.

The total cost after improved terminals is showed on Fig.3. It is the line ABC'D'E'F'. Each transshipment cost is reduced from BC and DE to BC' and D'E'. Then the intermodal transport is used in the longer distance more than OI'. It becomes more widely used than before improved terminals.

Concluding Remark

In Asia, the volume of international freight will be increasing. Also the intermodal transport will become more used as an efficient international physical distribution system. To use the intermodal transport systems more widely, it needs to reduce its total cost. For that purpose, terminals must be improved and transshipment cost must be reduced. We had to improve transport infrastructures continuously to make our international physical distribution systems more efficient.

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INTEGRATION OF THE INTERNAL SUPPLY CHAIN MANAGEMENT (SCM) COMPONENTS TOWARDS LONG RUN COMPETITIVENESS

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ABSTRACT

Propose - Economic growth of a country can be sustainable when it is able to be competitive in the long run. Hence, Malaysian government has implemented Economic Transformation Program (ETP) to ensure the achievement of long-term and sustainable economic growth for the country. It is well accepted that there are many factors that influence the achievement of long-term and sustainable economic growth. These factors consist of internal and external supply chain management (SCM) components.

Design/methodology/approach -192 electric and electronics (E&E) manufacturers were interviewed to determine their views on the importance of the integration of the internal SCM components towards the achievement of long term and sustainable economic growth.

Findings - Many studies had been conducted to evaluate the effects of external SCM components on the efficiency and performance for long-term and sustainable economic growth. However, very limited studies had been focused on the effects of internal SCM components in order to achieve long-term and sustainable economic growth of a country. Therefore this paper presents the findings from a research conducted to determine the factors and their integration towards the performance of internal SCM components on the long term competitiveness and sustainable economic growth.

Research limitations/implications –The study focuses only on manufacturer perspective and concentrates on their views but not the whole channel members in the supply chain.

Practical implications - The results provide insights on how integration of internal SCM components were applied in Malaysia E&E industry and how it could be improve in achieving towards long run competitiveness.

Originality/value – This study can be one of the first to address the integration of internal SCM to identify their influence towards long run competitiveness.

Keyword(s): Supply Chain Management (SCM); competitiveness; internal

Introduction

Nowadays, SCM has been a critical issue among industry players where it has been accepted to be one of the key factors contributes towards economic growth. Concerning towards transforming the nation, the government had come out with new implementation and strategic plan to be carried out. Economic Transformation Program (ETP) has been implemented to ensure long-term sustainable growth for the country's economy for the well-being of all Malaysians (Kok, 2012). Datuk Seri Idris Jala which is the minister in the Prime Minister's Department said that as a trade-dependent country, Malaysia need to have "competitiveness" as the key to achieve high-income nation by 2020 (Kok, 2012). Therefore, in order to increase the economic growth, it must have focus and competitive to become sustain for a longer period of time. Focusing on SCM, there are two major components identified which contributes towards competitiveness of the SCM which are the external and the internal components. However, many researches are not well focused on the internal components since these components seem to be under control by the organization. Through history, it also have been proven that many organizations collapsed due to the internal problems. Hence, it is important to focus on the internal SCM perspective which gives major impacts not only for the supply chain itself but also towards the country development.

Objectives

The objectives of this paper is to identify the integration of the internal SCM factors which contributes towards long run competitiveness and proposing a framework on selected internal SCM factors towards long run competitiveness.

The Importance of Integration

Li and Lin (2006) explained that logistics must have integration, agility, measurement, and positioning in order to increase competence among industry members. Integration can be seen as a technique used for internal logistical operating excellence and development of external supply chain relationships. A firm's can respond in a quick manner through integration of each element in the supply chain. Additionally, Bagchi et al. (2005) states that experts had agreed that integrated supply chain would enable firms to compete better. The basis of integration is well explained by Power (2005) where it can be characterized by collaboration, cooperation, trust, sharing of information and technology, and a shift from managing individual to integrate chains. Additionally, Lee, Kwon, and Severance (2007) had identified internal linkage as one of the major linkages which are critical and need to be focused on. This linkage needs integration where it helps in reducing costs (Flynn et al., 2010) and enhance efficiency (Danese and Romano, 2011). Thus, integration can help to facilitate supply chain process to enhance competitiveness.

Integration of the Internal SCM Components Towards Long Run Competitiveness

There are two major components in the supply chain which are the internal components which involves within an organization and the external components which involves between companies (Kotzab, Teller, Grant, and Sparks, 2011; Banomyong and Suptn, 2011; VanVactor, 2011; Lings, 2000). In order to achieve long run competitiveness, the internal components in SCM can be seen as the most important factor compared to the external factor where prior studies had not well discovered. Stock et al. (2000) and Bahinipati et al. (2009) had agreed with the importance of the internal parameter which contributes to the effectiveness and efficiency of supply chain performance. Ample of studies had well mentioned about the fact that the success of the SCM comes from the behavior within the organization where it reflects the whole supply chain (Mentzer, DeWitt, Keebler, Min, Nix, Smith and Zacharia, 2001; Melnyk, Lummus, Vokurka, Burns and Sandor, 2009; Sharif and Irani, 2012). Thus, properly manage of the internal SCM helps in achieving towards long run competitiveness.

Study by Grawe, Daugherty, and McElroy (2012) point out that competitiveness of an organization or a company comes from organizational itself. However, Aryee, Naim and Lalwani (2008) stated that companies are still grappling with internal process integration rather than focusing on their customer value. Therefore, identifying the internal SCM components will help managing the company through a better performance. The direct relationship proposes to highlight the importance of these selected internal SCM components which contribute in achieving long run competitiveness in the SCM process as illustrated in Figure 1 below.

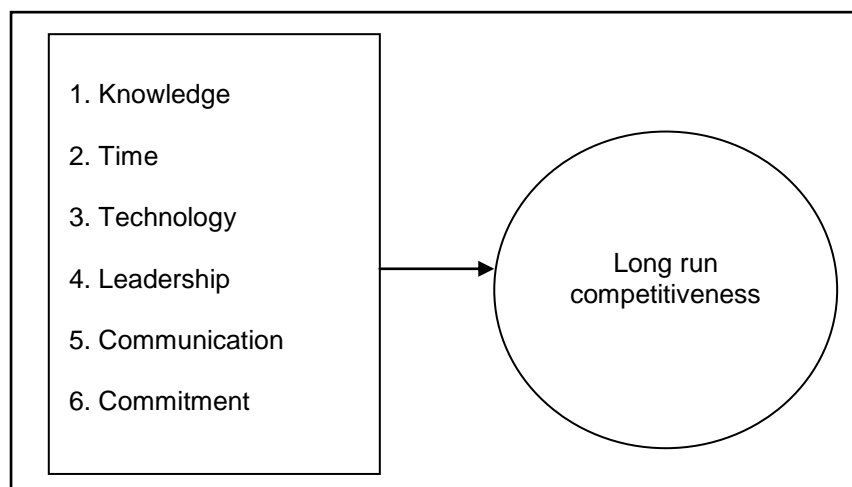


Figure 1: Illustration of the internal SCM in a proposed framework towards long run competitiveness

Studies by Stock et al., (2000) have brought new attention to how organizations coordinate the flow of information and materials across their supply chain. This shows that supply chain plays a major role in directing and controlling the situations towards economic development where the flow of the process has to be efficient and effective. In order to achieve the best performance in SCM, each component has to play its role in contributing towards the competitiveness in the supply chain. The collaborative SCM process can be supported by enhanced information sharing and collaborative planning among partners and supported primarily through mechanisms such as information integration and process coordination (Liu et al., 2005). In addition, studies by LaLonde and Masters (1994), Chow et al., (1995), Stock et al., (1998), Stank and Traichal (1998) shows that trends in global production have increased the supply chain performance where logistics strategies and practices are essential elements of business strategy. These include the internal supply chain linkages in their scale development. In order to achieve good performance in SCM which contribute towards long run competitiveness, several components which can be seen as an important component had been highlighted in this paper.

Methodology

This part of research work deals with different kind of stages where it involves in profiling issues through interviews, secondary data collection, and survey in order to have a better understanding. A structured questionnaire was designed by referring to the previous research by adopting and modified in order to maintain the reliability of the questions based on the structure of this research purpose. About 192 questionnaire were distributed to the manufacturer of E&E in Malaysia. After sampling had done, data from the questionnaire will go through an analysis stage by using SPSS 19th version such as validity, reliability, normality, correlation, multiple regression, and ANOVA test.

Results and Discussion

Advanced research analysis had been done to identify the integration of the internal SCM components contributes towards long run competitiveness. From the table of correlation coefficient analysis below, the integration of the internal SCM components shows that only two internal components that have a positive relationship with long run competitiveness which are leadership and knowledge. The integration of both components shows direct relationship with long run competitiveness.

Table 1. Correlation coefficient between internal factors and long run competitiveness

Factors		Long run competitiveness
Technology	Pearson Correlation	-0.179
	Sig. (1-tailed)	0.081
	N	63
Leadership	Pearson Correlation	0.030
	Sig. (1-tailed)	0.407
	N	63
Commitment	Pearson Correlation	-0.081
	Sig. (1-tailed)	0.264
	N	63
Knowledge	Pearson Correlation	0.158
	Sig. (1-tailed)	0.108
	N	63
Time	Pearson Correlation	-0.037
	Sig. (1-tailed)	0.386
	N	63
Communication	Pearson Correlation	-0.189
	Sig. (1-tailed)	0.069
	N	63

1. Knowledge

Wu (2008) stated that knowledge has become the only resource that offers competitive advantage and continued growth and prosperity for supply chain partners. There are lots of research which agree on the importance of knowledge creation in the process of supply chain. Malhotra et al. (2005) examined that to transfer new knowledge, supply chain partners are engaging in interlinked processes that enable rich information sharing, and building information technology that allow them to process information obtained from their partners. Weck (2006) had focused on the importance of customer relationship management (CRM) where it gives impacts on knowledge creation in the supply chain where he had found key critical success factors in the process on inter-firm knowledge creation. The key factors are the creation of “win-win” situation, clear role and responsibilities, a customer-oriented approach and the exchange of complementary specialist knowledge (Weck, 2006). Therefore, knowledge can be seen as the important factor to create effective and efficient collaboration among members where it creates the performance of each member in the supply chain process not only internally but also externally.

2. Leadership

Leadership can be seen as one of the important factors that play significant role in increasing or impeding for an organization thus, impact towards market performance. Agree by Lee and Dong (2009), an excellent leader can inspire their co-workers enhance work efficiency and also achieve their organizational goals. Obiwuru, Okwu, Akpa, and Nwankwere (2011) and Louis (2003) defined leadership as an individual behavior as the use of leading strategy to motivate and inspire their staff's potential for growth and development. They also agree that leadership has a relationship with organizational performance. Ogbonna and Harris (2000) stated that leadership can contribute towards major determinants of the success or failure of a group, organization, or even the entire country. In SCM, leadership is seen as one of the internal factors which is very important to determine market performance towards sustainability.

The importance of knowledge and leadership as the internal SCM components has been well established towards generating business performance. Therefore, with the discovered of the integration of these factors helps in contributing on new strategies in line with the government mission to be competitive and sustainable towards the country economic growth.

Conclusion

As a conclusion, the integration of the internal SCM factors (within organization) which mainly focus on organizational performance is lacking in most of the research that were not being well stated in their framework. Factors such as knowledge, time, leadership, technology, communication, and commitment need to be well described regarding on how they need to perform in order to achieve long run competitiveness with the additional components needed. Therefore, this paper introduces a new concept of framework to highlight the important integration of internal SCM components which contribute towards long run competitiveness. Throughout this paper, we can conclude that each component in SCM will gives major contribution towards developing the economic performance. Hence, in order to achieve long run competitiveness in market performance, the integration of internal SCM play as the key factors in making the SCM become successful, well organized and competitive.

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DOES LCC IMPROVE AIRPORT PERFORMANCE? : THE CASE OF REGIONAL AIRPORTS IN THE UK.

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ABSTRACT

Purpose: The purpose of this study is to make clear the effects of LCC (Low Cost Carrier) on the UK's regional airports.

Methodology: This study conducts two stage procedure to evaluate the LCC effects to airport management. At the first stage, we calculate the technical efficiencies of regional airports in the UK by DEA (Data Envelopment Analysis). Then at the second stage, we estimate some variables that influences on DEA scores calculated in the first stage by Tobit regression model.

Findings: Our findings are that LCC as well as charter flights are the most important contributor to airport performance of aeronautical activities. On the other hand, as for the total activities, charter flights make higher contribution to airport performance than LCC flights.

Research Implications: This research could demonstrate many factors influenced on management performance of airport.

Practical Implications: This research could give airport manager useful information about strategies of airside and landside operation.

Originality: Empirical analysis about LCC impacts to airports is research field with fewer previous studies.

Keywords: LCC; airport performance; DEA (Data Envelopment Analysis).

Paper type: Research paper

Introduction

Recently, LCC (Low Cost Carrier) has developed around the world. Especially in these days, many LCC companies in Southeast Asian such as Air Asia have entered into an air transport market and expand their network. In Japan, Peach Aviation that is the first LCC company in Japan starts their operation on March 1, 2012.

Along with LCC development, many airport operators in the world try to attract LCC companies. In this study, we will make clear the effects of LCC to airport management by quantitative analysis using the dataset of the UK. UK is the most advanced country regarding LCC. easyJet based in Luton UK is the second LCC company established in Europe and the number of its international scheduled passenger in 2009 is the third place in the world.

LCC in the UK

The first air transport policy which is mentioned LCC in the UK was the White Paper, "The Future of Air Transport" issued in 2003. As illustrated in Figure 1, traffic to/from UK regional airports grew rapidly over the past two decades. Total number of passengers using UK regional airports has increased by 150% since 1990¹.

¹> CAA (2005), p.ix.

According to CAA (2005), reasons behind such a growth are²:

1. Rapid expansion of low-cost carriers (LCCs) stimulated by the liberalization of European air services from 1993.
2. Impacts of LCCs unlocking latent demand from passengers who were keen to travel from their local airport.
3. Great tendency toward privatization or commercialization of regional airports: making competitive pricing and seeking out new air services more actively.

As seen above, LCC has a great effect on UK regional airports development.

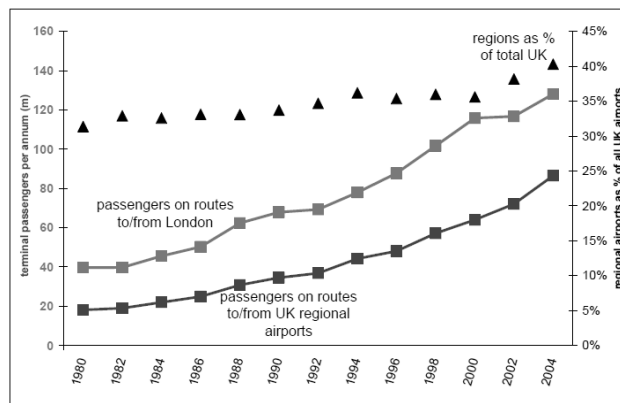


Figure 1: Traffic at UK regional airports 1980–2004

Source: CAA (2005), p.3.

Methodology

We employ two stage procedure to evaluate the LCC effects to airport management. At the first stage, we calculate the technical efficiencies of regional airports in the UK by DEA (Data Envelopment Analysis). Then at the second stage, we estimate some variables that influences on DEA scores calculated in the first stage by Tobit regression model.

Table 1 shows some previous studies regarding to airport productivity or efficiency and regression analysis. Most of these studies use DEA as an evaluation method of airport performance.

DEA is the method which evaluates technical efficiency defined as a ratio like output/input using linear programs. DEA provides a scalar measure of relative efficiency by comparing the efficiency achieved by a decision making unit (DMU) with the efficiency obtained by similar DMUs. The line connecting the most efficient DMUs is called "efficient frontier" which envelops inefficient DMUs. In general, DMUs on the frontier is defined as score 1, the other is scored in proportion to distance from the frontier (see Figure 2).

DEA can treat multiple input and output. Therefore, it is the most suitable method to evaluate airport efficiencies because it produces multiple outputs such as passengers and cargo.

First stage

In the first stage, we conduct two kind of DEA measurements; aeronautical activities (Measurement A) and total activities including non-aeronautical activities such as retail and car parking in terminal facility (Measurement B). Table 2 shows inputs and outputs of the DEA analysis. Our dataset is composed of one input and three outputs. Aeronautical costs (for the Measurement A) and total costs (for the Measurement B) are used as input variables. As for output variables, we use Work Load Units (WLU), air transport movements (ATM) and aeronautical revenue (for the Measurement A) and total revenue (for the Measurement B). WLU is a concept of aggregation by the proportion of one passenger to be corresponded to 100 cargo kilogram. All data is derived from CRI (2008). The DEA model is output-orientated CRS.

²> CAA (2005), pp.ix-x.

Author(s)	Samples	Method
Gillen & Lall (1997)	21 US airports	DEA>>>Tobit regression
Parker(1999)	BAA airports, 1979 to 1995	DEA
Sarkis(2000)	44 US airports	DEA
Ito (2001)	BAA airports, 1966 to 1995	DEA
Martín & Román(2001)	37 Spanish airports	DEA
Martín-Cejas (2002)	Spanish airports	Translog cost function
Abbott & Wu(2002)	Aussie airports in the 1990s	DEA
Fernandes & Pacheco(2002)	35 Brazilian airports	DEA
Pacheco & Fernandes(2003)	35 Brazilian airports	DEA
Bazargan & Vasigh(2003)	45 US airports	DEA
Pels, Nijkamp & Rietveld(2003)	European airports	DEA
Yoshida(2004)	30 Japanese airports in 2000	Endogenous-weight TFP
Yoshida & Fujimoto(2004)	67 Japanese airports in 2000	DEA, Endogenous-weight TFP
Yokomi(2005)	6 BAA airports, 1975 to 2001	Malmquist DEA
Oum, Adler & Yu(2006)	World's 116 major airports	Variable Factor Productivity (VFP)
Barros & Dieke(2007)	31 Italian airports, 2001 to 2003	DEA
Barros(2008a)	27 UK airports, 2000 to 2004	Random stochastic frontier model
Barros(2008b)	32 Argentine airport authorities, 2003 to 2007	DEA>>>Truncated bootstrapped two-stage regression
Chi-Lok, A.Y. & A. Zhang(2009)	25 major Chinese airports, 1995 to 2006	DEA>>>OLS and Tobit regression
ATRS(every year)	World's major airports	Residual (Net) Variable Factor Productivity

Table 1: Previous studies regarding to airport productivity or efficiency and regression analysis

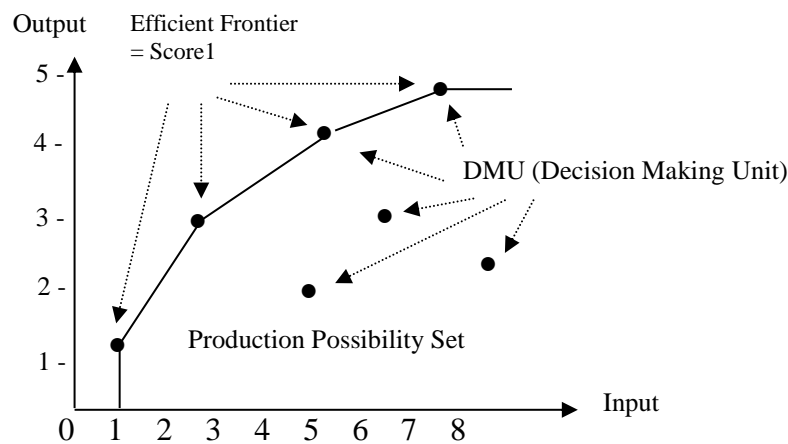


Figure 2: Concept of DEA

	Measurement A	Measurement B
	Aeronautical activities	Total activities
Inputs	Aeronautical costs	Total costs
Outputs	Work Load Units (WLU)*	
	Air Transport movements (ATM)	
	Aeronautical revenue	Total revenue

Table 2: Inputs and outputs of the DEA analysis

Table 3 shows sample of airports. We adopt 18 airports for Measurement A and 21 airports for Measurement B as our sample. We can not obtain the aeronautical cost data for Blackpool, Coventry and Doncaster Sheffield airport. The result of DEA analysis is shown in Table 4.

	Measurement A	Measurement B
Aberdeen	*	*
Belfast International	*	*
Birmingham International	*	*
Blackpool		*
Bournemouth	*	*
Bristol	*	*
Cardiff International	*	*
Coventry		*
Doncaster Sheffield		*
Durham Tees Valley	*	*
Edinburgh	*	*
Exeter	*	*
Glasgow	*	*
Humberside	*	*
Leeds Bradford	*	*
Liverpool	*	*
Manchester	*	*
Newcastle	*	*
Norwich	*	*
Nottingham East Midlands	*	*
Southampton	*	*
Total	18	21

Table 3: Sample of airports

Airport	Measurement A	Measurement B
Aberdeen	1.000	1.000
Belfast International	0.989	1.000
Birmingham International	0.660	0.660
Blackpool		0.319
Bournemouth	0.550	0.652
Bristol	1.000	1.000
Cardiff International	0.770	0.754
Coventry		0.470
Doncaster Sheffield		0.301
Durham Tees Valley	0.912	0.882
Edinburgh	1.000	0.964
Exeter	0.671	0.522
Glasgow	0.851	0.826
Humberside	0.537	0.553
Leeds Bradford	0.864	0.843
Liverpool	0.927	0.715
Manchester	0.933	0.689
Newcastle	0.907	0.659
Norwich	1.000	1.000
Nottingham East Midlands	0.871	0.740
Southampton	0.987	0.933

Table 4: DEA scores

Second stage

Next, in the second stage, we conduct regression analysis. Dependent variable is DEA efficiency scores of each airport calculated in the first stage. Independent variable is shown in Table 5. We define route structure (OTHINTSCH, CHAFLT and LHRSCH) and ownership structure (PRIVAT, PPP and COMMER) in addition to LCC service (LCC) as a factor affecting an airport performance. All data is derived from CAA (2006) and CAA (2007). We specify the Tobit model as follows. This model is preferred to OLS as a regression because DEA efficiency scores are censored from above at one. The result of Tobit regression is shown in Table 6.

$$Y_i^* = X_i' \beta + \varepsilon_i$$

$$Y_i = \begin{cases} Y_i^* & Y_i^* > 0 \\ 0 & Y_i^* \leq 0 \end{cases}$$

Y_i : DEA score of airport "i"

X : Matrix represented by LCC service, route structure and ownership structure variable

β : Parameter ε_i : Error term

Variable	Description	Source
OTHINTSCH	ATMs of non-EU international scheduled passenger flight.	CAA (2006) <i>UK Airport Statistics 2006 (annual)</i> .
CHAFLT	ATMs of charter passenger flights.	"
LHRSCH	To and from London Heathrow scheduled passenger flights dummy.	"
LCC	LCC ratio, which means the percentage of LCC passenger to total passenger numbers.	CAA (2007) <i>Air Services at UK Regional Airports (CAP 775)</i> .
PRIVAT	Full privatization dummy.	"
PPP	PPP dummy.	"
COMMER	Public owned commercialization dummy.	"

Table 5: Independent variable

Measurement A (Aeronautical activities)

dea	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
othintsch	-.0000562	.000024	-2.34	0.036	-.0001082	-4.30e-06
chaf1t	.0000489	.0000135	3.63	0.003 **	.0000198	.0000781
1hrschr	.2846481	.1352902	2.10	0.055 ***	-.0076285	.5769247
lcc	.0077053	.002247	3.43	0.004 *	.0028511	.0125596
privat	.1996362	.1643459	1.21	0.246 ***	-.1554116	.5546839
commer	-.2298884	.2141755	-1.07	0.303	-.6925864	.2328096
/sigma	.2475817	.0477903			.1443369	.3508264

Measurement B (Total activities)

dea	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
othintsch	-.0000594	.0000292	-2.03	0.059	-.0001213	2.53e-06
chaf1t	.0000452	.0000163	2.78	0.013 *	.0000107	.0000798
1hrschr	.2549884	.1601799	1.59	0.131 **	-.0845778	.5945545
lcc	.0041138	.0021403	1.92	0.073	-.0004234	.0086511
privat	.3143173	.1676567	1.87	0.079 *	-.041099	.6697336
commer	-.0823912	.247747	-0.33	0.744 *	-.6075915	.442809
/sigma	.3044152	.0540812			.1897683	.4190622

Table 6: Result of Tobit regression

***, ** and * indicates significance at a 1%, a 5% and a 10% level respectively.

Conclusion

As a result of our analysis, we found that LCC as well as charter flights are the most important contributor to airport performance of aeronautical activities. On the other hand, as for the total activities, charter flights make higher contribution to airport performance than LCC flights. It suggests that LCC passengers are supposed to spend relative less at a non-aeronautical facilities (restaurants and shops) on airport.

Other findings are that scheduled services to and from London Heathrow airport stimulate aeronautical performance of airport, and ownership structure is less important factor to airport performance than LCC and charter flights. However, as for the total activities, full privatized airports achieve relative higher performance.

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A COMPARATIVE REVIEW OF SUPPLY CHAIN OPTIMISATION

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ABSTRACT

Purpose: The paper aims to detail out the element of the supply chain optimisation and compare the elements of supply chain optimisation modelling which is the Mixed Integer Linear Programming (MILP), Knowledge Based Genetic Algorithm (KBGA), Supply Chain Operations References (SCOR) and Agent-Based Model (ABM).

Design/methodology/approach: The methodology of this study was carried out by reviewing literature on supply chain optimisation modelling (MILP, KBGA, SCOR and ABM)

Findings: Cost, capacity, inventory and time are the elements of supply chain optimisation from the literature review. Meanwhile time and capacity are the most vital elements from four type of optimisation modelling that had been studied.

Research limitations: This study only limits to four type of supply chain optimization modeling (MILP, KBGA, SCOR and ABM) and did not present the overall elements of optimisation modeling.

Originality/value: This paper differentiated four type of supply chain optimization modeling (MILP, KBGA, SCOR and ABM) in term of parameters and the purposed of the modeling to help researchers decide which of the modeling will be useful and more suitable.

Keywords: supply chain, optimisation, supply chain optimisation

Paper Type: Conceptual Paper

Introduction

Economic globalisation around the world especially Europe experienced rapid growth of freight transportation until 30% during the last decade (Arnold, Peeters and Thomas, 2004). Logistics play the vital role in supply chain industry for keeping the physical movement of goods with the main objective to deliver goods in exact quantity and condition to the right place just in time. Logistics cannot bring full role without an efficient transportation system. It is very important to manage the activities to be operated efficiently to guarantee the seamless journey of the chain (Nazery, 2006). In Malaysia, the mechanisms on movement of goods through the supply chains industries involved the mode of sea, land and air transportation. The allocation for transportation in this country has risen from RM6.5 billion in the Fifth Malaysia Plan (1986-1990) to RM32.51 billion in the Ninth Malaysia Plan (2006-2007). Currently, competitive industry around the world force companies to produce and deliver goods quicker to the end user by managing integrated logistics systems and supply chain efficiently (Rondinelli and Berry, 2000). Optimisation techniques are employed to aid decision in making the supply chain to determine the time point (period of interest) and its capacity for procurement, manufacturing and delivery activities (Chen and Kim, 2007). Even though there is a lot of supply chain optimisation modeling currently, but only the most suitable type of modelling will optimize the result.

Objective of the study

Many supply chains still operate traditionally by doing production orders and replenishes stock without considering the situation at either up or downstream tiers of the supply chain. Thus, it is not efficient to implement conventional supply chain to cope with the current competitive industry nowadays. This paper detailed out the element of the supply chain optimisation and compares the previous element supply chain optimisation modelling.

Scope of study

The study focused on four type of supply chain optimisation modeling (MILP, KBGA, SCOR and ABM) and only differentiated parameters and the purposed of the modeling.

Overview of the study

Supply Chain Characteristics

Supply chain is a system in moving products from supplier to customer after going through three stages of process which are the purchasing, production and distribution. Supply chain can be categorised as centralised control and decentralised control as below (Vonderembse, Uppal, Huang and Dismukes, 2006):

- a) Centralised control - A system manager needs to know the mechanism for the entire supply chain for the purpose of optimisation and the performance for the whole.
- b) Decentralised Control – Each player must know on how to move in order to maximising individual profit.

However, in reality no single agent has the totally power of control for the whole supply chain because every player in supply chain has their own incentives, information and own benefits. Figure 1 shows the basic supply chain process which divided into two segments which are the production planning and inventory control and the other segment is distribution and logistics. From this figure it shows that transportation play the important role in the supply chain as to deliver goods to distribution centre and to retailer.

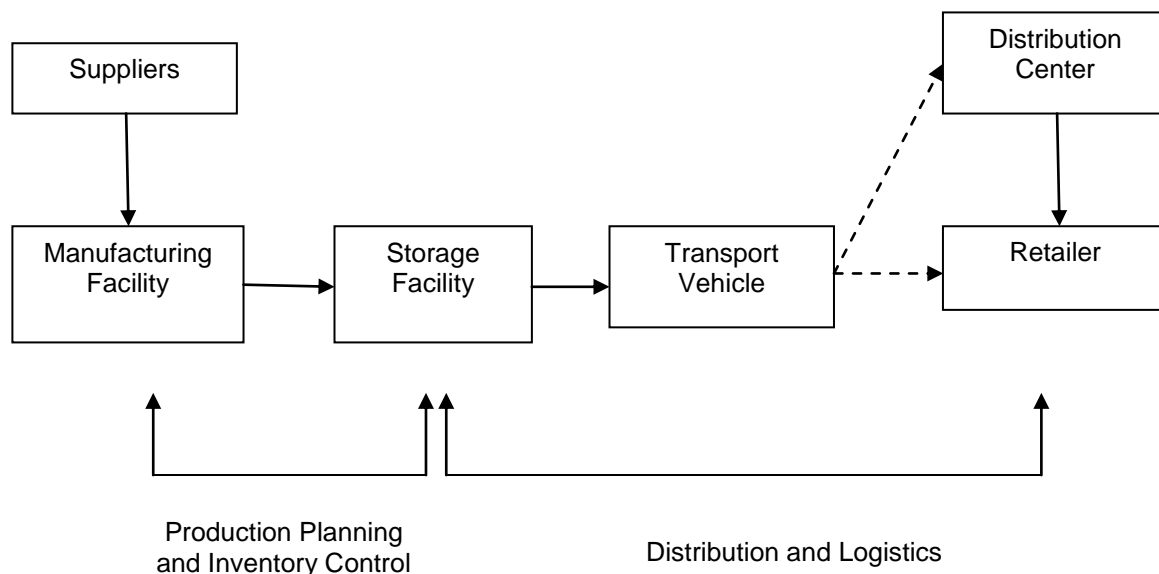


Figure 1.0: The Supply Chain Process (Beamon, 1998)

The characteristics of demand affected the capacity and inventory and in the supply chain (Holweg, Disney, Holmström and Småros, 2005). It means that the demand influenced the supply chain's characteristics to be designed differently for every sector. The seasonal products benefitted the synchronised ordering and common inventory control. The shelf life of the products determined the pace of supply chain operations. For example fresh foods have only shelf life for few days, so the collaboration on inventory levels are not available but the main benefits can be from the aspects of sharing the information and forecasting collaboration. The efficiency in the supply chain in electrical and electronics appliances derived from low inventory levels and high capacity utilisation make the synchronised very interesting. Electrical/ electronic industrial sector are more knowledgeable to be efficient and effectively and could be greener than any other industrial (Zhu, Sarkis and Lai, 2008). Meanwhile in automotive sector, the characteristics are slightly different as it started with the development, design, marketing, extracting raw materials, fabrication and assembly and ends with fit and finish in retailer's show room (Vonderembse, et. al., 2006).

Theories Relating to Supply Chain Optimisation

Supply chains nowadays are complicated networks that extend to longer distances which make them vulnerable to a variety of risks (Vilko and Hallikas, 2000). Disruptions affecting one entity or process will interrupt the operations of other members of the chain. Optimisation techniques will be employed to support decision making for the processes in supply chain (Chen, et. al.,2007). This decide the delivery process, procurement capacity, manufacturing and time of interest. Supply chain efficiency and effectiveness depends to the delivery promptness, leadtime performance and waste elimination (Li and O'Brien,1999). Optimised supply chain operations could be done by minimising the operation cost of supply chains under lead time performance. Lead time performance means required maximum delivery delay and expected delivery delay. Meanwhile delivery promptness are the gap between required delivery delay and expected delivery delay. The wholesalers and retailers should integrate with the logistics functions so the transportation providers will be more efficiently managed the transportation and distribution functions (Tan, 2001). It means that the integrated logistics and smart partnership with supply chains could give benefits in term of, provided visibility, reduced demand uncertainty, consolidated distribution centre, reduced transportation costs and replace inventory with information. Since 1990's researchers tried to collaborated supply chain to create a flawless supply chain to increase responsiveness and reduced inventory cost. Supply chain collaborations has strongly been advocated by academicians and consultant in the concept of Collaborative Forecasting Planning and Replenishments (CPFR), Continuous Replenishment (CR) and Vendor Managed Inventory (VMI), From all the system previously, it is obvious that they created and established one part or one entity of the supply chain instead of the whole supply chains (Holweg, et. al., 2005).

Element in supply chain optimisation from literature

The main element to be determined in the supply chain optimisation will be the time point allocation and the demand and supply activities (Chen, et. al., 2007). Logistics cost formed a main part of supply chain's cost as distribution planning and inventory control and will affected the overall costs of the supply chain (Prakash, Chan, Liao and Deshmukh, 2012). This statement means that the selection of mode of transportation will affect the the supply chain as a whole. This supported by Tan (2001) that the integrated logistics and the supply chain will give benefits such as reduced demand uncertainty, visibility, consolidate distribution centre, reduced transportation costs and substitute inventory with information. Currently, extremely aggressive environment improved decisions at strategic and management level for efficient supply chain approach. Supply chain optimisation not only depends to operational level but from the strategic planning as well (PAPERGIORGIOU, 2009).

Methodology approach

The methodology approach in this study was through reviewing from previous literature meanwhile and analysed four type of optimisation modelling (MILP, KBGA, SCOR and ABM). Table 1.0 below shows four different type of optimisation modelling by purposed and parameters involved.

Tools/ Models Criteria	Mixed Integer Linear Programming (MILP)	Knowledge Based Genetic Algorithm (KBGA)	Supply Chain Operations References (SCOR)	Agent-Based Model (ABM)
Sources/ authors	Chen, et. al., (2007) Perea-López, Ydstie, and Grossmann, (2003).	Prakash, et. al., (2012)	Stefanovic, Stefanovic and Radenkovic, (2009).	Akanle and Zhang, (2008). Barbati, Bruno and Genovese, (2012).
Purpose of Modelling	High flexibility and effectiveness in supply chain	Network optimisation	Integrates of business process engineering, benchmarking and process measurement	Optimising supply chain configuration to cope with customer demand over a period of time
Variables/ Parameters involved	-Time -Capacity (manufacturing, delivery)	-Time -Cost -Inventory -Transportation -Capacity	-Time -Cost -Transportation -Capacity	Dimension depends to the purpose of modelling: -time -capacity - inventory -location -transportation
Type of modelling	Computational	Mathematical	Simulation	Computational

Table 1: Supply Chain Optimisation Modelling

Findings

This section discusses on the findings from the literature mention in the previous section.

Element in supply chain optimisation from literature

The main elements in supply chain optimisation are as below:

- a) Capacity – Capacity consist of supply and demand that should be manufactured or delivered to meet the supply and demand (Chen, et. al., 2007).
- b) Inventory - Inventory control and distribution planning should be well organised because it will affected the total cost of the supply chain (Prakash, et. al., 2012)
- c) Time – It considers at the time point allocation on when the activities whether manufacturing or delivering will be organised (Chen, et. al., 2007).
- d) Cost - Cost is the vital part in supply chain optimisation as it will affect the entire process in supply chain itself (Beamon, 1998).

Element in supply chain optimisation from Table 1

From the Table 1, it shows that there are many types of supply chain modelling for research and industrial used. Mixed Integer Linear Programming (MILP) and Agent-based Model (ABM) are computational modeling, Knowledge Based Genetic Algorithm (KBGA) is mathematical modelling meanwhile supply Chain References (SCOR) is simulation modelling There are many purpose of supply chain optimisation modelling for example to optimise the entire supply chain network, subproblem of the supply chain or optimise within certain period of time or certain constant parameters. The practical usage of the supply chain modelling depends to the complexity of the supply chain modelling itself whether to be used by academicians or industry practitioners. KBGA had implemented mode of transportation in the model. Papageorgiou, (2009) stated that simulation models can be used to study the detailed dynamic operation of a fixed configuration under operational uncertainty, and can be used to evaluate expected performance measures for the fixed configuration to a high level of accuracy. Meanwhile mathematical models are used to optimise high-level decisions involving unknown configurations, taking an aggregate view of the dynamics and detail of operation. Computational modelling limits to the complexity of the modelling system and ease of use.

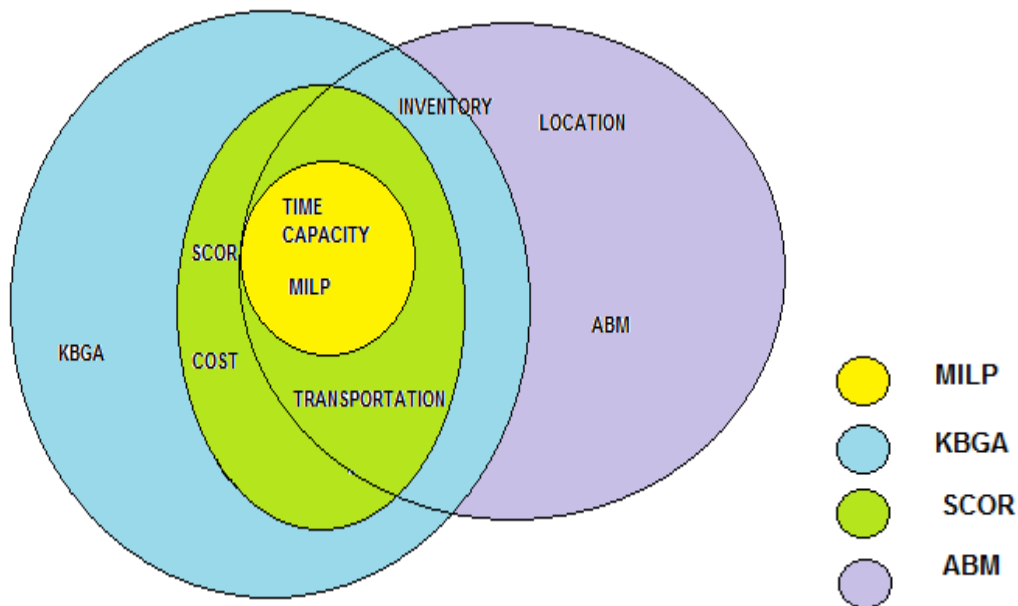


Figure 1: Parameters in Supply Chain Optimisation Modelling

Discussion and conclusions

Optimisation is compulsory in supply chain because it will provide accurate information for all members in the system, well planned manufacturing and delivery process, timing information, efficiency and the capacity to meet the supply and demand in the system. From the discussion in previous chapter, it is obviously that the optimisation is important to guarantee the seamless journey in supply chain. Optimisation in supply chain depends to the four main elements in supply chains which are the capacity, inventory, time and cost. When all the main elements in the supply chain are efficient, the optimisation will be utilised. Optimisation is the basic needs in supply chain as industries nowadays are moving ahead of very competitive environment every single day. Optimisation is crucial especially to decentralised control supply chain which no system have been controlling the entire supply chain which makes it vulnerable to risks and inefficiency process. Furthermore, this finding will also help the researchers to develop or improving the current supply chain optimisation modelling. From the figure 1 above, it shows that five supply chain optimisation modelling sharing the same parameters of time and capacity (supply and demand). It means that these two parameters are the most vital in supply chain optimisation. Apart from these two parameters, cost also represents the important parameters for KBGA, and SCOR for commercialised reason and thus gives implement cost efficiency element in the modelling. It concludes that time and capacity along with the cost for suitability for industrialised used. This is because efficiency also implies total benefits divided among the players and this means cost plays a major part in determine the effectiveness (Guardiola, Meca and Timmer, 2007). As in a nutshell, the findings of this study will help future researcher to determine the type of supply chain optimisation modelling to be use with the suitable parameters.

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OVERVIEW OF HALAL SUPPLY CHAIN PROCESS: CASE OF POULTRY INDUSTRY

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ABSTRACT

Purpose: The paper aims to identify and outline the halal supply chain process in the food industry particularly the poultry industry.

Design/methodology/approach: This study was conducted through literature review and face to face interviews. The interviewees comprise those who dealt directly or indirectly in the poultry processing industry and also Muslim scholars in Peninsular Malaysia.

Findings: Findings from the interviews show that the majority of the small abattoirs did not bother to follow the *halalan toyyiban practice* as underlined by Syariah Islamic perspectives. This means that even though the product is *halal* it is not consumable due to the lack of hygiene being practiced. The literature review provides evidence that studies that viewed food supply chain from Islamic perspectives are lacking. This has limited in-depth discussions on the issue. Similarly, the concepts of supply chain and logistics are also new to the Muslim scholars.

Research implications: This research could create awareness among the consumers, manufacturers, logistics service providers, suppliers as well as the government on the importance of implementing halal supply chain.

Practical implications: This research also provides guidelines to the practitioners on various halal control points that need to be given attention.

Originality/value: Fewer attempts have been made by researchers in applying Islamic concepts and principles into specific disciplines such as supply chain. Even though many studies have focused on halal issues and supply chain issues, but the two have been conducted in isolation. Thus, this study contributes to knowledge by integrating the two disciplines and come out with the *halal* supply chain.

Keywords: *halal*; *halal* supply chain; poultry; abattoir

Paper type: Research paper

Introduction

The halal concept is increasingly receiving a wide attention nowadays. This is because the demand for halal food consumption is increasing annually due to the increasing of Muslim population globally, which is approximately 1.8 billion people. Yousef (2010) highlighted that the halal food market constitutes about 16 percent of the world food trade in which the trade value has been estimated at US\$547 billion in the global halal market (Anonymous, 2010a). Consequently, the trend has attracted the attention of all countries to generate more halal food producers.

In a largely Muslim country such as Malaysia, the halal concepts is apprehended through various activities to the public and industry players such as awareness of halal concept, training of personnel, offering facilities and also encourage foreign direct investment. This notion is not only for the food sector, it is also including for non-food sectors such as pharmaceuticals, cosmetics and financial services. Therefore, Malaysian government had designated particular area in every state known as

halal hub or halal park as to inspire halal products enhancement. Facilities provided at the halal hub for the halal manufacturers and industry players stimulate local and foreign investors to invest in Malaysia which can boost the international market of the halal industry.

Nonetheless, recently Muslims realize that the halal concept is not only confined to food on the other hand it is also including the process of distribution, handling, packaging and storage. The concept of halal and also *toyyiban* as 'wholesome' as stipulated in Islam covers nutritious, quality, cleanliness and safety for everyone and not meant only for Muslim society which can be practice in a production of food product. For instance, the halal authentication of food products must cover from the source of raw materials to the consumers. Accordingly, any activities along the supply chain such as handling, storage and distribution must be syariah compliant which *halalan toyyiban* concept can be applied. Any halal products cannot be mixed with haram products and must be segregated (Jaafar et al., 2011a). This has formed halal supply chain significantly broadly accepted and acquired by the consumers that also will increase demand for halal supply chain within the halal food industry players.

In addition, recently consumers are not only concerns on the halal of the product itself but also the processes that are involved with it. Consumers chose to buy the particular halal products as the product has went into halal process. Therefore, the main issue which can be seen today are the issues related to halal logistics where the industry players do not clearly understood the concept of halal logistics and frequently is being misunderstood by the industry players. For them halal logistics means adding extra cost such as compartmentalized the warehouse, food segregation according to its nature and others. So, company will reluctant to apply halal logistics and this is will create barrier of implementing halal logistics in the halal food industry. Furthermore, awareness of halal logistics needs to be informed and exposed to the industry players and as well as to the public.

Previous studies on halal had looked into aspects of intention on halal purchase (Shaari and Arifin, 2009); satisfaction towards halal products (Danesh et al., 2010); institutional issue (Othman et al., 2009); quality aspects of food industry (Talib et al., 2009); and (Omar et al., 2008); traceability in the meat chain (Gellynck et al., 2002); slaughtering influence product quality (Petracci et al., 2010) and consumption of halal food (Hamlett et al., 2008). Whereas in the area of food research, studies have been done on effective management of food safety and quality (Manning and Baines, 2004); quality assurances in the food supply chain (Manning et al., 2006); the traceability data management for food chains (Folinas et al., 2006); agri-food (Da Xu, 2011) and (Hobbs and Young, 2000). Halal logistics research focus on information technology (Bahrudin et al., 2011); applying halal in the supply chain management (Tieman, 2011); integration of supply chain (Nik Muhammad et al., 2009) and halal processed food (Kamaruddin et al., 2012); halal logistics innovation (Jaafar et al., 2011b); human resource (Pahim et al., 2012a, Pahim et al., 2012b); and halal supply chain focusing on food (Omar and Jaafar, 2011). As a result, this research differs from other studies on halal and other food and agri-food chain which has been identified previously.

With regards to that, this on-going study is aimed at identifying each control point of the halal products along the supply chain process so as to ensure the *halalness* of the food product supplied to the consumer. This is known in the industry as the concept of 'from farm to fork' or 'from farm to table'. Therefore, the study will be focusing on the poultry industry in the Klang Valley, Malaysia.

Background of Study

Understanding the Concept of Halal

Halal is an Arabic word which means lawful or permissible by Islamic laws. By definition, halal includes anything that is free from any component that Muslims are prohibited from consuming. The opposite word for halal is haram meaning prohibited or forbidden in Islam. In cases where people are unsure whether the food is halal or not (i.e., referred to as 'Syubhah') they have to avoid taking it. The Prophet (peace be upon Him) has a provision guideline concerning Syubhah, which is reported by Bukhari, Muslim, Abu Daud, Ibn Majah and Darimi:

What is Halal is clear. And what is Haram is also clear. And in between those two is a dubious area in which many people do not know about. So whoever distanced himself from it, he has acquitted himself (from blame). And those who fall into it, he has fallen into a state of Haram.

Therefore, anything that is halal to eat or consume which is considered by Islamic laws can give good impact to the human body and life, as anything that we eat will portray our attitudes and behavior.

As stated in a verse from Surah Al-Maidah (88):

“And eat of what Allah has provided for you [which is] lawful and good. And fear Allah , in whom you are believers”. This means that all Muslims need to eat halal food and avoid prohibited food as prohibited food will give bad impact to the human body and life.

The Implementation of Halal Concept

According to Yousef (2010) the world food trade makes up 16 percent of the halal food market. With 1.8b number of Muslims population in the world, with an increase of about 140 percent Muslims in Europe over a decade and 1.0b Muslims living in Asia, it shows that the Muslim population is increasing and the halal market is widening as well. From this population, about \$66.6bn value of halal food are consumed annually in Europe which is the highest compared to India \$23.6b and China \$20.8b and the least is North America \$16.1b. (Figure 1)

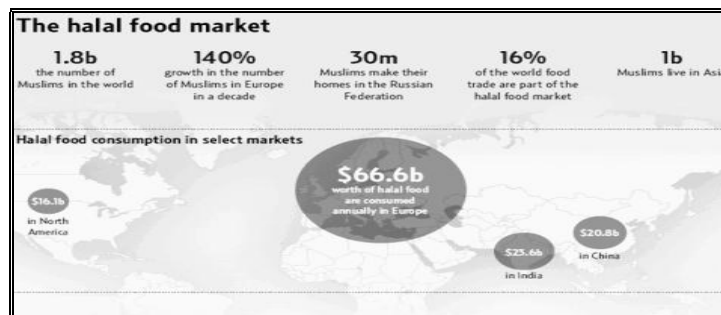


Figure 1 : The Halal Food Market

Source: Yousef, D. K. (2010). "UAE: Halal food numbers look tasty." Size of global Muslim population creates significant customer base. From <http://gulfnnews.com/business/general/halal-food-numbers-look-tasty-1.679007>.

Lanigan (2010) states that the halal market value is about €4.5 billion and €1 billion is for food service usage. Here, the figure has increased twenty times over the last five years and at the same time various halal choices have been initiated by the top French brands such as Fleury Michon, Herta, Liebig and Maggi in order to capture the halal market. The French halal market also is bigger four times than organic market of France.

Malaysia is aiming towards success in the halal industry and the aim is to become a global hub in term of production and trade of Halal products and services; this has been outlined in the Third Industrial Master Plan 2006-2010 (IMP3). In the IMP3, the halal industry covers food, non-food products including pharmaceuticals, health products, medical devices, cosmetics and toiletries; and services including logistics, packaging, branding and marketing, printed and electronic media and travel and tourism (Anonymous, 2006). As a result, nowadays the halal concept has been implementing in various subsectors of the industries in the market.

Development of poultry industry

Development of poultry industry can also be seen from the poultry consumption of a region or country according to human population in those particular areas. Accordingly as the population increases, the market for poultry consumption will also be increasing broadly.

In Asia, the population of Malaysia was about one third the population of Thailand in 2000 but Malaysia is expected to equal the population of Thailand by 2015. The poultry consumption in Malaysia in 2000 was 31.6 per kilogram per person per year and had increased to 35.6 in 2005. For the next two years, the number of chicken taken per kilogram per person per year increased by 1 percent and more less slightly decreased by 1 percent from the year 2008 to 2010. Since the Asian population is almost half of the world population from the year 2000 to forecast the same in 2015, the world poultry consumption is almost double the size of Asia poultry consumption during the year 2000 to 2005. (Table 1).

	Human Population (millions)			Poultry Consumption (kg/person/year)		Chicken (kg/person/year)				
	2000	2010	2015	2000	2005	2006	2007	2008	2009	2010
Malaysia	23	28	30	31.6	35.6	38.5	38.9	38.7	37.8	37.3
Thailand	62	68	70	13.8	11.6	12.4	12.5	11.9	12.1	12.5
Asia	369.8	416.7	439.1	6.8	7.6	-	-	-	-	-
World	611.5	690.9	730.2	10.9	12.6	-	-	-	-	-

Table 1: Asian population and poultry meat consumption.

Adopted Source: <http://www.thepoultrysite.com/articles/1793/european-chicken-meat-consumption-trends-2010> assessed on 16 October 2010

Table 2 shows the projected production of major food commodities in Malaysia in 2010. Malaysia poultry consumption is larger than that of Thailand which is about 21 kilo grams per person per year in the 2005. From the year 2000 – 2010 rice, marine fish and poultry are projected to be the top three highest commodities produced (Anonymous, 2005). Therefore, as a result of poultry consumption being major world food consumption and also the top five food production commodities in Malaysia this study has been carried out and focused on the poultry industry in Malaysia.

Commodity	Metric Tonnes ('000)		
	2000	2005	2010
Padi	2,141	2,400	3,202
Marine Fish	1,286	1,325	1,409
Aquaculture	168	250	662
Beef	17.5	28.5	45.0
Mutton	0.9	1.5	2.3
Pork	159.8	209.0	241.0
Poultry	714.3	980.1	1,295.0
Eggs	399.0	443.0	600.0
Total	4,887	5,637	7,456

Table 2: Projected Production of Major Food Commodities in Malaysia 2010

Adopted Source: Safie, B. A. I., & Yunus (2008). From Farm to Table: Extension perspectives in Malaysia - Focus on critical factors affecting food quality, productivity and safety in crops. International Conference on Agricultural Extension (Agrex08), Putrajaya.

Research Methodology

The framework proposed in this study is based on two stages of data collection. First, four (4) preliminary interviews have been conducted whereby each interview took about an hour. The questions that have been asked covered the informant background, type of company and the current state of poultry slaughtering process. Second, three (3) Muslim scholars, all experts in the syariah perspective were interviewed in order to identify whether the halal concept is being applied in the current process of halal supply chain of the poultry industry.

The first stage of interviews was to identify the current state of poultry processing in the small scale slaughter houses. As the existing process has been identified, the second stage of interviews needed to reconfirm whether the existing slaughtering process is carried out in accordance to syariah. Therefore, from the interviews that have been done, the researcher reached a saturation point as

stated by Glase and Strauss (1967). As a result of the interviews and the saturation point which has been reached by the researcher the proposed framework is developed and confirmed.

Position	Industry	Type of Company	Length of Experience in the industry	Slaughtering Process
Owner	Poultry	Abattoir	More than 15 years	*known
Owner	Poultry	Abattoir	More than 20 years	*known
Owner	Poultry	Abattoir	More than 15 years	*known
Owner	Poultry	Abattoir	More than 20 years	* known

*known to the slaughtering process according to Syariah perspective

Table 3: Background of Informants in the First Stage of Data Collection

Position	Industry	Type of Company /Sector	Length of Experience in the industry	Slaughtering Process
Muslim Scholars	Islamic Department	Public Sector /Government	More than 5 years	*known
Muslim Scholars	Education	Public Sector /Government	More than 20 years	*known
Muslim Scholars	Education	Public Sector /Government	More than 15 years	*known

* Known -- the slaughtering process according to Syariah perspective

Table 4: Background of Informants in the Second Stage of Interviews

Result from the interviews had identified supply chain process encompassing of nutritional feeding and syariah compliance slaughtering which also include proper handling, cleanliness, proper storage and proper packaging will lead to halal supply chain process. It is essential to safeguard the halal food goes through halal supply chain as to provide a halalan toyyiban food to the customers.

Proposed Framework

Figure 2 envisages the proposed conceptual framework of the halal supply chain process which is based on the poultry industry in Malaysia.

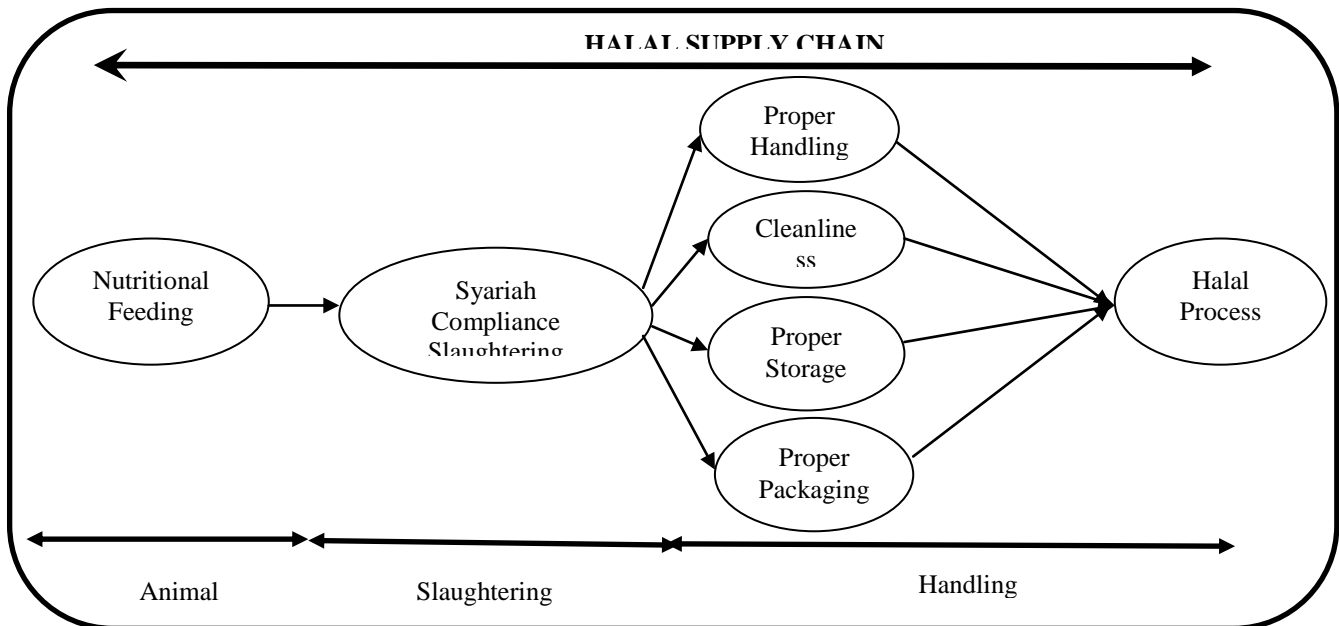


Figure 2 : The Proposed Framework of the Halal Supply Chain.

The proposed framework of halal supply chain process can be classified into four sections namely animal feed, slaughtering, handling and lastly creation of the halal supply chain.

Animal Feeding

The initial in the halal supply chain is animal feeding which is important in order to ensure the halalness of the product at the beginning of the product source. The Department of Veterinary Services (DVS), Malaysia roles and responsibility is enforcing and checking animals at the farm in Malaysia through its veterinary personnel in ensuring the animal is healthy and safe for consumption. There are scheme such as SALT (Skim Amalan Ladang Terbaik) which the farmer must follow and implement in ensuring the animals are healthy and safe food for consumers before selling in the market. This has also been supported by the Malaysian Standard Development System (2004), where a halal food standard has been launched that is the 'Halal Food: Production, Preparation, Handling and Storage – General Guidelines (MS 1500:2009)'. In the MS 1500:2009, it includes the Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP) which lay down the procedure of preparation and handling food that currently under the Malaysian Authority. The first basic requirement in the MS 1500:2009 is the sources of halal animal feed.

In the area of poultry, halal supply chain can be ensured through the animal feeding process whereby the animal is being fed with halal feed mill. At this point, during the feeding stage the feed mill must not contain animal enzymes such as pork even though the purpose is to encourage animal growth. Therefore, nutritional animal feeding is important so as to ensure that everything going into the animal body is halal and the same goes to the customer's body upon eating the animal.

Syariah Compliant Slaughtering Process

The second stage that is the most crucial in the halal supply chain is the 'Syariah Compliant slaughtering processes'. In the slaughtering process, the animal welfare needs to be considering as stipulated in the 'syariah perspective or law'. As in accordance to Syariah the slaughter person must be Muslim, the use of sharp knife to slaughter the animal, recite Tasmiyyah and so on must be follow by those who own the slaughter house (Qardawi, 2002). Even in the abattoir if the slaughter man is Muslim the way they handle the poultry is important during the slaughtering process; this is to ensure the quality, cleanliness and safety of food being offered to the people.

Recently, awareness of halal logo in the market by the consumers make them searching for halal products that have logo. This led to increasing demand for halal products, as well as demands for halal certified products. Currently, Muslim consumers whether teenagers or adults only looking for halal logo but the problem in Malaysia there are numerous halal logos from private companies or government in the market. Thus these make consumers confused and sometimes even only look at the word halal. The above situation is not new in Malaysia because there is no such act for halal. Hence, food manufacturers, food outlets, logistics players, slaughter houses and others have taken this opportunity to use the word or private halal logo in the market. Therefore, the Department of Islamic Development Malaysia (JAKIM) has a role to play in checking and enforcing that food outlets and also the slaughtering process in the abattoirs or slaughter houses are in accordance with Islamic law or Syariah perspective. Awareness of government halal logo to the consumers is important in order to create a '*halalan toyyiban*' environment in Malaysia meaning that in Malaysia the products are not only halal but good to consume.

Handling Process

The third crucial part is the proper handling process after the slaughtering of poultry. The way of handling the poultry can make the halal poultry become non-halal if the materials used to carry non-halal products are being used to carry the halal products. Since halal also comprises quality, cleanliness and safety food therefore the concept of cleanliness is also being applied to poultry handling as well as proper packaging and storage. The types of packaging being used must be halal and do not include any animal hormones from porcine source. Normally, the halal logo only shows halal for the ingredients and does not include the packaging itself. Therefore, the product packaging must also be halal. In terms of storage for poultry whether fresh or frozen, it still remains the same where it cannot be mixed with other non-halal products in the same place so as to avoid contamination. Therefore, proper segregation and dedication is advisable to ensure the halalness of the products and the halal concept is realized. In order to promote the halal concept, Kontena Nasional Sdn Bhd, a Malaysian company and halal certified logistics provider, had launched samak service for containers as value added services (Anonymous, 2010c). It is the first such service offered in Malaysia as well as the whole world in ensuring clean and halal containers are provided in the market through ritual cleansing. This shows that with the support from logistics providers the concept of halal can be achieved.

Halal Supply Chain

Thus, the final poultry process is followed through a halal supply chain which will be obtained after the three stages as explained above. Starting from farm to consumer, all activities along the supply chain must be halal in order to ensure the effectiveness of halal supply chain. This halal process can be achieved after completing or going through all stages in the halal food supply chain in the poultry industry.

Currently, in the food industry existing systems, the Hazard Analysis Critical Control Point (HACCP) is not a concept from farm to table. The thought of HACCP being successfully applied from farm to table concept needs to re-examined, as HACPP alone is not enough and must be supported by other prerequisite programs to assure food safety (Sperber, 2005). Hazard Analysis Critical Control Point (HACCP) is an approach to ensure food safety and pharmaceutical safety at all stages of production and preparation processes which include packaging and distribution and others, rather than inspection at the finished product. It addresses the danger from physical, chemical and biological contamination and acts as prevention. The use of HACCP is to recognize the potential of food safety hazards so that necessary action called Critical Control Points (CCPs) can be taken to reduce the hazard risk (Anonymous, 2010b). As recommended by Bonne (2008), following the Hazard Analysis Critical Control Points (HACCP) principles and incorporating the quality assurance system, halal meat quality can be assured and doubt among the Muslim consumer can be reduced as the HACCP system is recognized internationally. How the system is being done is from beginning to end of the meat supply chain by identifying and monitoring halal critical control points in each of the supply chain activity.

Discussion and Conclusions

Notwithstanding lots of research and review from the literature and problems being identified in the industry, more studies still need to be done on the logistics industry of developing countries particularly Malaysia. Prior studies which have been carried out in other countries can be used as a guideline in establishing the halal supply chain for the poultry industry. As advocated by Bonne (2008),

religion influences the cultural eating habits; therefore to meet the religious-inspired requirements precisely, the halal meat chain needs to be changed by following the Islamic requirements of halal meat production and retailing. This is to ensure that the requirement can be transformed from preferred process characteristic into a set of principles, standards and specification of halal meat production. A HACPP-principle which includes halal control points is required to ensure halal meat status. From this, it can form an integrated quality assurance system by means of monitoring, controlling and guaranteeing of these principles of such institutional body.

The concept of halal can be applied to all and not meant for Muslims only. Therefore, when there is a need for halal products definitely it means creating new and more business for food producers, suppliers and others. The need is to evaluate whether the existing process is already halal whereas consumers are unaware of it. In case it is considered as halal, then the information needs to be disseminated to the public. If not necessary actions need to be taken to ensure the halal nature of poultry is being implemented from farm to customer.

In conclusion, the small, medium and big scale abattoirs and poultry product manufacturers in Malaysia must be thoroughly checked by the relevant parties so as to ensure only halal poultry is being offered in the market. Currently the concept of halal is already being implemented but the concept of 'toyyiba' is normally being ignored by the operators. Therefore, the researchers recommend that proper guidelines for the halal food supply chain need to develop for use by the global halal industry.

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STRUCTURAL EQUATION MODELING IN ROAD ACCIDENT RESEARCH: A LITERATURE REVIEW

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ABSTRACT

Purpose: This study is presented the applications of Structural Equation Modeling (SEM) in Road accident research and identified some significant research gaps for future research.

Design/methodology/approach: This paper is focused on the applications of Structural Equation Modeling (SEM) in Road accident research. A systematic literature review methodology was employed to analyze published applications of the Structural Equation Modeling (SEM) and identify methodological issues gleaned from reviewing those literatures.

Findings: The findings of this paper focus on empirical applications of SEM which include: (1) CFA models; (2) PA models; and (3) SEM models that combine both measurement and structural components. Research studies in the past focused on the association between model and empirical data. However, they lacked of advance statistical analysis of the variables relationship in the model such as Mediator analysis and Moderator analysis etc.

Research limitations/implication: This study was resulted from reviewing literatures related to applications of SEM from the previous publications in the international journals in the past decade. However, this study was excluded other forms of published applications of SEM.

Practical implications: The findings lead to development of SEM model to apply in road accident researches which the developed model is able to describe causes of road accident with more understanding.

Originality/value: The results of this study are presented understanding situation of application of Structural Equation Modeling (SEM) and indicating guideline for road accident research in the future with advance level.

Keywords: Structural Equation Modeling(SEM), Confirmatory Factor Analysis(CFA), Path Analysis(PA), Road accident model, review literature.

Introduction

The Structural Equation Models (SEM) is defined as the method for measuring relationships among latent variables which is originated by Sewall Wright's in 1916 (Bollen, 1989). This model was not used pervasively until 1980 when it was brought by Bagozzi(1980). This technique has been attracted many marketers and consumer behavior researchers since then. For the road accidents researchers, this new statistical approach was not popular at the beginning. But recently, structural equation modeling (SEM) has become well known among those empirical researchers who are conducting researches on the road accidents. Furthermore, Structural Equation Models are employed in many related research articles as a tool to analyze the primary data which appear in the various international journals. Although the SEM application of road accident is used regularly and frequently, there are few guidelines and even fewer standards of the SEM application that researchers remain to conduct analyses, presenting and interpreting the results. Hence, there are still large variances in the results across related publications.

For example, the SEM reviews which appear occasionally found in psychology (Hershberger, 2003), marketing (Baumgartner and Homburg, 1996), MIS (Chin and Todd, 1995; Gefen et al., 2000), strategic management (Shook et al., 2004), logistics (Garver and Mentzer, 1999), and organizational research (Medsker et al., 1994). Even though there are various fields of SEM application, there is no review on road accidents. What is more, there still some issues that researcher should realize about it. Steiger (2001) states that there are many SEM textbooks disregard many significant issues. He notices that it could be insufficient guidance about using SEM correctly. Because of the complexities of using SEM and revealed problems in other fields, a specific review of the literature of road accidents seems to take time and has to be warranted. Accordingly, to conduct the research, there are three objectives. Firstly, we differentiate the published research about road accidents in terms of related criteria such as (1) sample size; (2) variables; and (3) model measurements. At the beginning, we define a different when using two conditions which are frequently used interchangeably in road accident covariance structure modeling (CSM) and structural equation modeling (SEM). Long(1983) mentions that CSM represents a common class of models including ARMA time series models, multiplicative models for multi-faceted data, circumplex models, as well as all SEM models, as well as all SEM models.

Accordingly, it could be seen that SEM models are a subset of CSM models. The current review of SEM models is limited by the researcher because other types of CSM models are not often used in road accident research. In addition, Structural Equation Modeling is defined as a tool to specify, estimate, and evaluate models of linear relationships among a set of variables which are observed in terms of using a generally smaller number of unobserved variables. SEM models consist of observed variables which can be called manifest or measured, measurement variables (MVs) for short and unobserved variables (underlying or latent, LVs for short) that can be a nature independent (exogenous) or dependent (endogenous). LVs, hypothetical constructs, cannot be directly measured because multiple MVs naturally represent the SEM which is served to be indicators of the underlying constructs. Moreover, the SEM model is defined as a priori hypothesis about a pattern of linear relationships among a set of observed and unobserved variables.

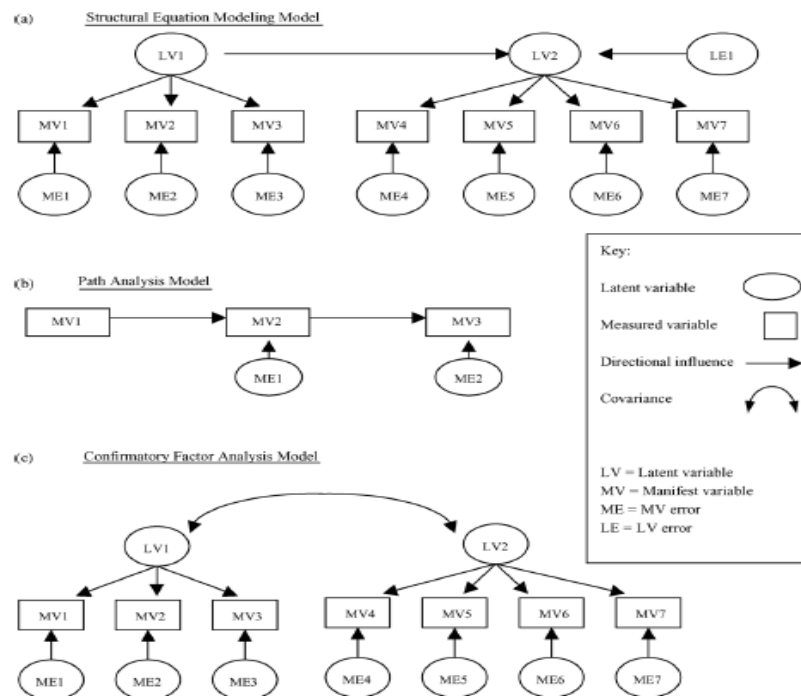


Figure 1 The Presentations of SEM, PA and CFA models (Goldstein and Shah, 2005)

Gefen et al (2000) identify that the main purpose of using SEM is to establish the validity of a priori model rather than to 'find' a suitable model. Therefore, two special cases of SEM that are regularly used in road accident researches are Path Analysis (PA) and Confirmatory Factor Analysis (CFA). The patterns of directional and non-directional relationships are specified by PA models among MVs. Long (1983) notes that to use SEM, researcher has to refer to three model types composed of SEM, PA and CFA as can be seen in figure 1.

Review of published SEM research

In this study, the researcher emphasizes on the articles which have been published internationally under the topic how to apply SEM in the research on the road accidents. The scopes of this research are to study 1) Confirmatory Factor Analysis (CFA models) 2) Path Analysis (PA models) and 3) Structural Equation Models (SEM), which covers both 1) and 2). However, in this research, regression analysis is not included such as Partial Least Squares (PLS) and Exploratory Factor Analysis (EFA models). That is because the analysis of EFA only focuses on measuring variables (MV) and each group of Latent Variables (LV) while the scope of SEM is broader than EFA. The main purpose of regression and PLS models are to predict the variance of explanation in the dependent variable(s) which are compared to the development of theory and testing in the form of structural relationships (i.e. parameter estimation) in SEM. The theoretical difference between these approaches is the critical decision whether to use PLS or SEM (Anderson and Gerbing, 1988). Additionally, the fundamental assumptions in PLS and regression are less constraining than SEM, therefore, this leads to the problems and concerns in conducting these analyses resulting in a significantly different. As a result, regression and PLS models are not included in our review.

Methodology

In this study, a systematic review of literature is used to gain more accurate results and validity. Cook et al. (1997) suggests that to apply a systematic review in the research, it is necessary to explore the systematic way and determine the criteria to select the reports of the previous researches clearly to avoid investigator bias. Moreover, the researcher dedicated to present the results based on the application of SEM in the research on road accidents by using the search term "road accidents" and "Structural Equation Models" in different four main databases including Emerald, SpringerLink, ProQuest and Science Direct.

Critical issues in the application of SEM

Having said about SEM, there are many significant issues which have been considered whether for evaluating a measurement model or examining the fit of structural relationships, separately or simultaneously. In this research, we concentrate on three issues: (1) sample size; (2) variables; and (3) model measurements including issues related to evaluation, interpretation and presentation of results.

Sample size

Sample size issues have been attracted by several authors (e.g., Anderson and Gerbing, 1988; Bentler, 1990; Bentler and Yuan, 1999; Bollen, 1990; Hoogland and Boomsma, 1998). The mostly commonly used SEM estimation methods today are: normal-theory maximum likelihood (ML), generalized least squares (GLS), weighted least squares (WLS), and etc. However, the ML method is frequently used, which also requires a sufficient sample size, particularly when non-normal data are involved. According to Monte Carlo studies of the performance of various estimation methods, there are several proposed heuristics: (1) A minimum sample size of 200 is necessary to reduce biases to an acceptable level for any type of SEM estimation (Kline, 1998; Loehlin, 1998; Boomsma and Hoogland, 2001). (2) Sample size of ML estimation should be at least fifteen times for number of MVs (Stevens, 1996). (3) Sample size for ML estimation should be at least five times of the number of free parameters in the model, together with error terms (Bentler and Chou, 1987; Bentler, 1995); and (4) with strongly kurtotic data, the minimum sample size should be ten times the number of free parameters (Hoogland and Boomsma, 1998).

Adequacy of sample size has a significant impact on the reliability of parameter estimates, model fit, and statistical power. MacCallum et al (1996) question that how large a sample should be for SEM is deceptively difficult to determine because it is dependent upon several characteristics such as number of MVs per LV, degree of multivariate normality (West et al., 1995), and estimation method (Tanaka, 1987). Suggested approaches for determining sample size include establishing a minimum (e.g., 200), having a certain number of observations per MV, having a certain number of observations per parameters estimated (Bentler and Chou, 1987; Bollen, 1989; Marsh et al., 1988), and through conducting power analysis (MacCallum et al., 1996). While the first two approaches are totally different, the latter two have been studied extensively. According to the previous researches on the road accidents, it found that there are several related articles which use both approaches. For the minimum of sample size, 100 sample sizes is the least number which has been used in the SEM application research. Having discussed about sample size, a certain number of observations per parameters estimated has been use widely in international publication.

Variables in SEM model

SEM models consist of observed variables (Measured variable: MV) and unobserved variables (Latent variable: LV) that can be independent (exogenous) or dependent (endogenous) in nature. LVs are hypothetical constructs that cannot be directly measured, and in SEM are typically represented by multiple MVs that serve as indicators of the underlying constructs. The sources of variables have been taken from the previous adapted models. According to the study of SEM application, it could be categorized by three different groups which based on road safety approaches, behavior and psychology approaches, and the integrated approaches.

For the first group, it based on road safety approaches which consist of human factor, vehicles factor and environmental factor (see figure 2).

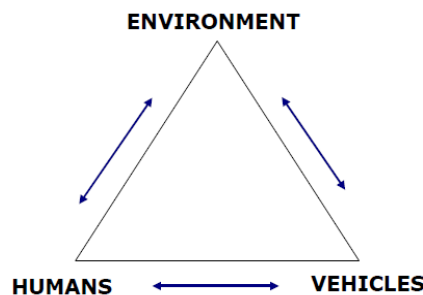


Figure 2 Road Safety Triangle

The triangle concept is based on an intuitive understanding. Among three factors present the relationship in a complex system of road safety. Human-being as those traveling can predefine environment inside or outside moving vehicles. Many different approaches and theories are based on this concept. (e.g. the driver-vehicle interaction(interface), a large area of interest of vehicle manufacturers and psychologists, or vehicle-road interaction, a broad study area of both road and vehicle engineers). Eksler, (2010) agrees that the pyramid concept has been preferred by those researchers and policy makers. The triangle concept has traditionally been used by road safety practitioners and other stakeholders.

For the second group, it based on behavior and psychology approaches, which normally study about the mechanistic of road accidents. In the study of driving behavior, the researcher focuses on the causes of risk-driving, which leads to road accidents such as Risk perception, Attitude, Driving skill, and the mood of Driver. In the study of driving psychology, it has been focused on the decision-making process and the risk perception such as Theory of Planned Behavior (TPB), which is significant principle of these approaches.

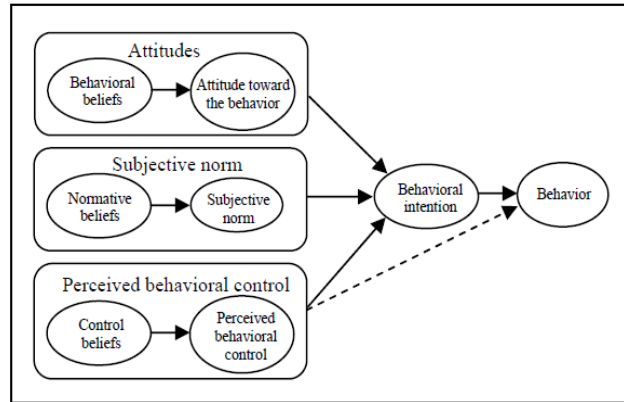


Figure 3 Theory of planned behavior (Piriyawat, 2008)

According to the Theory of Planned Behavior (TPB), the person will behave with causes which they are attitudes toward behavior, deference to Influence of people all around (subjective norm), and their perceptions or beliefs that present their behaviors in the right direction (perceived behavior control). In addition, actual behavioral control does not only believe that it will be controlled, these 3 factors except actual behavioral control still affect to the Behavioral Intention, and aforementioned Intention will push behaving. These 3 factors will be occurred by a fundamental belief as Figure 3.

The last group is a combination (integrated approaches) between first group and second group which is interesting developments because the practical accident cannot be categorized and divided into clear causes. There is a complexity of characteristics and mechanisms in accident occurrences. These developments will enable us to more understand the mechanism of accident occurrences. However, the study still is not found clear principles in integrating factors.

Model Measurements

The study was found that most research was focused on measuring the compatibility of Structural Equation Modeling (SEM) and data collected, determining the influence of direct effect and total effect to explain the causal relationship of latent variables in SEM, and including confirmatory factor analysis of latent variables and observed variables. Nevertheless, the study was found the interesting point of the application of SEM. The research works relating to road accidents still have used correlational research to study the casual relationship of variables which have presented the influence of variables consisting of direct effects and indirect effects. These influences are transmitted through mediator variables or intervening variables.



Figure 4 Mediator and Moderator effects

The study of application of Structural Equation Modeling (SEM) in research works relating to road accident have not found a study of influence transmitted through Moderator variables which can be found in the laboratory research and correlational research (Baron and Kenny, 1986). In the

model, the analysis of one model may have both Mediating effects and Moderating effects in the same model. The characteristics of Mediating effects and Moderating effects have several Mediating and Moderating variables. So, the model is more complex, which conforms to the complexity of accident occurrences.

Summary

Structural equation modeling is becoming widely used in many research fields, such as Marketing, Education, and Psychology. The Confirmatory Factor Analysis (CFA) and the Structural Equation Modeling (SEM) are able to analysis with Observational Variable (MV), Latent Variable (LVs). Path Analysis (PA) used to analyze and justify type of relationships that is direct or indirect relationship. Therefore, makes it likely that SEM will enjoy widespread used in the future. For SEM application in road accident research should be increase level of analysis to present the influence of variables consisting of direct effects and indirect effects.

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OPTIMUM DESIGN OF SHUTTLE BUS ROUTES WITH SERVICE LEVEL RISKS

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ABSTRACT

Purpose: The purpose of this paper is to model the Shuttle Bus Problem as a variant of the Capacitated Vehicle Routing Problem (CVRP) in which demands by customers appear probabilistically and the minimum service levels are specified. Probability-based constraints are added to the discrete optimization problem with uncertainty in passenger numbers in delivery and pickup at specified stopping points on the bus route.

Design/methodology/approach: Using an evolutionary algorithm in Excel Solver, optimum routes with required service level can be obtained by minimizing the total time spent and travel distance traveled by the vehicles.

Findings: For the numerical problem instances, results show different options generated for separate delivery and pickup, delivery and backtracking pickup and simultaneous delivery and pickup routes. Results are also obtained for single-bus and multiple-bus services for comparison in order to show the effect of different variables.

Practical implications: Three different models are studied and compared. These will help the route planner to understand the behavior of the problem and to select the optimum service to customers. Considering service level and maximum passenger travel time will also have impact on the customer satisfaction.

Originality/value: Different possible options in designing shuttle bus routes are proposed. This paper also proposes to add the service level concept in the optimization of the CVRP.

Keywords: Bus shuttle service, Capacitated vehicle routing problem, Route optimization, Service level, Simultaneous delivery and pickup

Article Classification: Research paper.

Introduction

A typical Vehicle Routing Problem (VRP) concerns the transport of items between depots and customers by means of a fleet of vehicles. The VRP occurs commonly in many real-world supply chain situations which attract many research attentions. Examples of VRP are mail delivery, school bus routing, airport shuttle service, waste collection, product distribution, parcel delivery and pick-up, dial-a-ride systems, and many others. In general, solving a VRP means to find the best route to service all customers using a fleet of vehicles. The solution must ensure that all customers are served, respecting the operational constraints, such as vehicle capacity, limitation in travel distance or travel time, and the driver's maximum working time, etc. The objective is to minimize the total distance or the total transportation cost. For single vehicle without capacity constraint the simple VRP becomes a traveling salesman problem (TSP). Extension to this is the parallel TSP when multiple vehicles are allowed to travel along different routes and each location on the routes is visited only once. Combining the various elements of the problem, a whole family of different VRPs can be defined. For example when vehicle capacity must be considered in the problem, it becomes a capacitated vehicle routing problem (CVRP) which was introduced by Dantzig and Ramser (1959). A related problem is the VRP with backhauls; that is the problem in which each vehicle can both deliver goods and collect product such as wastes but it must complete all deliveries

before starting to collect. The integration of forward logistics and reverse logistics in supply chain has also resulted in the development of vehicle routing problem variant namely, capacitated vehicle routing problem with simultaneous delivery and pick up (CVRPDP). This problem can be treated as a basic capacitated vehicle routing problem CVRP when either pickup or delivery demand is zero.. All the VRPs are NP-hard which means that the time to solve the problems increases exponentially as the number of required stops increases. However, many heuristics procedures has been proposed which include a popular constructive algorithm based on the classical concept of savings introduced by Clark and Wright (1964). Heuristic methods for solving the VRPs are also demonstrated in Sule (2001) and Ghiani et al. (2004). More recently many metaheuristic methods are widely used and more successful in the optimization of the VRPs (Crispim and Brandao 2005, Tang and Gallvao 2006, Bianchessi and Righini 2007, The and Kachitvichyanukul 2009, Lal et al. 2009, Gajpal and Abad 2009 Kanthavel et al. 2012).

Problem formulation and solution method

The shuttle bus service can be modeled as a basic CVRP or CVRPDP with simultaneous delivery and pickup. It is defined as follows.

Data: A fleet of buses with limited capacity leaving from and return to one terminal, a set of preselected stops with demands for passenger delivery and pickup, a matrix of distances between the terminal and locations of all the stops.

Constraints: Each stop must be served by one bus. Each bus leaves the terminal carrying all the passengers it must deliver and returns to the terminal carrying all the passengers it must pickup. At any point along its tour each bus cannot carry a total passenger load greater than its capacity.

Objective: Minimize of the overall length of the tours or maximum passenger travel time.

Three shuttle bus models are studied in this paper.

1. Separate delivery and pickup: This is a simple model when separate buses are used, those for delivery of passengers from the terminal to their destination and the others are used to pick-up the passengers along the routes back to the terminal. This model will provide more available passenger load capacity.
2. Delivery and backtracking pickup: In this model the same bus travels through all the destinations to deliver all the passengers and then backtrack through the same route to pickup the passengers going to the terminal. The total number of passengers to deliver or pickup must not exceed the bus capacity. The maximum passenger travel time is therefore only half of the total travel time of the bus.
3. Simultaneous delivery and pickup : This final model provides a combined service to deliver and pick-up passengers at the same stops. The net vehicle load must be calculated to consider both the delivery demand and pickup demand at each stopping point. The net load at each stop must also meet the bus capacity as a constraint.

These three models for a single bus can be shown in Fig.1

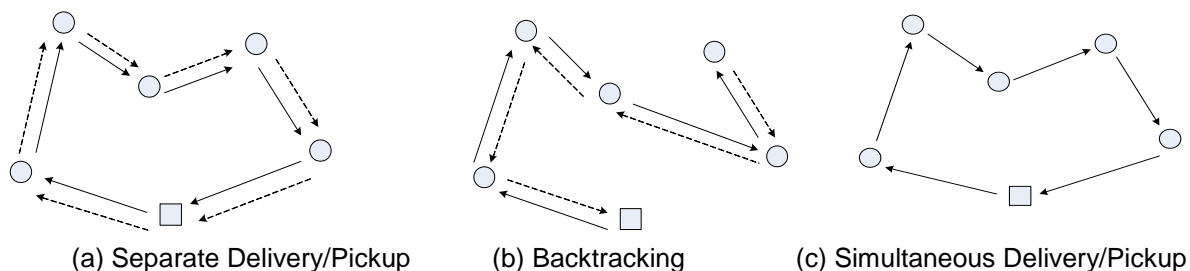


Figure 1: Shuttle bus models

The quantitative models can be conveniently built by using Excel spreadsheet. The Evolution Solver can find the solutions of the optimization problems created for three different shuttle bus models. For the CVRP, it has been shown that this approach performs quite well compared to other heuristic methods (Lal, 2009). To make sure that the best solution is found in each case few replications of the optimization starting from different initial solutions should be performed.

Service Level

The concept of service level is borrowed from industrial situation involving inventory availability. In this paper a service level (SL) will defines the availability of the bus capacity when compared to the demand. A service level of 95 % means that there is a risk of 5 % that the bus capacity is not sufficient to meet the demand of the passengers. Therefore a higher service level means better service availability for the customers. In shuttle bus service design the service level may be define as following:

$$z = (\text{Bus capacity} - \text{Demand}) / \text{SD}$$

and SL > 95 % when $z > 1.645$

SL > 98 % when $z > 2.055$

where SD stands for standard deviation which can be calculated by taking the square root of the variance associated with the demand. For the separate delivery and pick up model and the backtracking model the demand is the larger of the total delivery demand and the total pickup demand. In the simultaneous delivery and pickup model the net demands are calculated at the terminal and all stopping points. The largest net demand is used in determining the service level. The optimization models for the shuttle bus routing design with service level risk includes additional constraints on the value of z in the above equation.

Numerical Examples

A numerical example is used to test the performance of the method used for this study. The VRP with simultaneous delivery and pickup has one terminal (node1) and 8 stopping points (nodes 2 to 9). The distances between the nodes are given in Table 1. The demands for delivery and pickup at nodes 2 to 9 are shown in Table 2. Assuming the demands are deterministic or static and the vehicle capacity is at 15 units, this problem is described by Sule (2001) and a solution is obtained by using a modification of the heuristic procedure by Clarke and Wright (1964). The reported solution requires three vehicles with the total travel distance of 132. However, the method used in this paper produces a solution which requires two vehicles with a total travel distance of 111. A comparison is also made for a backtracking model (Sule, 2001) which also shows a much more superior solution to the solution obtained by the CW heuristic procedure.

From	To 1	2	3	4	5	6	7	8	9
1	0	4	7	12	17	26	32	48	56
2	4	0	8	8	6	10	15	22	30
3	7	8	0	15	16	20	21	18	35
4	12	8	15	0	8	9	12	7	10
5	17	6	16	8	0	13	12	20	19
6	26	10	20	9	13	0	6	10	17
7	32	15	21	12	12	6	0	20	15
8	48	22	18	7	20	10	20	0	8
9	56	30	35	10	19	17	15	8	0

Table.1: Distances between stopping points for passenger delivery and pickup (km)

Stop Point	Delivery		Pick up	
	Mean	Variance	Mean	Variance
2	4	0.70	3	0.50
3	3	0.60	2	0.50
4	3	0.50	1	0.25
5	4	0.70	6	1.00
6	5	0.70	4	0.80
7	3	0.25	4	0.40
8	3	0.30	5	0.70
9	2	0.20	3	0.50

Table 2: Mean passenger demands and variances for delivery and pick up.

From the good performance of the method it is then used to solve the Shuttle bus problems under different conditions with uncertain demands. Table 2 contains the data of mean demands and associate variances for delivery and pickup. The additional conditions for the service level requirements are also added to the problems.

The results are obtained for single large bus with a capacity of 32 passengers or two small buses each with an 18 seats capacity. Table 3 shows the results for single bus routing design while Table 4 shows the resulting routes using two buses. The results also show the route distances and service levels which can be satisfied. Given the travel speed of 60 km per hour, a delivery of passengers takes 5 minutes, a pickup of passengers takes 5 minutes, a combined delivery and pickup takes 8 minutes, the total time taken for each route can be calculated as also shown in Tables 3 and 4.

	Route distance(km)	Time (min)	Stops sequence	SL (%)
Separate delivery and pickup	78	118	1,3,4,9,8,6,7,5,2,1	>98
Delivery and backtrack pickup	126	206	1,3,2,5,4,9,8,6,7,6,8,9,4,5,2,3,1	>98
Simultaneous delivery and pickup	86	150	1,3,2,6,7,9,8,4,5,1	>95

Table 3: Routing design with one bus (bus capacity= 32 passengers)

	Route distance(km)	Time (min)	Stops sequence	SL (%)
Separate delivery and pickup	63, 48	83, 68	(1,4,8,9,5,1), (1,3,7,6,2,1)	>95
Separate delivery and pickup	76, 46	96, 66	(1,6,9,8,3,1), (1,2,5,7,4,1)	>98
Delivery and backtrack pickup	82, 56	122, 96	(1,3,8,6,7,6.8.3.1), (1,2,5,4,9,4,5,2,1)	>95
Delivery and backtrack pickup	90, 60	130, 100	(1,3,6,8,9,8,6,3,1), (1,2,5,4,7,4,5,2,1)	>98
Simultaneous delivery and pickup	48, 63	80, 95	(1,2,6,7,3,1), (1,4,8,9,5,1)	>95
Simultaneous delivery and pickup	46, 69	78, 101	(1,2,7,6,4,1), (1,3,8,9,5,1)	>98

Table 4: Routing design with two buses (bus capacity= 18 passengers)

Discussion and Conclusions

The results of the numerical examples provide the following observations:

1. The separate delivery and pickup model generally provides the shortest route distance and total time. However, with separate tours twice the number of buses is required. The shorter time to complete the route may be desirable by the customers.
2. The backtracking model uses only half of the number of buses as required by the separate delivery and pickup model. While the route distance is the longest which means longer cycle time and driver working time, the maximum travel time for passengers is shortest equaling half of the total time of the complete route. Therefore, with proper scheduling customer can enjoy shorter travel time from and to the terminal.
3. Simultaneous delivery and pickup model gives shortest travel distance but take longer total time. This means that customers may not like the lost time for dropping and picking up passengers unless these operations can be made more efficient.
4. With single shuttle bus the service level is lower than the other two models. This means that it will require bigger bus capacity if a 98% service level is required.
5. A higher service level can be achieved with two shuttle buses because of the larger combined capacity and also flexibility in designing the bus routes.
6. With two shuttle buses, a slight increase in the total travel distance and travel time can increase the service level from 95% to 98% by having different stops and sequences.

The above observations can be useful in better understanding the behavior of the shuttle bus problem. Actual situations will also require additional information on the cost of operating buses of different capacities in order to decide on the tradeoff between cost and customer service. This paper describes different models as options for shuttle bus routing design and the mathematical approach which can be used successfully to solve a variant of vehicle routing problem.

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JUST-IN-TIME PRODUCTION PLANNING OF A PAINTING SECTION TO MEET CUSTOMER ORDERS

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ABSTRACT

Purpose: The purpose of this paper is to study the production planning under the just-in-time delivery demand. JIT is a very common arrangement in manufacturing especially in the automotive industry in Thailand. Suppliers are required to strictly follow the daily even hourly schedule of product delivery to a customer. Any delay can cause significant penalty and other expediting costs. This has necessitated most suppliers to avoid the costs by careful production planning and to rely on inventory.

Design/methodology/approach: This paper describes a situation in a car bumper manufacturing plant using a simulation approach to improve its production planning of the painting section. There are 50 combinations of designs and colors of bumpers which have to be produced according to advance orders and meeting delivery requests in just-in-time order cycle of 45 minutes. Although inventory is used to absorb the real-time delivery request, the manufacturer still encounters difficulties in matching its product availability with the real time orders from its customer. Since the product requires large storage spaces and a necessary number of storage dollies in circulation, this also imposes a limit to the inventory level. Frequent changes in production plan and expediting are thus necessary and incur very high cost. A simple spreadsheet simulation model is used to determine a better planning policy.

Findings: The results show that a better policy can be adopted and leads to about 75 percent reduction in the undesirable cost.

Originality/value: The method used in this study shows the importance of selecting a good production planning that can be applied to similar just-in-time environment. This will improve the efficiency in production and allows more effectiveness in meeting real time orders of the customer.

Keywords: Just-in-time production, Production planning, Simulation, Spreadsheet model.

Paper type: Research paper.

Introduction

Improvement in efficiency and effectiveness of the manufacturing operation in any enterprise is an important factor for competitiveness. Thus cost control, high quality and on-time delivery are parts of the effort to attain highest customer satisfaction. Presently, it is found that in many industries in Thailand especially the automotive industry customers demand just-in-time delivery of products from their suppliers. The motivation of this requirement is the reduction in storage spaces and inventory. In the case of a manufacturer of plastic auto-parts with a large car assembly plant as its customer, the just-in-time delivery demand for a big item such as the front and rear bumper set requires a large storage area and the special racks or circulating storage dollies. The production process consists of plastic injection, assembly and painting. The final stage of the manufacturing process is painting and the painting section must carefully design the production plan to meet the customer real time order. However, the current approach is not effective causing over-stocking of some bumper sets while having frequent shortage of the others. This results in special interruption in the production sequence, special premium freight costs, delay penalty costs and storage costs to the facility. In the mean time the company must try to improve and maintain the annual delivery performance evaluated by its customer. Therefore, the management of the company is seeking an improvement to its production planning approach to reduce costs and be more effective in meeting customer demands.

The order process and just-in time delivery

In general the order from the customer consists of a monthly forecast, a weekly forecast, a 3-day advance order list (AON) and real time orders or the committed release. The forecasts are provided by the customer so that the company can plan the pre-order of raw materials for production. The 3-day advance order list will specify the item numbers and quantities of different bumper sets to be produced and ready for delivery as activated by the real time orders. This advance order list specifies 200 bumper sets per day which will be demanded by allowing at least 3 days for production lead time. The committed release is the real time order with a commit number which has to be followed by the delivery sequence to the customer. The just-in-time delivery is synchronized with the takt-time of 2.4 minutes of the customer's production line and allows for lead time for the supplier to transport the products.

Currently the painting section produces 20 bumper sets in one cycle of 48 minutes. The production of the painting section is 100 sets per shift or 200 sets for one day. The delivery truck can carry 16 bumper sets for each delivery cycle of 45 minutes. In a simple approach the company can produce the bumper sets according to the advance orders with given at least 3 days of lead time and meet the customer real time demand. However, this means a very high inventory which requires a large storage area and also more dollies for carrying the products. The current daily production plan adopted by the painting section is to produce according to the 3-day advance order list (AON). Every morning the planner will check the inventory and adjust the production quantities of different bumper sets for the next day list of AON. The planner also tries to maintain a specified level of stock for each type of bumper based on its average demand.

One cause of the problem encountered by the current method of production planning is that the items in the 3-day advance order number (AON) is only a short-term commitment to allow for production lead time. However, on each day depending on the real production demand of the customer the real time order sequence (committed number) generally differs from the AON. When this mismatch of these order sequences causes inadequate inventory and inability to meet actual demand at any time, the company can not deliver the required products and must pay for the disruption in the production process of the customer. Inventory is also in excess for some items which requires more dollies and causing insufficient dollies to be used for the transport of the products.

Study objectives

The objective of this study is to understand the current situation and problems of the existing production planning of the painting section for just-in-time delivery of car bumper sets to its major customer. The study will use a simulation approach to compare different planning policies in order to find a guideline for a better production plan.

Simulation model

Monte Carlo simulation method is a very popular tool in management science for modeling a variety of stochastic problems. It is simple and can be used with Excel to set up and solve many problems. The ability of Excel spreadsheet software is adequate for solving many real life problems on personal computers. The approach in using the simulation technique is described in many standard texts (Barlakrishnan et al. 2007, Lawrence and Pasternack 2002).

The discrete simulation model is developed for this study by using Excel spreadsheet. In order to limit the size of the model it is decided to study the demands of the bumper sets. There are in total of 50 different combinations of design and colors of bumper sets required by the customer. However, some bumper sets have very small demands and it is easier to manage the small demand items separately by producing the required quantity as inventory to satisfy the real time order. It is therefore necessary to determine the maximum inventory quantity with tradeoff between inventory holding cost and the total cost due to stock-out as follows.

Determination of maximum inventory = X pieces for three days

Inventory holding cost = 445 baht / piece/day

Interruption of the production sequence by inserting an item = 12 baht

Penalty cost due to delay = 4370 baht per piece

Premium freight cost for extra delivery = 700 baht

Therefore, $X < (12+4370+700)/(3 \times 445) = 3.80$

From the above approximate calculation of the maximum inventory, it is decided to select all the bumper sets with demands not more than 4 sets in three days. These items will be separately produced in advance according to the AON. Only remaining ten types of bumper sets with medium and large demands are then used in the simulation of production in the planning cycle.

Description of the spreadsheet

The Excel spreadsheet is designed as shown in Fig.1 and the data columns are described in Table 1.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ				
1	JIT Simulation (Car bumpers)										Stock =										25 %										Production ratio based on remaining demand									
2	Color codes: 1=																																							
3	Production 2 shifts (100 pcs/shift) per day. Three days forecast with one day demand from customer																																							
4	#	Rnc Col	Stock										Demand										Ratio																	
5			1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10								
6	0		30	20	20	15	15	10	10	10	10	10	10	150	120	80	80	60	60	40	40	40	40	40	40	40	600	0	20	33	47	57	67	73	80	87	93	100		
16	10	62	5	27	18	19	14	14	10	9	10	9	10	140	117	78	79	59	59	40	39	40	39	40	39	40	590	0	20	33	46	56	66	73	80	87	93	100		
17	11	85	8	27	18	19	14	14	10	9	9	9	10	139	117	78	79	59	59	40	39	39	39	39	39	40	589	0	20	33	47	57	67	73	80	87	93	100		
18	12	59	5	27	18	19	14	13	10	9	9	9	10	138	117	78	79	59	58	40	39	39	39	39	39	40	588	0	20	33	47	57	66	73	80	87	93	100		
19	13	14	1	26	18	19	14	13	10	9	9	9	10	137	116	78	79	59	58	40	39	39	39	39	39	40	587	0	20	33	47	57	66	73	80	87	93	100		
20	14	61	5	26	18	19	14	12	10	9	9	9	10	136	116	78	79	59	57	40	39	39	39	39	39	40	586	0	20	33	47	57	66	73	80	87	93	100		
21	15	36	3	26	18	18	14	12	10	9	9	9	10	135	116	78	78	59	57	40	39	39	39	39	39	40	585	0	20	33	46	57	66	73	80	86	93	100		
22	16	0	1	25	18	18	14	12	10	9	9	9	10	134	115	78	78	59	57	40	39	39	39	39	39	40	584	0	20	33	46	57	66	73	80	86	93	100		
23	17	96	10	25	18	18	14	12	10	9	9	9	9	133	115	78	78	59	57	40	39	39	39	39	39	39	583	0	20	33	46	57	66	73	80	87	93	100		
24	18	84	8	25	18	18	14	12	10	9	8	9	9	132	115	78	78	59	57	40	39	38	39	39	39	39	582	0	20	33	47	57	66	73	80	87	93	100		
25	19	47	4	25	18	18	13	12	10	9	8	9	9	131	115	78	78	58	57	40	39	38	39	39	39	39	581	0	20	33	47	57	66	73	80	87	93	100		
26	20	58	5	25	18	18	13	11	10	9	8	9	9	130	115	78	78	58	56	40	39	38	39	39	39	39	580	0	20	33	47	57	66	73	80	87	93	100		
27	21	14	1	28	21	21	15	13	11	10	9	10	10	149	114	78	78	58	56	40	39	38	39	39	39	39	579	0	20	33	47	57	66	73	80	87	93	100		
28	22	37	3	28	21	20	15	13	11	10	9	10	10	148	114	78	77	58	56	40	39	38	39	39	39	39	578	0	20	33	47	57	66	73	80	87	93	100		
29	23	11	1	27	21	20	15	13	11	10	9	10	10	147	113	78	77	58	56	40	39	38	39	39	39	39	577	0	20	33	46	56	66	73	80	86	93	100		
30	24	35	3	27	21	19	15	13	11	10	9	10	10	146	113	78	76	58	56	40	39	38	39	39	39	39	576	0	20	33	46	56	66	73	80	86	93	100		
31	25	27	2	27	20	19	15	13	11	10	9	10	10	145	113	77	76	58	56	40	39	38	39	39	39	39	575	0	20	33	46	56	66	73	80	86	93	100		
32	26	49	4	27	20	19	14	13	11	10	9	10	10	144	113	77	76	57	56	40	39	38	39	39	39	39	574	0	20	33	46	56	66	73	80	86	93	100		
33	27	7	1	26	20	19	14	13	11	10	9	10	10	143	112	77	76	57	56	40	39	38	39	39	39	39	573	0	20	33	46	56	66	73	80	86	93	100		
34	28	57	5	26	20	19	14	12	11	10	9	10	10	142	112	77	76	57	55	40	39	38	39	39	39	39	572	0	20	33	46	56	66	73	80	86	93	100		
35	29	4	1	25	20	19	14	12	11	10	9	10	10	141	111	77	76	57	55	40	39	38	39	39	39	39	571	0	19	33	46	56	66	73	80	86	93	100		
36	30	86	8	25	20	19	14	12	11	10	8	10	10	140	111	77	76	57	55	40	39	37	39	39	39	39	570	0	19	33	46	56	66	73	80	86	93	100		
37	31	57	5	25	20	19	14	11	11	10	8	10	10	139	111	77	76	57	54	40	39	37	39	39	39	39	569	0	20	33	46	56	66	73	80	86	93	100		
38	32	18	1	24	20	19	14	11	11	10	8	10	10	138	110	77	76	57	54	40	39	37	39	39	39	39	568	0	19	33	46	56	66	73	80	86	93	100		
39	33	58	5	24	20	19	14	10	11	10	8	10	10	137	110	77	76	57	53	40	39	37	39	39	39	39	567	0	19	33	46	56	66	73	80	86	93	100		
40	34	34	3	24	20	18	14	10	11	10	8	10	10	136	110	77	75	57	53	40	39	37	39	39	39	39	566	0	19	33	46	56	66	73	80	86	93	100		
41	35	16	1	23	20	18	14	10	11	10	8	10	10	135	109	77	75	57	53	40	39	37	39	39	39	39	565	0	19	33	46	56	66	73	80	86	93	100		
42	36	76	7	23	20	18	14	10	11	9	8	10	10	134	109	77	75	57	53	40	38	37	39	39	39	39	564	0	19	33	46	56	66	73	80	86	93	100		
43	37	7	1	22	20	18	14	10	11	9	8	10	10	133	108	77	75	57	53	40	38	37	39	39	39	39	563	0	19	33	46	56	66	73	80	86	93	100		
44	38	61	5	22	20	18	14	9	11	9	8	10	10	132	108	77	75	57	52	40	38	37	39	39	39	39	562	0	19	33	46	56	66	73	80	86	93	100		
45	39	71	6	22	20	18	14	9	10	9	8	10	10	131	108	77	75	57	52	39	38	37	39	39	39	39	561	0	19	33	46	57	66	73	80	86	93	100		
46	40	46	3	22	20	17	14	9	10	9	8	10	10	130	108	77	74	57	52	39	38	37	39	39	39	39	560	0	19	33	46	56	66	73	79	86	93	100		
47	41	87	9	26	22	19	16	11	12	11	10	11	12	149	108	77	74	57	52	39	38	37	38	39	39	39	559	0	19	33	46	57	66	73	80	86	93	100		

Figure 1. Excel spreadsheet for the production of car bumpers

Column	Description
A	Commit number or real time order for each bumper set
B	Random number
C	Type of bumper set to be delivered (committed order)
D to N	Inventory levels of 10 types of bumper sets
O to Y	Remaining demands for 3 days
Z to AJ	Ratios of remaining demands
AK to AU	Production quantities for the bumper sets for every 20 sets
AV to BF	Daily AON for 200 different bumper sets
BG to BP	Stockout for a bumper set required by real time order

Table 1. Descriptions of the columns in Excel spreadsheet.

The data used in the trial spreadsheet simulation is the actual 3-day advance orders (200 AON per day for six days) and 1200 real time orders (committed orders for six days) generated by random number as in the Monte Carlo method during a production period in a given month.

Two different production policies with different stock levels are tested in the simulation. These are:

Policy 1: Production of bumper sets follows the 3-day advance order numbers (AON) and maintain 20 percent inventory level. This is the current policy adopted in the production planning.

Policy 2: Production of bumper sets with the mix based on the ratio of their remaining advance orders and maintain inventory as a percentage (20%, 15%, 10%) of the demands.

The results are encouraging and significant cost reduction can be found in using the new planning decision with Policy 2. The actual 1091 commit numbers or real time orders for the production period are then used instead of using the random number generation method. The results are therefore compared under the situation and shown in Table 2.

Description	Unit cost (baht)	Policy 1 (stock 20%)		Policy 2 (stock 20%)		Policy 2 (stock 15%)		Policy 2 (stock 10%)	
		time/unit	baht	Time/unit	baht	time/unit	baht	time/unit	baht
Inserting an item in paint sequence	12	29	348	0	0	5	60	22	264
Delay penalty	4,370	29	126,730	0	0	5	21850	22	96,140
Premium freight	700	29	20,300	0	0	5	3,500	22	15,400
Average inventory holding	445	105	46,725	104	46,280	73	32,485	46	20,470
Total			194,103		46,280		57,895		132,274

Table 2 Comparison of the simulation results

Conclusions and suggestions

The planning of production in the final stage of manufacturing car bumpers to satisfy just-in-time delivery demand has incurred excessive cost to the company in this study. The production of different types of bumper sets follows the advance orders which allows at least 3 days for the production lead time. However, it is costly to build up the required inventory to meet the actual real time demand. The limited availability of storage areas and circulating dollies to carry the products also prevent the company to use a simple production planning approach with large inventory. The currently adopted planning policy is to produce according to the 3-day advance order list from the customer. However the real time orders (commit order numbers) received by DATA LINK from the customer depend on the actual production situation at the customer's production line. This study shows that the painting section should adopt a new policy in production planning by producing each type of bumper set according to the ratio of the remaining advance orders. The simulation results show that the new production policy performs better than the current policy and the significant cost reduction of about 75 percent can be achieved. The study also allows following general observation about just-in-time delivery in a similar situation:

1. Advance commitment with sufficient production lead time is helpful to the supplier.
2. Real time order (on-line) should agree with the advance order as much as possible to avoid interruption in the supplier's production plan and necessity of inventory to cover the uncertainty.
3. Supplier should track the commitment and delivery of each product. Production must then be based on the remaining advance orders.
4. Short production lead time and spare capacity outside normal production cycle will be useful in correcting and adjusting the production in order to maintain just-in-time delivery required by the customer.

Although this study provides certain guidelines to reduce the cost of just-in-time delivery for the company, it is limited by investigating only the decision about the production mix in each production cycle of the painting section. However, further investigation may be useful by studying the inventory level for each product type and determining the best inventory policy.

References

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