

ICLT 2013

THE 5th INTERNATIONAL CONFERENCE
ON LOGISTICS & TRANSPORT 2013



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THE 5th INTERNATIONAL CONFERENCE ON LOGISTICS & TRANSPORT 2013 (ICLT 2013)

“SUSTAINABLE SUPPLY CHAIN MANAGEMENT IN ASIA PACIFIC”

November 5-8, 2013.

Doshisha University, Kyoto, Japan

INTRODUCTION

This is the 5th international conference organized by the Thai researchers' consortium of Value Chain Management and Logistics (ThaiVCML), the Centre for Logistics Research at Thammasat Business School, Thammasat University and the Faculty of Engineering, Chiang Mai University. This is major event for researchers in transport, logistics, supply chain and value chain management. This year's event in Kyoto, Japan continues with successful conferences held in Chiangmai (Thailand), 2009; Queenstown (New Zealand), 2010; Male(Maldives), 2011 and Chiangmai (Thailand), 2012. This year's event is held during 5th – 8th November 2013 which is hosted by the Faculty of Commerce, Doshisha University in Kyoto.

Under the theme of “Sustainable Supply Chain Management”, the following topics werewelcomed at the conference:

- Procurement & Supply Management
- Supply Chain Design/Configuration
- Planning & Forecasting
- Supply Chain Risk
- Relationship & Collaboration
- Sustainable Supply Chain
- Production Planning & Operations
- Production & Inventory
- Inventory Fulfilment
- Supply Chain Performance
- International Logistics
- Global Supply Chain
- Humanitarian Logistics
- Multimodal transport
- Maritime Logistics
- Freight Logistics
- Logistics Service Providers
- E-Logistics
- Logistics Development Policies
- Logistics Facilitation

The conference best paper of this year will be speciallyselected and considered for publication in the International Journal of Physical Distribution and Logistics Management and there will be a special ICLT2013 issue in the International Journal of Logistics Research and Applications. The selected papers will undergo future blind review from our scientific committee panel.

WELCOME ADDRESS FROM THE CONFERENCE CHAIRS

On behalf of the organising committee, we would like to welcome all participants to the 5th international conference on Logistics and Transport (ICLT 2013). It has been 5 years since the first conference was hosted in Chiangmai (Thailand). This ICLT conference is expected to continue on an annual basis in order to facilitate the sharing of ideas, research findings, and teaching directions related logistics and supply chain from an academic perspective.

The theme for this year's event is "Sustainable Supply Chain Management in Asia Pacific". This theme is a reflection and an extension of ICLT2012's theme, "Supply Chain Risk Management in Asia Pacific" and tries to further explore the growing importance of "Sustainable Supply Chain Management" in today's business world.

"Sustainable Supply Chain Management" is a concept that still remains fuzzy with numerous interpretations. Sustainability can be understood based on 3 dimensions: (1) economic sustainability; (2) environmental sustainability and (3) social sustainability. The challenge to identify the balance between these 3 seemingly opposite objectives remains an elusive challenge.

Nonetheless this concept does lead to greater opportunities in reviewing and revising processes, operations, and production activities that can comply with this given paradigm. Other potential advantages of sustainable supply chain management can cost reduction, waste reduction, cycle time reduction, risk mitigation, and asset utilization.

We would like to sincerely thank all presenters, reviewers, our scientific committees, and keynote speakers for their appreciated contribution. We also apologise in advance if there are any difficulties you may encounter while participating the conference. Finally, we hope that you will enjoy this conference and we hope that the deliberations will be fruitful and successful.



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TABLE OF CONTENTS

A causal relationship model of green supply management and competitiveness <i>Porpan Vachajitpan</i>	1
A methodological framework on airport performance measurement <i>Bérengère Pin, Poti Chao, Apichat Sopadang</i>	9
A multi-objective optimization of the fleet sizing problem for Thai rice exporter: a case study <i>Rachata Khumboon</i>	19
A pilot study on the attractiveness of container terminal operators <i>Taih-cherng Iirn, Kuo-chung Shang</i>	28
A sustainable Logistics network framework development <i>Kamol tharuarak, Shahyahan Khan, Vuttichai Chatpattananan</i>	35
An empirical investigation on the implementation of green practices in the Logistics service industry <i>Pietro Evangelista, Jukka Hallikas, Anni-Kaisa Kähkönen</i>	42
An empirical study of truck payload allocation <i>Areekamol Tor.Chaisuwan, Nakorn Indra-Payoong, Sarawut Jansuwan</i>	50
An exploratory study of thai SMEs supply chain management practices <i>Therakorn Yardpaga, Phil Megicks, Dongping Song</i>	59
An investigation into the freight pick-up delivery activities in city center of Jakarta <i>Nahry, R. Jachrizal Sumabrata</i>	68
Analysis of optimal number of manual and e-toll service gates at Laem Cha Bang port <i>Usa Sathitmon, Pairoj Raathanachonkun</i>	76
Application of ramp-up management methods for job production <i>Dipl.-Wirtsch.-Ing. Henning Strubelt, Prof. Dr.-Ing. Hartmut Zadek</i>	84
Challenges in delivery fulfilment of online shopping <i>Veron Tai, Max Ee, Yan Weng Tan</i>	92
Container shipping trends and their impact on port development and competitiveness <i>Wei Yim Yap, Yan Weng Tan</i>	99

Critical evaluation of Mandalay dry port, Myanmar	107
<i>John Black, Thida Kyu, Violeta Roso, Kam Tara</i>	
Development of green supply chain performance indicators for an Arabica coffee chain	115
<i>Rungchat Chompu-Inwai, Pischanok Jamigranont</i>	
Dynamic facility location problem for Mae Moh mine	123
<i>Poon Thiengburanathum, Thanakorn Saungkaew</i>	
Factors effecting decision making on electronics industry supply chain redesign within Asean economic community	131
<i>Sakgasem Ramingwong, Korrakot Yaibuethet Tippayawong, Apichat Sopadang</i>	
Halalan Toyyiban supply chain the new insights in sustainable supply chain management	137
<i>Emi Normalina Omar, Harlina Suzana Jaafar, Muhamad Rahimi Osman, Nasruddin Faisol</i>	
Implementation of governmental Logistics policies to enhance competitiveness in Thailand's industrial sector	145
<i>Korrakot Yaibuathet Tippayawong, Apichat Sopadang, Sakgasem Ramingwong</i>	
Improving the value of the information service flow in Logistics process integration	155
<i>Kari Korpela, Sirpa Multaharju, Jukka Hallikas</i>	
Influence of culture and cultural differences on supply chain risks	164
<i>Sakgasit Ramingwong</i>	
Issues and challenges in implementing halal Logistics	172
<i>Azlina Hj Muhammad</i>	
Managing effective Logistics and supply chain management for Thailand's one tambon, one product (OTOP)- a way to creating sustainable business	178
<i>Taweesak Theppitak</i>	
Managing lateral transshipments in a supply chain environment	184
<i>Dilupa Nakandala, Henry Lau</i>	
Non-hierarchical connections in a transportational AHP model	192
<i>Szabolcs Duleba</i>	
Opportunities and challenges of Logistics in a hyper-aged society	197
<i>Jimyoung Lee</i>	
Outsourcing in humanitarian Logistics in Thailand	205
<i>Thomas E. Fernandez, Ruth Banomyong, Nanthi Sutthikarnnarunai</i>	

Performance of transportation service provider: a literature review <i>Hatairat Bandittayarak, Piyawat Chanintrakul</i>	212
Supply chain network design under RFID adoption <i>Yu-Chung Tsao, Chia-Hung Chen</i>	219
Targeting industry for Thailand East-West economic corridor <i>Wapee Manopiniwes, Sakgasem Ramingwong, Varattaya Jangkrajarn</i>	224
The analysis of information architecture model of tourism Logistics websites <i>Lachana Ramingwong</i>	232
The concept of halal Logistics – an insight <i>Harlina Suzana Jaafar, Emi Normalina Omar, Muhamad Rahimi Osman, Nasruddin Faisol</i>	240
The conceptual framework of lean Logistics in Malaysia <i>Azlina Hj Muhammad</i>	246
The delay cost of truck and freight pricing practices <i>Areekamol Tor.Chaisuwan, Nakorn Indra-Payoong, Sarawut Jansuwan</i>	252
The development of reverse Logistics performance assessment tool <i>Rujirat Theantanu, Atita Kongkarattanak, Sathaporn Opananon</i>	262
The impact of weather changes to pedestrian rail commuters: an overview <i>Hasmi Mokhlas, Norlida Abdul Hamid</i>	270
The role of capabilities in Logistics service business <i>Sirpa Multaharju, Jukka Hallikas</i>	274
The role of responsible buying practices in supply risk management <i>Jukka Hallikas, Anni-Kaisa Kähkönen, Katrina Lintukangas, Pietro Evangelista</i>	282
Using online geocoding and directions map services to enhance the capability of route planning and management systems <i>Trasapong Thaiupathump, Rungchat Chompu-Inwai</i>	289
Vulnerability in supply chain risk management <i>Jyri Vilko, Lauri Lättilä</i>	295

A CAUSAL RELATIONSHIP MODEL OF GREEN SUPPLY MANAGEMENT AND COMPETITIVENESS

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Introduction

In the past, supply chain management (SCM) as a business function was concerned mainly with only bottom-line financial considerations. However, for more than two decades many purchasing and supply chain professionals have understood the impacts that purchasing and SCM have on social, economic and environmental processes and systems. The term "triple bottom-line" becomes an accepted objective in the business community. Research in this area has consistently shown that professional purchasers and SCM managers who consider environmentally preferable criteria in the procurement have the influence to reduce or even eliminate waste and environmental impacts as well as reduce costs. In fact, global experience and examples show how environmentally preferable criteria early in the procurement process improve the organizations' environmental performance, while addressing ethics, social and economic concerns.

Overall, the implementation and integration of green SCM concepts which contributes to an organization's green procurement can allow an organization to prevent or reduce financial and environmental risk. Alternatively, organizations may want to involve their suppliers at the design stage or develop a supplier network and pre-qualify suppliers that have responsible environmental management. Green purchasing should bring many important benefits for its practitioners: better corporate image, risk management, production efficiency, stronger supplier relationships, improvements in environmental performance, and enhancing business competitiveness. The concept of supply management is broader than purchasing or procurement. However, in this study the investigation will be restricted to green purchasing decision, supplier selection, cooperation and relationship with suppliers. A theoretical model will be presented to explain the impacts of the commitment to environmental policy and social responsibility on the competitiveness of business firms. The model is assessed by survey data from manufacturing and service companies in Thailand. This paper examines the following research questions:

RQ1. Does commitment on environment have impact on firms' competitiveness?

RQ2. How management support and employee participation impact on green supply management?

RQ3. Do corporate social responsibility and corporate image has impact on green purchasing?

Literature Review

Green CSR and Competitiveness

Since the Intergovernmental Panel on Climate Change (IPCC) released the first assessment report in 1990 citing "unequivocal" proof of global warming caused by man-made emissions of greenhouse gases, many of the big corporations in the world have adopted highly visible "green" strategies, embracing environmentalism in their business operations. These corporations understand that part of their role is to be socially responsible motivated by desire to do what is right. It is not just an attempt to polish their public image and fend off government regulation. Research shows that in a competitive market, the perception about corporate social responsibility (CSR) can be a major differentiation point for companies, but it must be a sincere, deeply held element of the corporation's culture. The rewards for adopting environmentally sound policies within a corporation may take a long time to become clear. However, in the long term, it is believed that companies can profit from well-designed strategies that embrace environmental responsibility with their corporate image. With increasing environmental regulations firms are expected to fulfill socially responsible business practices (Cetindamar, 2001; Pilkington and Dyerson, 2006). In an effort to address supply chain activities centered on environmental awareness, there has been a research stream, green supply chain management, which conceptualizes commitment on environment initiatives (Srivastava, 2007).

The relationship between green supply chain management (GSCM) and economic results has been increasingly studied by researchers. Klassen (1993) and Preuss (2002) argued for integrating environmental issues into the mainstream of SCM. Handfield et al. (1997) suggest that environmental sustainability efforts be integrated throughout the value chain. Whether going "green" really pays has been investigated with some inconclusive results (King and Lenox, 2001; Rao and Holt, 2005). Seuring (2004) questioned whether the adoption of environmental sustainability results in environmental and economic tradeoffs for the supply chain partners. However, there are also empirical studies which show positive relationship between environmental performance and business performance (Hervani et al., 2005; Albino et al., 2009). These studies support the thesis that green performance driven by environmentally conscious supply chain practices also enhances firms' competitiveness. Recently,

researchers has proposed that successful implementation of GSCM practices such as green purchasing, cooperation with customers, eco-design, and investment recovery will lead to improved environmental and economic performance which support improved operational and organizational performance (Green et al., 2012; Lee et al., 2012).

Green Purchasing

Green purchasing is the method wherein environmental and social considerations are taken with equal importance, if not more, to the price, availability and performance criteria used to make purchasing decisions. Green purchasing is also known as “environmentally preferred purchasing (EPP), green procurement, affirmative procurement, eco-procurement, and environmentally responsible purchasing. Green purchasing has been defined as an environmentally conscious purchasing initiative that tries to ensure that purchased products or materials meet environmental objectives set by the purchasing firm. Examples of the objectives are reducing the sources of wastages, promoting recycling, reuse, resource reduction, and substitution of materials (Min and Galle, 2001; Zsidisin and Siferd, 2001). In other words, green purchasing ensures that purchasing or supply chain managers consider the issue of environmental sustainability in the purchasing of inputs, in addition to the traditional purchasing criteria of cost, quality, and delivery (Jimenez and Lorente, 2001; Kannan et al., 2008). Research in green purchasing gains more attention along with green supply chain management. EITayeb et al. (2010) studied the drivers for green purchasing of Malaysian firms with certified ISO 14001. They found international regulations, customer pressures, and expected business benefit having different influences on the green purchasing adoption.

Hamner (2006) summarized some basic green purchasing activities which were in common practices as follows:

- (1) Product content requirements. Buyers specify that purchased products must have desirable green attributes such as recycled or reusable items instead of wastes.
- (2) Product content restrictions. Buyers specify that purchased products must not contain harmful materials or environmentally undesirable attributes such as lead, CFCs, plastic foam in packaging materials.
- (3) Product content labeling or disclosure. Buyers require disclosure of the environmental or safety attributes in the contents of the purchased product. Such disclosure can be done using green seals and indicators of relative environmental impact such as scientific certification system offered by various accepted certification organizations.
- (4) Supplier questionnaires. Buyers send questionnaires to suppliers asking them to provide information about their environmental aspects, activities and/or management systems.
- (5) Supplier environmental management systems. Buyers require suppliers to develop and maintain an EMS. The buyer may require the supplier to certify the system.
- (6) Supplier certification. Buyers require suppliers to have an EMS that is certified as fully compliant with one of the recognized international standards such as the ISO 14001, and the European Union's Restriction of Hazardous Substance (RoHS) directive, Eco-Management and Audit Scheme.
- (7) Supplier compliance auditing. Buyers audit suppliers to determine their level of compliance with environmental requirements.

Supplier Selection

The identification and analysis of criteria for selection and evaluation of vendors has been the focus of attention for many academicians and practitioners. In his seminal work, Dickson (1966) conducted a questionnaire survey mailed to about 300 commercial organizations in the US, primarily manufacturing firms. The purchasing managers of these firms were asked to identify factors that were important for selecting suppliers. The factors ranked according to usage by the organizations are quality (96.6%), price (93.9%), delivery (93.9%), service (81.8%), technical capability (63.6%), financial strength (51.5%), geographical location (42.4%), reputation (42.4%), reciprocal arrangements (15.1%) and other factors (12.1%). Cheraghi et al. (2004) studied the critical success factors for supplier selection of 110 research papers between 1966 to 2001. They concluded that selection criteria continued to change based on an expanded definition of excellence. However, non traditional criteria such as factors representing environmental and CSR issues did not even exist in the list. In recent years, as increasing environmental awareness has favored the emergence of the new green supply chain paradigm, green criteria have been incorporated in the supplier selection decision. In particular, the focus is the incorporation of corporate social responsibility (CSR) and environmental responsibility requirements into supplier selection. Tuzkaya et al. (2009) identified 6 major criteria: pollution control, environmental and legislative management, green product, green image, environmental costs, and green process management”. Awasthi et al. (2010) proposed 12 environmental criteria: use of

environmental friendly technology, use of environmental friendly material, green market share, partnership with green organization, management commitment, adherence to environmental policies, green R&D projects, staff training, lean process planning, design for environment, environment certification, and pollution control initiatives. Wong et al. (2012) extended the criteria to include both environment and CSR for supplier selection.

Supplier relationship

Supplier relationship has been classified into three types. Transactional relationships are the most common and the most basic type of buyer/supplier relationship. This relationship is referred to as an arm's-length relationship where neither party is concerned about the other parties well being. There is very little trust involved in this relationship and it could be a one time transaction between the buyer and supplier. A collaborative relationship is one of mutual benefit to both parties. There is a varying level of trust, but some is required. Companies will cooperate and work together for increased savings and future innovations. As trust and participation are important elements for success, collaborative relationships must be fully supported from the entire organization. A buyer must have the authority to negotiate with a supplier and come to an agreement that carries mutual trust and benefit. The third type of buyer-supplier relationship is the alliance relationship. An alliance is formed for a systematic approach to enhance communication between the two firms. Unlike collaborative relationships, an alliance is built to have a strong trust where both firms can be on the same level and help each other out when needed.

Supplier cooperation and relationship has been a common practice in successful SCM. Extending the supplier relationship from economic-based activities to environmental programs is also becoming common. Green supply chain management is to enhance firms' environmental performance through inter-organizational collaboration with business partners and increase efficiency by cost saving programs and proactive risk management practices (Rao and Holt, 2005). A collaboration in green management supports inter-organizational innovation practices throughout the supply chain from concept to disposal (Gerrard and Kandlikar, 2007; Hong et al., 2009). External coordination with customers and suppliers from product concept to disposal (Linton et al., 2007), and involvement of suppliers are required from the early stage of product development (Huang and Mak, 2000; Gerwin and Barrowman, 2002; Koufteros et al., 2007).

The Research Methods

The literature review provides a theoretical framework to investigate the relationships among firms' commitment to environment, green supply management and firms' competitiveness in this study. A set of hypotheses was developed with a structural model for the statistical analysis. The hypotheses are:

- H1a. Firms with strong commitment to environmental policy and implementation tend to have higher level of management support and employee participation in environmental management.
- H1b. Firms with strong commitment to environmental policy and implementation tend to have higher practice of green purchasing.
- H2. Firms with higher CSR and conscious about corporate image tend to have higher practice of green purchasing.
- H3. A firm's level of management support and employee participation in the environmental management is positively related to the level of green cooperation and relationship with its suppliers.
- H4. Green purchasing decision is positively related to better cost and competitiveness.

The data for the analysis were collected from both manufacturing and service companies in Thailand with 149 respondents and the demographic summary is as follows.

- . Types of business: Manufacturing (83), Service (66)
- . Number of employees: Less than 500 employees (73), Equal or more than 500 employees (76)
- . Certified Environmental Management System (ISO 14001): Yes (95), No (54)
- . Location inside an industrial estate: Yes (85), No (64)
- . Business operations: International (122), domestic only (27).

A questionnaire using 1 to 5 point Likert scale was developed to measure the response from the sample companies. The model constructs and their definitions are listed in Table I. The measurement item descriptions and variables are listed in Table II. Descriptive statistics obtained by using the SPSS software are also presented in Table II. All measured variables are sufficiently normally distributed with skewness and kurtosis coefficients within the -0.069 to -0.976 and 0.227 to -1.014 ranges respectively. Cronbach alpha values were also calculated for the measurement scales and all exceed the recommended 0.70 level indicating sufficient reliability (Garver and Mentzer, 1999). The theorized model is assessed following a structural equation modeling methodology. The traditional path analysis

methodology based on regression analysis described by Kline (1998) is also considered as an appropriate model development and testing methodology. Although the sample size is not large, Hair et al. (2006) argue that sample sizes from 150 to 400 are generally suitable for structural equation modeling analysis with sample size varying according to the complexity of the model and the number of parameters to be estimated.

Table I Construct definitions and variable names

Construct	Definition
Cost savings and competitiveness (COSCOM)	Cost savings and increase in business competitiveness due to the green supply management.
Corporate social responsibility and corporate image (CSRCIM)	Corporate social responsibility and public image of the organization in relation to its environmental management.
Policy and implementation (POLIMP)	Level of commitment the environmental policy and its implementation in the organization's supply chain.
Purchasing decision (PURDEC)	Purchasing criteria and practice under the environmental policy
Supplier cooperation and relationship (SCOREL)	Cooperation and relationship with suppliers to promote environmental protection.
Support and participation (SUPART)	Level of the management support and employee participation in the environmental policy and activities.
Supplier selection (SSELEC)	Selection of suppliers under the environmental policy.

Results

The Lisrel 8.72 software was used to analyze the model as it is customary for theoretical model testing. Hair et al. (2006) recommend the use of one absolute fit index, one incremental, and the chi-squared result as measures for the overall fit of the measurement model. Figure 1 displays the final model with the structural equation modeling results given in the LISREL 8.72 output. The final model includes only the paths which have significant regression coefficients. The standardized coefficients for the effects of various constructs are also presented in Table IV. Almost all of the coefficients are significant at $p < 0.01$ level. The results relating to fit of the model generally support a claim of good fit. The chi-square is 403.38 ($p = 0.687$) with 418 degrees of freedom thus producing the relative chi-square (chi-square/degrees of freedom) value of 0.97 which is less than the 3.00 maximum recommended by Kline (1998). The root mean square error of approximation (RMSEA) is 0.00 which is below the recommended maximum of 0.08 (Schumacker and Lomax, 2004). While the goodness of fit index (GFI) of 0.85 is below the 0.90 level recommended by Byrne (1998), it is more heavily impacted by a small sample size and, as Byrne (1998) points out. The comparative fit Index (CFI) and incremental fit Index (IFI) are more appropriate when the sample size is small. The CFI (1.00) and IFI (1.00) both exceed the recommended 0.90 level (Byrne, 1998). Another commonly used indicator is the standardized root mean square residual (SRMR) of 0.047 is below 0.05 the recommended maximum.

The results from the LISREL output are also used to evaluate other measures with the following tests:

Reliability – high inter-item correlation (Cronbach alpha in Table III); all above 0.70.

Convergent validity – items converge to measure one factor rather than many (single dimension with adequate loadings; most above 0.60 except two in Table II)

Discriminant validity – the items form a factor that is different from other variables in the model (average variance extracted for all constructs are above or near 0.5 in Table III).

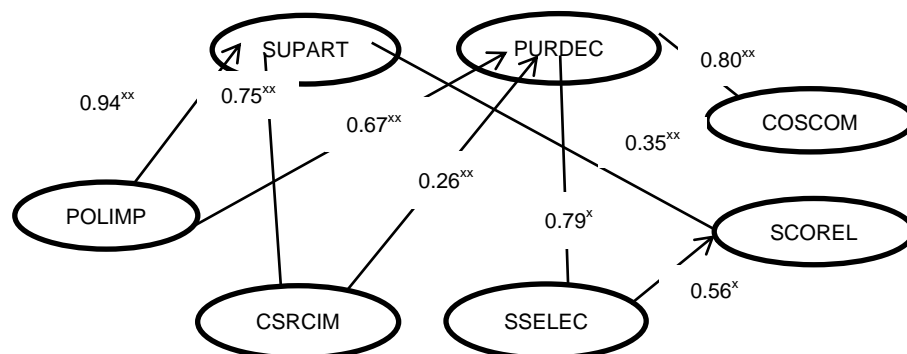
Predictive validity – variables can predict dependent variables or be predicted by independent variables (all constructs show expected statistical significance ($p < 0.01$ except two with $p < 0.05$) and adequate size of coefficients in Table III).

Table II Constructs and measurement scales with Cronbach alpha, descriptive statistics, and standardized loading

Construct/measurement variables	Alpha	Mean	SD	Loading
<u>POLIM</u>	0.919			
P1 Have a clear environmental management policy		3.88	1.219	0.77
P2 Rigorous environmental management practice		3.74	1.198	0.77
P3 Apply 3R(Reduce Reuse Recycle) policy in processes		3.70	1.137	0.63
P8 Strict compliance to law and regulations		3.70	1.075	0.79
P9 Have qualified and knowledgeable EM staff		3.46	1.106	0.78
<u>SUPART</u>	0.915			
P5 Have training and promote understanding at all levels		3.58	1.066	0.71
P6 Continuous internal and external communication		3.37	1.099	0.73
P7 Management supports in EM activities		3.62	1.094	0.79
P10 Employees aware about environmental impacts		3.42	0.953	0.77
P12 Continuous management interests and supports		3.45	1.087	0.78
<u>CSRCIM</u>	0.884			
B1 Avoid violating environment laws and regulations		3.62	1.183	0.64
B2 Feeling proud in company's role and personal contribution		3.43	1.080	0.77
B10 Build good community relationship		3.59	1.139	0.75
B13 Build employee cooperation through EM activities		3.48	1.172	0.77
<u>PURDEC</u>	0.882			
S1 Specify standards for environmental impacts		3.16	1.066	0.80
S2 Prohibit toxic or dangerous materials		3.52	1.206	0.73
S3 Specify appropriate product labels		3.77	1.193	0.51
S4 Require supplier's information on EM		3.18	1.139	0.46
<u>SSELEC</u>	0.875			
S4 Require supplier's information on EM		3.18	1.139	0.29
S5 Select suppliers with ISO 14001 certification		3.30	1.261	0.79
S6 Evaluate supplier's environmental management		3.08	1.177	0.85
<u>SCOREL</u>	0.944			
S7 Cooperation with supplier in product R&D for environment		2.78	1.150	0.75
S8 Exchange and suggest new ideas on EM		3.03	1.153	0.77
S10 Work with suppliers in developing community environment		2.82	1.169	0.76
S12 Cooperate in doing product life cycle analysis		2.85	1.207	0.82
S13 Promote development of EMS and activities by suppliers		2.83	1.229	0.83
<u>COSCOM</u>	0.940			
B5 Cost reduction and increase productivity		3.68	1.054	0.60
B6 Reduce legal claims and compensations		3.60	1.089	0.78
B8 Reduce barriers to export		3.55	1.205	0.79
B9 Reduce customer's pressure to comply with standards		3.59	1.121	0.80
B11 Increase competitiveness		3.78	1.138	0.85
B12 Create good images for company and products		3.92	1.069	0.81

Table III Results with standardized coefficients, DE=Direct effect, IE=Indirect effect, TE=Total effect

Latent variables	R ²	Effects	POLIMP	SUPART	CSRCIM	PURDEC	SSELEC
SUPART	0.88	DE IE TE	0.94 - 0.94				
CSRCIM	0,56	DE IE TE	- 0.70 0.70	0.75 - 0.75			
PURDEC	0.76	DE IE TE	0.67 0.18 0.85	- 0.20 0.20	0.26 - 0.26		
SSELEC	0.63	DE IE TE	0.67 - 0.67	- 0.16 0.16	- 0.21 0.21	0.79 - 0.79	
SCOREL	0.74	DE IE TE	- 0.71 0.71	0.35 0.09 0.44	- 0.12 0.12	- 0.45 0.45	0.56 - 0.56
COSCOM	0.32	DE IE TE	- 0.68 0.68	- 0.16 0.16	- 0.21 0.21	0.80 - 0.80	

Figure 1. Structural equation model results: Standardized coefficients are significant at ^xp< 0.05; ^{xx}p< 0.01.

Discussion and Implications

The main aim of this study is to determine the relationship between green supply management and business competitiveness. Drawing from the literature review there has been very limited study for its confirmation especially with empirical data. The proposed structural equation model is an attempt to develop a causal relationship with theoretical support giving some useful recommendations to practitioners in green supply management. The model shown in Figure 1 has passed the goodness-of-fit tests and results can be used to support the acceptance of all the hypotheses.

H1a is accepted which posits that firms with strong commitment to environmental policy and implementation tend to have higher level of management support and employee participation in environmental management. Figure 1 and Table III also indicate interesting strong relationships between POLIMP and CSRCIM. High level of management support and employee participation depends on strong commitment on environmental policy and implementation with the direct effect coefficient of 0.94. In turn high level of management support and employee participation in environment activities leads to higher level of corporate social responsibility and maintaining high corporate image (the direct effect coefficient of 0.75).

H1b is accepted which posits that firms with strong commitment to environmental policy and implementation tend to have higher practice of green purchasing. The direct effect of POLIMP on PURDEC is displayed in Figure 1 with the standardized regression coefficient of 0.67. In addition, through indirect influence the total effect of the relationship is 0.85.

H2 is accepted which posits that firms with higher CSR and conscious about corporate image tend to have higher practice of green purchasing. Figure 1 indicates that CSRCIM has a direct effect on green purchase decision with regression coefficient of 0.26. CSRCIM is also a mediating variable of the impacts from the firm commitment to environmental policy and implementation.

H3 is accepted which posits that a firm's level of management support and employee participation in the environmental management is positively related to the level of green cooperation and relationship with its suppliers. From the results it is found that management support and employee participation in environmental management has a total impact coefficient of 0.44 on the level of supplier cooperation and relationship in environmental activities.

H4 is accepted which posits that green purchasing decision is positively related to better cost and competitiveness. Results show that green purchasing decision alone has direct effect with regression coefficient of 0.80 on firms' cost and competitiveness. Table III also shows that cost and competitiveness of firms also indirectly influenced by other important variables such as POLIM (0.68), SUPART (0.16), and CSRCIM(0.21)

Conclusion

In this study a causal relationship model is proposed to explain the effect of environmentally concerned supply management on the overall cost reduction and business competitiveness. Although increasing number of research on green supply chain management is being conducted globally. Most of the results are specific within a country and thus need to be reconfirmed if they will be developed into accepted theory. The reported results from analyzing data from companies in Thailand show a strong influence of the level of commitment to environment policy and implementation on business competitiveness. The effect is mediated through management support and employee participation in the green initiative, corporate social responsibility and corporate image and green purchasing decision. Therefore, it is a strategic imperative that business organizations should incorporate environmental sustainability in its mission. It is also necessary to provide management support and promote employee participation in the environmental programs which include green CSR. The results also suggest business organizations to incorporate green criteria in supplier selection and promote collaboration and supplier relationship through environmental sustainable practices.

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A METHODOLOGICAL FRAMEWORK FOR AIRLINES HUB PERFORMANCE MEASUREMENTS

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Purpose: The purpose of this study is to identify criteria and to provide a methodology so as to evaluate an airlines hub.

Design/methodology/approach: A methodology is presented with a process flow diagram. Then, criteria are determined in two groups: internal and external criteria. Internal criteria refer to specific measures to one airport like the number of passengers. External criteria underline threats and opportunities, like an important economic growth in the country or seasonality issues in the area. Afterwards, benchmarking is used for internal criteria. Benchmarking is divided in two tools: internal (or self-) benchmarking and external (or peer group) benchmarking in aims to gain competitive results.

Findings: Based on the proposed methodological framework, we were able to apply it on Thailand as a case study. The result has helped to clarify the competitive strategy of the airline company as well as to gain a deeper understanding of the drivers of efficiency.

Research limitations/implications: This research is a qualitative exploration of the performance criteria of airlines hub and intends to bring a model of evaluation. The contributing criteria are mainly derived from context analysis.

Practical implications: In combining these three analyses, it's possible to obtain a basis of a SWOT analysis of the airport which can help managers to plan actions. The proposed methodological framework is aimed to provide a solid foundation in measuring the performance of an airport.

Originality/value: This research has attempt to use multiple analytical methods to gather more precise data and improvement solutions for airline hub performance measurements.

Keywords: Methodological framework, airline hubs, benchmarking, performance measurement

Paper type: Conceptual research paper

Introduction

Following the globalisation trend in modern economies, air transport is expected to grow in double digits in the next 20 years and the main flow is expected to move toward Asia-Pacific region (Boeing 2012). According to Skytrax's World's Airport Awards 2013 index, several Asian-Pacific airports have been appointed in the top 40 airports of the world (World's Airports Awards, 2013). However, when using these indices as an indicator for airport hub performances, the question of validity, reliability and usability are questioned. The objective of this research is to identify the related criteria in analysing the performance of an airport hub through a methodological framework. The methodological framework consists, SWOT, PESTLE and Benchmarking. The methodological framework is designed for managers to determine strategic actions plans.

Methodology

Once Peter Drucker, famous American management consultant said: "What gets measured, gets managed." (*The Practice of Management American, 1954*). Indeed, to be able to manage and so, to define a planning, it's necessary to measure different indicators. The aim of this research is to obtain an overall vision of an airlines hub. For that, criteria will be classified in two main parts: organisational criteria (internal criteria) and environmental criteria (external criteria). Once the initial analysis is complete, the strengths and weaknesses will be emphasised by internal criteria and opportunity and threats by external criteria in an SWOT analysis. Following, the methodology, adapted from ICAO, 2013 "Airport Economics Manual", is explained after point by point.

Internal measurements

A. Identifications of key performance areas and indicators

The criteria are divided up in different key performance areas (KPAs). Each KPA includes a variety of indicators named key performance indicators (KPIs). Key performance indicators allow measuring the airport. ICAO's policies (ICAO, 2012. Doc 9082) recommended underlining four KPAs, i.e. safety, quality of service, productivity and cost-effectiveness. However, managers may select additional KPAs according to their objectives.

B. Establishment A performance objective and targets for each KPA and KPI

According to "Airport Economics Manual" (ICAO, 2013) it's essential to express a goal that improves on today's performances in a qualitative and focused way. At least one objective for each KPA should be defined. Moreover, one unique realistic and achievable target value has to be set for each KPI.

C. Data collection and results

Obtaining valuable information is fundamental to have accurate source data, clear definitions of services and units of measures and to be transparent with methodologies employed. If the data are not precise and accurate, the results will be incorrect and useless.

D. Benchmarking

Benchmarking can be defined as the search for best practices for organisations of all sizes to achieve better performance. It is an effective structural approach which allows to analyse and to evaluate one industry's operation for opportunities so as to implement an action plan. (Robert J., Boxwell Jr., 1994). Three different type of benchmarking can be portrayed: (Cicero J., 2012.)

Internal Benchmarking is to compare processes, products or services within the organisation (inter departments, sites, departments, subsidiaries) in order to increase performances. The data accessible to collect and allow describing the current general "state of play". Competitive Benchmarking is to compare a process or function with competitors. This study is more delicate because the information collection about practices of competitors is challenging. Therefore, it's necessary to have good relations with its competitors. Generic Benchmarking is to compare a process with a company belonging to a different sector. This kind of benchmarking is very productive. Indeed, companies can gain a lot with sharing information with non-competing businesses to develop networks of exchange and collaboration. In this research, we will be focusing on the first two benchmarkings.

External measurements

PESTLE is a useful tool for identifying the threats and opportunities of a company (external criteria) which can appear in its environment through some major structural forces: Political, Economic, Social, Technology, Environmental and the Legislation. Following, a list of questions of non exhaustive that the airport can use to detect current threats and opportunities are provided in the annexe. To get good quality information is fundamental to have accurate source data, clear definitions of services and units of measures and to be transparent with methodologies employed. If the data are not precise and accurate, the results will be incorrect and useless. The PESTLE results emphasise opportunities to maximise and the threats in order to increase the organisation's potential. It helps managers to make decisions and to plan for future events.

SWOT analysis

SWOT as an analytical tool to get the Strengths, Weaknesses, Opportunities and Threats of an organisation. The external and internal benchmarking emphasize the internal drivers (strengths and weaknesses). Whereas, the PESTLE analysis underlines essentially the external environment (Opportunities and Threats). In combining these three analyses, it's possible to obtain a basis of the SWOT analysis of the airport. Once this study above carried out, it's time for planning and forecasting. The SWOT analysis brings results about weaknesses, threats, but also opportunities. New initiatives can be planned. Furthermore, performance assessments can help support and justify investment decisions. Forecasts are an important input to cost-benefit analyses. Information disclosure is an important component and often an obligation. Moreover, an appropriate disclosure of performance information can build public confidence.

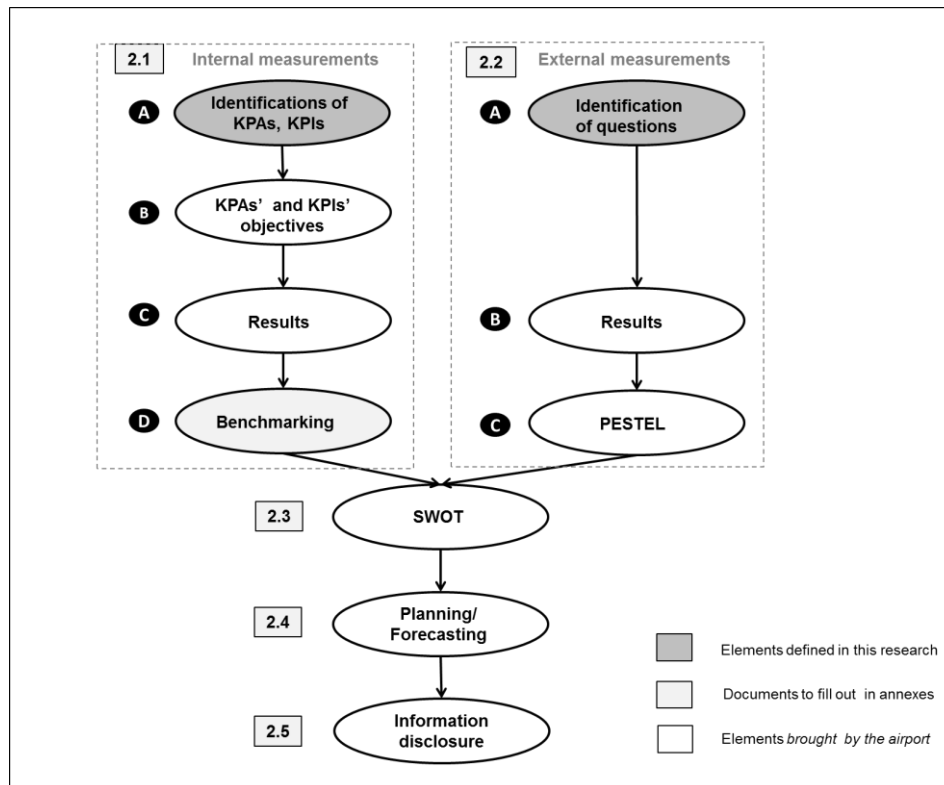


Figure 1: Methodology to evaluate and improve airport's performances

Airlines hub criteria

Before setting criteria, it's important to select principles to obtain suitable numbers of key performance areas and indicators. ICAO's policies (ICAO, 2012. Doc 9082) recommended to emphasize four KPAs, namely, safety, quality of service, productivity and cost-effectiveness. Nonetheless, managers may choose additional KPAs according to their objectives. Also, the numbers of KPIs has to be sufficient, but limited to acquire an overall vision and to be able to collect and process all statistical data.

For instance the "Guide to Airport Performance Measures" (ACI, Wyman O. 2012) provided a structure for effectiveness for economic and managerial performance of airports with six functional areas and forty two indicators. On the other hand, the "Resource Guide to Airport Performance Indicators" (Hazel. et al., 2001) proposes a system of indicators with a twenty-three functional categories, twenty-nine core performance indicators and one hundred thirty-one key performance indicators after interviewing forty industry experts and two industry workshops. The document provides more precisions and, in analysing this paper, it's possible to regroup some criteria.

Other indicators, not mentioned the "Guide to Airport Performance Measures" like "maintenance" or "information technology", are identified. Additionally, the two other papers "Passengers' expectations of airport service quality" (Fodness, et al. 2005) and "A competence-based strategic management model factoring in key success factors and benchmarking" (Chen, 2005) confirm indicators set before, and underline other judicious criteria or the "Total passenger per employee". Examining these different documents and research paradigms to develop a framework of airlines hub's performance indicators measures, the study delineates nine key performances areas and seventy key performance indicators defined in this section. Criteria are mostly measured annually and cost indicators have to require the same currency for benchmarking.

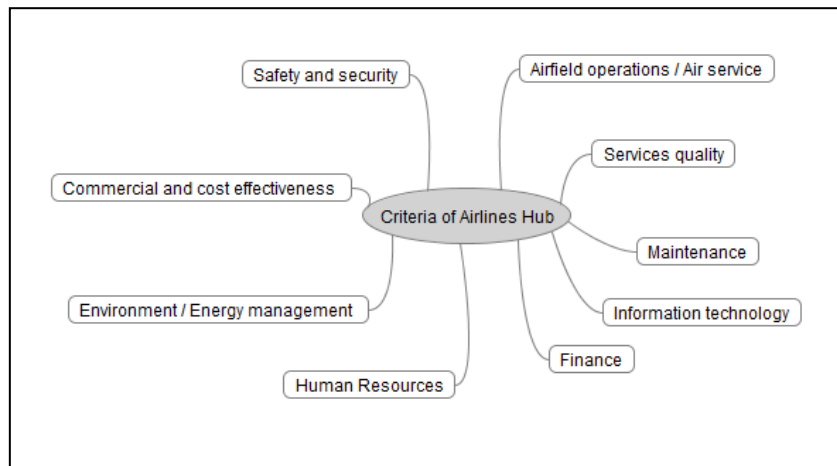


Figure 2: The Key Performance Areas

Airfield Operations/ Air services

These are the core measures used to characterize and categorize airports, such as the number of passengers and operations. Although airports may have little control over these core indicators, especially in the short term, they are important indicators of overall airport activity, and important drivers and components of other indicators.

Services quality

Airport performance measures for Service Quality focus on passenger perception of and objective measures of airport service delivery. This increasingly important area reflects the evolution of airport management from having a primary focus on facilities and operations to having a strong customer service focus in a competitive environment.

For the first criteria in this area “customer satisfaction”, the survey could be based on these following examples of indicators mentioned in the paper “Passengers’ expectations of airport service quality” (Fodness D. et al. 2005):

- Ease of finding one’s way;
- Attitude of employee
- Accuracy of screen information;
- Cleanliness of washrooms;
- Overall passenger satisfaction;
- Attitude and efficiency of customs officers;
- Expectation about airport’s decor;
- Expectation about specific facilities and restaurants;
- and Atmosphere of the airport: convenient layout of terminal.

Human Resources

Human Resources performance measures are used primarily to give precision about employee’s numbers, diversity, job satisfaction, and training.

Cost effectiveness – Productivity

These measures are closely related measures of an airport’s performance. In this section, some technical expressions are used. There are defined here. Operating cost refer to labour, contracted services, maintenance, utilities and energy and non-operating cost to capital and financing costs, site constraints, local construction costs, cost of capital, and many other factors. The Total Cost combines operating costs and non-operating costs. Contrary to aeronautical revenue which stands for of airfield, terminal space, gate charges, non-aeronautical revenue is about management decisions, contractual terms, facilities constraints, natural resources on site, location in areas. Work Load unit is a global unit that is delineated by one passenger (departing or arriving) or by 100kg of freight (inbound or outbound). (ACI, Wyman O., 2012). At least, concession is the right to operate a certain commercial activity at the airport, commonly on an exclusive basis and usually at a specified location. (ICAO, 2013.)

Safety and security

Safety and security are the most important airport responsibilities. The airport performance measures for Safety/Risk Management are a diverse set of indicators measuring accidents, injuries, security violations, and police costs.

Environment and energy management

Environment and energy management has become a strong focus for airport managements. These performance measures are used primarily to expose energy consumption of various aspects of the airport with a variety of environmental indicators relating to emissions, discharges, noise, use of green building and other environmental sound practices, etc.

Maintenance

Maintenance performance measures are primarily used to measure the cost of maintaining areas of the airport, buildings, systems, and equipment, etc. A clean terminal area and escalators in service, for instance, are crucial points for customer satisfaction.

Information technology

When considering airports, most people think of the airfield, terminals, people movers, roadways, and rail used to flow passengers to baggage, cargo, large and small aircraft, etc. Often overlooked, however, is the hidden infrastructure of Information Technology and Systems (IT&S), which enables the airport and all of its intricate facets to efficiently and safely function minute-by-minute and day-to-day. Information Technology performance measures underline the availability and functioning of network and the meantime to repair system.

Finance

Financial performance measures are used to determine all aspects of an airport's financial performance, including revenues and costs for the airport in total. Contrary to aeronautical revenue which stands for of airfield, terminal space, gate charges, non-aeronautical revenue is about management decisions, contractual terms, facilities constraints, natural resources on site, location in areas. Other specific wording is debt service which concerns capital development phase as expansion, modernization programs, but also interest rates, debt structure, and insurance. Eventually, eBitdA is driven by multiple factors including aeronautical charge levels, the success of the airport's commercial program, and the passenger level and growth rate. Higher revenue and lower operating costs result in greater eBitdA (ICAO, 2013).

Benchmarking*Internal Benchmarking*

This part is focusing on the internal benchmarking (or self-benchmarking) which refers to the airport's performances considered it over time. On the contrary, with the external benchmarking, the airport's performances are compared against other airports either at a single point of time or over a period of time. (Wyman O., ACI, 2012). Internal benchmarking is essential to understand trends of the airlines hub over time and to help managers to forecast and to plan.

External Benchmarking

External benchmarking involves comparing airport with others. When used carefully, benchmarking is a powerful analytical tool. However, it's very important to be aware that benchmarking between airports is difficult and can often be misleading. Definitions, content, data collection, and accounting practices may also differ between two airports. If airport managers attempt to make performance comparisons with other airports, differences in operational, structural, commercial and organisational situations can be adequately reflected in the analysis. To the extent that such comparisons are made, great caution should be exercised in interpreting the results, especially when the goals are to understand performance drivers and shortfalls, and thus establishing best practices. "To conclude this part, it's essential to find truly comparable "peer" airports in terms of the many factors that drive the indicator." (ACI, Wyman O., 2012) and (ICAO, 2013. "Airport Economics Manual").

PESTLE Analysis

PESTLE is a mnemonic which in its extended form denotes P for Political, E for Economic, S for Social, T for Technological, L for Legal and E for Environmental. (Source: pestleanalysis.com).

PESTLE analysis is an audit of an organisation's environmental influences so as to guide strategic decision-making with the information collected. It's very useful to understand risks associated with market (the need for a product or service) growth or decline. The hypothesis is that the organisation will have favourable position on its competitors to respond to changes, if it is able to audit its present environment and evaluate possible changes."(CIPD, 2010).

To use this tool, the most suitable way is to ask questions in conducting a scan of the economic environments. The results display the opportunities to maximise and the threats in order to increase the organisation's potential. This analysis helps managers to make decisions and to plan for future events. (CIPD, 2010).

Political

This force underlines issues or opportunities about political stability, monetary policy, fiscal policy, international policy and trade tariffs. (Matthieu, 2013) A government may impose a new tax to which entire revenue generating structures of organisations and it may affect the economic environment to a great extent. (Source: pestleanalysis.com)

Main questions: What is the political situation of the country and how can it affect the industry? Are there international or home market pressure groups which affect airport's economy?

Economic

In this point, economic growth patterns, interest rates, inflation rate, purchasing power, foreign exchange rates are precise (Matthieu, 2013). There are determining for an economy's performance that impacts on the company. For example, an increase in the inflation rate of any economy would affect the companies' price of their products and services. Additionally, the purchasing power of a consumer would be also impacted. (Source: pestleanalysis.com)

Main questions: What are the prevalent economic factors? What are seasonality issues?

Social

The social raise the question about social environment like population, demographics, education, cultural trend, lifestyle and health. (Matthieu, 2013). For Western countries, for instance, there is high demand during the holiday season. (Source: pestleanalysis.com)

Main questions: How much importance does culture has in the market and what are its determinants? What are particular demands about safety or facilities for babies, aging people, handicapped people and so?

Technological

Technological factor relate to research and development & D discover, automation, innovation support, and technology transfer (Matthieu, 2013). They can influence favourably or unfavourably the market favourable. (Source: pestleanalysis.com) For example, the improvement of high-speed connections to and from the airport (motorways, high-speed rail, regional bus lines) in Amsterdam Schiphol Airport in December 2012 (Source: Annual report 2012).

Main questions: What technological innovations are likely to pop up and affect the market structure? Does the airport provide competing technology?

Legal

Legal point refers to industrial property, safety standards, contract law, labour rights, consumer law (Matthieu, 2013). There are certain laws that affect the business environment in a certain country while there are certain policies that companies maintain for themselves. (Source: pestleanalysis.com)

Main questions: Are there any current legislations that regulate the industry or can there be any change in the legislations for the industry? Are there law about open-sky?

Environmental

The issues of surrounding environment include weather and climate, geographical location, global changes in climate clean energy, recycling and regulations (Matthieu, 2013). As instance, the number of snowing day is significant in certain countries and has to be taking into count for the airports logistic. Other example is the integration of sustainability aspects in all airport processes of Amsterdam Schiphol Airport in December 2012 (Source: Annual report 2012).

Main question: What are the environmental concerns for the industry?

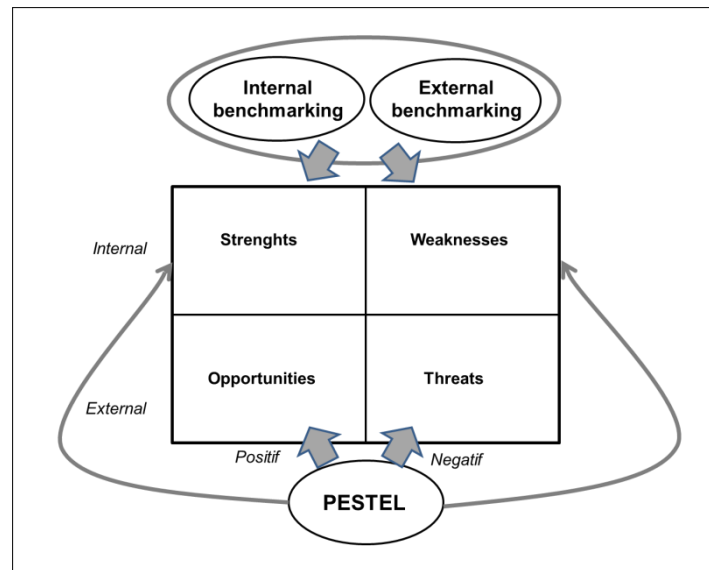


Figure 3: Methodology to get a basis of SWOT analysis

Evidently, this SWOT analysis can be completed by other components. The questions following are example to help to complete the SWOT analysis (MindTools, 2013):

Strengths which characterize the competitive advantages:

- What advantages does your organisation have?
- What do you do better than anyone else?

Example: Large network of connections and frequencies), Amsterdam Schiphol Airport in December 2012 (Source: Annual report 2012).

Weaknesses which represent organisational barriers or limitations:

- What could you improve?
- What should you avoid?

Example: In Sydney Airport, a weakness is investment from European airports because of improper management of resources (Source : <http://www.sydneyairport.com.au/>)

Opportunities which highlight a favourable situation like new opportunities for profit or growth:

- What good opportunities can you spot?
- What interesting trends are you aware of?

Examples: Expansion of destinations network and frequencies, Amsterdam Schiphol Airport in December 2012 (Source: Annual report 2012). All Thai Airways domestic and international flights now operate from Suvarnabhumi airport. (Source: <http://www.bangkokairportonline.com/>, July 2013)

Threats which emphasise potentially damaging external forces:

- What obstacles do you face?
- What are your competitors doing?

Example: The rise of fuel price.

Bangkok at risk of sinking into the sea : Parts of Thailand's capital could be underwater by 2030 unless the government takes steps to prevent disaster, say experts . (Source : Guardian Weekly, Tuesday 13 September 2011).

Strategic factors which contribute to the success of an airlines hub development.

The location is the base of a hub development. This is the first criterion for its success. An airline hub located in a heart of dense population area can offer multiple destinations with a short span of flying time. For example, Amsterdam Schiphol Airport is located at the centre of Europe and serves main European cities in fewer three hours. In the same way, Hong Kong International Airport is located at the heart of Asia and covers half of the world's population within five hours of flying time (ACI, Kwok M., 2010).

Having a good strategic location is not sufficient to success in hub. A political environment favourable to the development of airlines is necessary. Liberalization refers to a relaxation of previous government restrictions like the liberalization of air-service agreements. Deregulation is the process of removing or reducing state regulations. For example, relaxing domestic and regulatory constraints. Hubs existed before the deregulation, but the removal of restrictions on market entry and exit, along with policies permitting airline mergers, gave the possibility to surviving carriers to consolidate hub-and-spoke networks. In US, Canada and Europe, the deregulation and liberalization trended to the disappearance of weaker airlines through bankrupt and, in a same time, at the birth of upstart competitor.

Liberalization helped also low-cost carriers' development. The major motivation of deregulation in South East Asian countries in 2000s is to boost tourism, business travel after the financial crisis of the 1990s (Zhang A. et al., 2008). Prior to deregulation movements (end of 1970s-early 1980s), many airline services were taking place on a point-to-point basis. On the above figure, two airline companies are servicing a network of major cities. Many direct connections exist, but the frequency of services is low and fare tickets are expensive. With deregulation, a system of hub-and-spoke network emerges.

The hub and spoke mechanism allows a number of cities to be linked to a central hub with short-haul traffic or long-haul operations. For example, the airline Emirates links long-haul to long haul traffic between Europe and Asia, Africa and Australia via its hub at Dubai. A common consequence is that each airline assumes dominance over a hub and services are modified. The two hubs are connected to several spokes. With hub and spoke network, regional markets are dominated and passengers benefit from better connectivity (although delays for connections and changing planes more frequently) and lower costs (Rodrigue J.P., 1998).

Case of Thailand

Thailand is an effective example of deregulations in ASEAN. In Thailand, deregulations had been set gradually in the 2000s. First: entry deregulation. The private airlines are allowed in domestic route. Second step: the fare regulation. Airlines are free to charge prices, but under an upper limit (Zhang A. et al., 2008). The growth of hub-and spoke operations has changed the competition among airlines and airports in a structural way. The competitive position of airlines and airports is usually compared in terms of aircraft movements, number of passengers or cargo volumes. The measurement of network performance in hub-and-spoke systems should take into account the quantity and quality of both direct and indirect connections. (Matsumoto H. et al., 2007). Having many airlines which serve multiple destinations is essential for airlines hub. For instance, Singapore Changi Airport serves more than 100 airlines flying to over 240 cities in about 60 countries (Facts and Statistics, accurate as of May 2013, <http://www.changiairport.com>).

Connectivity: Many people make transfer at hub airports even a good direct connection is available. Why? Because other available alternatives have better frequencies, better travel time or better price. Fare of direct routes is, in general, more expensive than fare of indirect routes. The ticket fare is function of the number of competitor on the route, the travel time, the number of transfers, carriers). In the research "Air network performance and hub competitive position: evaluation of primary airports in East and Southeast Asia", (Matsumoto H. et al., 2007.), the authors define the number of connectivity unit like the product of quality and number of operations (Matsumoto H. et al., 2007). The hub connectivity performance is the average of hub connectivity. Hub connectivity increases drastically, once the number of direct connections exceeds a certain threshold.

A strong local and regional economy is decisive for the growth of hub to provide the huge demand for passenger travelling and cargo shipping (ACI, Kwok M., 2010). This condition is essential to enable an efficient process for the transit passenger and for their baggage with the minimum connecting time even at peak traffic time (ACI, Kwok M., 2010). Moreover, the hub airports should have sufficient capacity in the airport, a safe, secure and environmentally sustainable operations and good customer service to provide the best airport quality services.

Conclusion and limitations

As a conclusion, this research is a qualitative exploration of the performance criteria of airlines hub and intends to bring a model of evaluation. After delineating the procedure, criteria which refer to the airport have been identified to help managers to underline strengths and weaknesses of the airport.

Strategic factors contributing to the success of an airlines hub development have also been presented. Furthermore, the research has brought one approaching tools (Internal and External Benchmarking, PESTEL Analysis and SWOT analysis) to get a global vision of the entire airport at the present. However, benchmarking is difficult and complex, especially for external benchmarking, and the risk of misleading is significant. For this reason, in order to gain a deeper understanding of the drivers of efficiency, it will be interesting to apply process level benchmarking of particular activities to get more precise data and improvement solution.

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A MULTI-OBJECTIVE OPTIMIZATION OF THE FLEET SIZING PROBLEM FOR THAI RICE EXPORTER: A CASE STUDY

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Abstract

This paper aims at providing the multi-objective optimization model which deals with the fleet sizing problem for a rice exporting company in Thailand. The company transports the rice from Northern area to Bangkok seaport with the distance of 300 km. The fleet sizing decision is made based on three objectives including 1) minimizing total fleet cost, 2) minimizing total environmental impact, and 3) maximizing the customer satisfaction (demand) simultaneously. The time uncertainty of unloading process at the seaport is considered as a primary factor to determine fleet size. The methodology consists of 3 main steps. In the first step, the decision problem is formulated as a multi-objective, integer, non-linear programming minimised simultaneously. The number of truck in the fleet is the finding variable. In the second step, the significant data is collected from the company who collect the rice from local area and transport them to the seaport. The data of unloading process at the seaport is also collected to identify the total travelling time of the truck. In the last step, the model is verified and validated using the collected data from company.

Keywords:

Fleet sizing, Multi-objective optimization, Time uncertainty of unloading process

Introduction

Globally, the value of exports and imports of agricultural commodities has increased considerably after 1970 as shown in Figure 1 [1]. Much of this growth has been driven by increased import demand from middle-income developing countries. This phenomenon drives the agriculture-based countries to change to their logistic infrastructure, especially in transportation system, to facilitate the domestic trading and the export growth. Thailand, a strong tradition of rice production, has the fifth-largest amount of land under rice [cultivation](#) in the world and is the world's second largest exporter of rice [2]. It enhances continuously its transportation system as one of primary mechanisms to improve its economic and social stability. Road network system is improved to link many agricultural areas, locating in upper central provinces and middle of Thailand, with the trading hubs and exporting seaports. Nowadays, two main seaports are Bangkok seaport and Laemchabang seaport play an important role for exporting their local rice to many parts of the world such as Africa, Middle East, USA, and others. In many cases, the rice exporters collect rice from farmers and subcontract the third-party logistics provider to transport the rice to the seaport for forwarding by shipping to the customer's destination.

Third party logistics providers typically specialize in [transportation](#) services that can be customized to customers' needs. However, as the steadily increase in the exporting amount, many rice exporters has faced with the decision to perform a transportation task by themselves. There are three main aspects which need to be considered in decision of transferring toward fleet ownership. They include 1) cost aspect, 2) environmental aspect, and 3) service quality. Firstly, the cost of fleet ownership can be reduced as the market growth. This is due to the ownership in truck fleet can improve the truck utilization and the transportation cost could be reduced. However, it is necessary to carefully compare between life cycle cost of fleet ownership and that of outsourcing this task to third party logistics provider. Secondly, the truck ownership can give the opportunity of reducing the environmental impact. Today, the environmental issue induce many companies to initiate the project of reduction in environmental burden as social responsibility. Transportation is considered as one of significant driver to improve the environmental performance. As a result, transportation should be considered as a key factor of making decision on fleet ownership. Finally, the ownership of truck provides the opportunity of improving the service level to the customer. Service quality is emphasized on the sending the product to customer on the right time and the right quantity. The truck ownership provides the company to

control many factors which may affect the quality of service. In the case of rice exporter, the time uncertainty of unloading rice at seaport makes the company and its logistics provider unable to control the shipping time to customer. Thus, the ownership of truck fleet provides the company to justify the fleet size to accommodate the uncertainty of unloading process at the seaport.

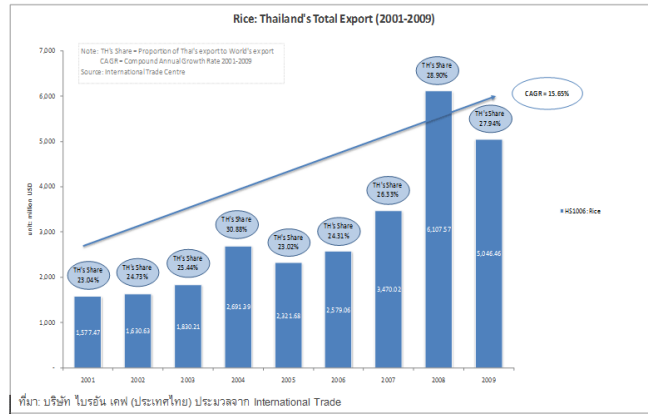


Figure 1: Thailand's growth in rice export from 2001 to 2009 [2]

As a consequence, this research aims to propose a decision support model for rice exporter to make the decision of whether having their own truck fleet or outsourcing this task to third party provider. The multi-objective optimization consists of three aspects including the minimization of total cost, the minimization of environmental impact, and the maximization of service quality. The decision is made base on the number of trucks in transportation fleet. The organization of the paper consists 4 main sections including introduction, methodology, application, and conclusion. The model development is presented in the methodology section which is followed by this section. Then the application section shows the results of the model applications. Finally, the conclusion section summarises the content and a future work of the paper.



Figure 2: Rice collected at local area in northern part of Thailand



Figure 3: Truck transporting rice from local area to Bangkok seaport

Methodology

In order to achieve the objective of the research, the methodology framework as shown in **Error! Reference source not found.**4 is proposed.

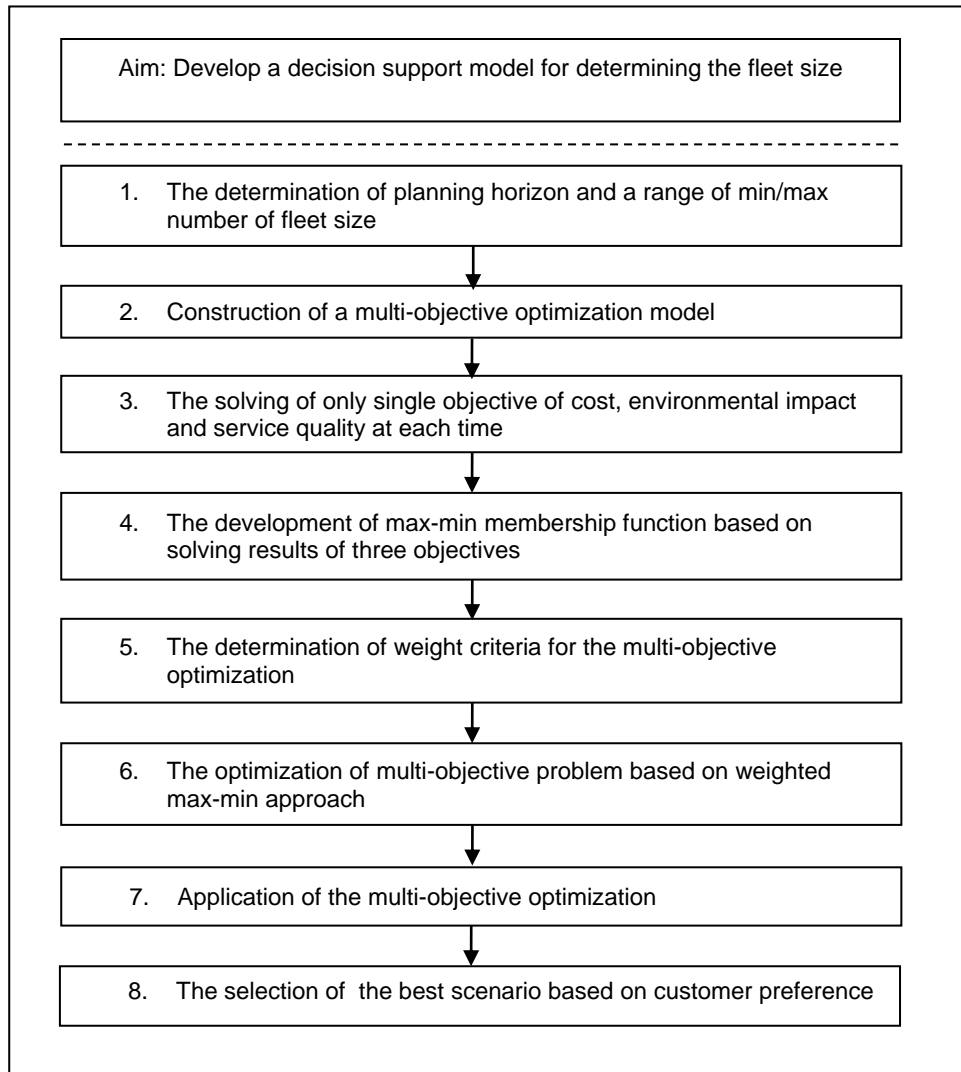


Figure 4: The decision support model for determining the fleet size

Step 1: A planning horizon and a range of number of leasing during planning horizon determination

In the first step, a planning horizon and a range of min/max number of fleet size are determined. The data of rice transportation is collected from the company. This includes the data of outsourcing the transportation task to the service provider and the data of owning transportation system. As described by the company, 7 trucks should be the minimum number of fleet size and 35 trucks is the maximum number. In addition, the functional unit of 10 years are defined as service span of trucks.

Step 2: Construction of mathematical model

The second step concerns about the development of a multi-objective optimization model. The formulation of the mathematical model is carried out based on the mixed integer non-linear

programming to identify the values of these decision variables. Three objectives of the model which are the minimization of total leasing costs, the minimization of environmental impact, and the maximization of service quality are formulated. To achieve these goals, several main constraints need to be taken into account. The mathematical model is constructed based on the three following components which are 1) decision variable 2) objective functions and 3) constraints.

Decision variable

N = Number of trucks in fleet

Objective function

2.1 The minimization of the cost

This objective function is to ensure that the fleet size model generates minimum total cost and the cost of owning the truck fleet is less than that of the outsourcing logistics service. This cost components are based on the Life Cycle Cost (LCC) approach, consisting of 1) cost of product acquisition, 2) cost of operation including driver's salary, energy consumption, maintenance, and other costs, and 3) cost at end-of-life stage. It can be described in mathematical form as Equation 1.

$$\text{Min } C_t = N \times (C_a + (C_d + C_e + C_m + C_o) + C_{eol}) \quad (1)$$

Where

Decision variables:

- N = Number of truck in fleet;
- C_a = Cost of truck acquisition (baht);
- C_d = Cost of driver's salary (baht);
- C_e = Cost of energy consumption (baht);
- C_m = Cost of maintenance (baht);
- C_o = Other cost such as insurance and tax (baht);
- C_{eol} = Cost of end-of-life (baht);

2.2 The minimization of the environmental impact

This objective function is to ensure that the fleet size model generates minimum environmental impact and the environmental impact of owning the truck fleet is less than the outsourcing logistics service. The environmental impact component based on the simplified LCA approach is proposed by Manmek [3]. The total cycle environmental impact of the leasing system consists of 1) environmental impact of product acquisition and 2) environmental impact of operation including energy consumption, spare parts, and 3) environmental impact at the end-of-life stage. It can be described in mathematical form as Equation 2.

$$\text{Min } EI_t = N \times (EI_a + (EI_e + EI_m) + EI_{eol}) \quad (2)$$

Where

Decision variables:

- N = Number of truck in fleet;
- EI_a = Environmental impact of truck acquisition (point);
- EI_e = Environmental impact of energy consumption (point);
- EI_m = Environmental impact of maintenance (point);
- EI_{eol} = Environmental impact of end-of-life (point);

2.3 The maximization of the service quality

This objective function is to ensure that the fleet sizing model provides the maximum service quality. This function is to describe the uncertainty in the unloading process at the seaport. This process can take from 1 day to 5 days based on the traffic condition and the delay of processes. The uncertainty in

this process affects the number of trucks in fleet. The more truck is congested during the shipping process, the more spare truck is required in the fleet size.

Step 3: The solving of single objective of cost, environmental impact, and service quality at each time

Step 3 concerns about the solving of single objective of cost, environmental impact, and service quality at each time. After the mathematical model is developed in the previous step, the single objective of cost, environmental impact and service quality is solved separately. The solving is based on two types of objective functions which are minimization and maximization. The cost and environmental impact of the system are aimed to be minimised. To the contrary, the service quality is expected to be maximised. The results of this stage are the minimum and maximum values of each objective function.

Step 4: The development of the max-min membership function based on the solved results of three objectives

In Step 4, the max-min membership function is developed based on the solved results of three objectives [4]. The membership function of an objective determines the closeness of its optimum value to the target. This linear function presents the optimal value existing at any point between minimum and maximum values. Among the set of optimal solutions, the best and worst values for each objective is defined as Z_k^+ and Z_k^- respectively. They are shown in Table 1.

Table 1: The best and worst value for each type of objective function

Objectives	Max and min values for each objective		
	Z_k^-	Z_k^+	Z_k^-
Minimization goal	-	$\min(Z_k(x))$	$\max(Z_k(x))$
Maximization goal	$\min(Z_k(x))$	$\max(Z_k(x))$	-

Linear membership function of an objective for minimizing is calculated from Equation 3 and the linear membership function of an objective for maximizing is calculated from Equation 4.

The linear memberships function for minimization goal:

$$\mu_{zk}(x) = \left\{ \begin{array}{ll} 1 & \text{if } Z_k(x) < Z_k^+ \\ (Z_k^- - Z_k(x)) / (Z_k^- - Z_k^+) & \text{if } Z_k^+ \leq Z_k(x) \leq Z_k^- \\ 0 & \text{if } Z_k(x) > Z_k^- \end{array} \right\} \quad (3)$$

The linear memberships function for maximization goal:

$$\mu_{zk}(x) = \left\{ \begin{array}{ll} 1 & \text{if } Z_k(x) > Z_k^+ \\ (Z_k(x) - Z_k^-) / (Z_k^+ - Z_k^-) & \text{if } Z_k^- \leq Z_k(x) \leq Z_k^+ \\ 0 & \text{if } Z_k(x) < Z_k^- \end{array} \right\} \quad (4)$$

Where $\mu_{zk}(x)$ is the linear membership function of objective k

Z_k^+ and Z_k^- are the best and worst values of objective k .

Step 5: The determination of weights for linear membership functions

Step 5 is to determine the weight of linear membership functions for the multi-objective optimization. The weight of the objective function (w_k) is the value which reflects the relative importance of the objective function. The greater the value of the weight, the more important the objective function. Likewise, the lesser value of weight represents a lower importance of the objective function. The weight of objectives (w_k) is required for the multi-objective optimization in order to set the priority for the trading off among the linear membership functions.

Step 6: The optimization of the linear membership functions to identify the optimal values

The optimization of membership functions is conducted simultaneously in this stage. This optimization can be achieved by the weighted max-min model [5]. This approach uses the ratio of achievement as a parameter to present the closeness of the function's values to the predetermined objective values. This ratio is defined as λ (lambda). The objective of this model is to maximise the value of λ to ensure that every function's value approaches as close as possible to its objective value. It is based on the consideration of weight for each objective. This model is formulated as shown in Equation 5 to Equation 9:

$$\text{Max } \lambda \quad (5)$$

Subject to:

$$\mu_{zk}(x) \geq \lambda w_k \quad k = 1, \dots, q \quad (6)$$

$$\lambda \in [0,1] \quad (7)$$

$$\sum_{k=1}^q w_k = 1, \quad w_j \geq 0 \quad (8)$$

$$x_i \geq 0, \quad i = 1, \dots, n \quad (9)$$

Where λ = ratio of the achievement level of objective functions

$\mu_{zk}(x)$ = the linear membership function k

w_k = weight of membership function k

k = index of objective functions

q = number of membership functions

x_i = decision variables

i = index of number of decision variables

n = number of decision variables

Application

In step 7 of the methodology, the optimization of the multi-objective optimization model is applied to the case study of Thai rice exporter. The data collected from company include the cost aspect, environmental aspect, and service quality. Some data of cost aspect is shown in Table 2. Some of environmental impact is presented in Table 3. The service quality data is illustrated in Table 4.

Table 2: Cost data inputted into the model

Cost items	Cost values
1. Amount of rice to transport per day	240 ton
2. Truck capacity	35 ton
3. Truck price	4,500,000 baht
4. Driver salary per year	216,000 baht
5. Maintenance per year	1,500,000 baht
6. Other cost per year	185,200 baht

Table 3: Environmental impact data inputted into the model

Environmental items	Environmental values
1. Truck acquisition	565.5 point
2. Truck manufacturing	133.1 point
3. Truck distribution	3.1 point
4. Truck energy use	5,283.6 point
5. Truck maintenance	2.2 point

Table 4: The probability of transportation time

Transportation time	probability
1 day	10%
2 days	20%
3 days	30%
4 days	30%
5 days	10%

Thus, the service quality can be described in the mathematical form as Equation 10.

$$Max S = \begin{pmatrix} 0.0, n < 7 \\ 0.1, n \geq 7 \\ 0.3, n \geq 14 \\ 0.6, n \geq 21 \\ 0.9, n \geq 28 \\ 1.0, n \geq 35 \end{pmatrix} \quad (10)$$

After the model is applied based on collected data, the results are presented in Table 5. Sample scenarios are illustrated to provide weights of three aspects which are cost, environmental, and service quality. The results show the optimal number of truck in fleet depends vastly on data and weights. It can be seen that the fleet size ranges from 7 to 35 trucks. In some cases, the cost and environmental impact is considerably weighed, the fleet size is quite small of 7 trucks. The scenario 3 shows the example of this situation which weights of cost, environmental, and service quality are 0.5, 0.5, and 0 respectively. However, as the service quality is highly prioritised, the number of truck increases significantly. The scenario 7 is the example for this situation. Their weights which are 0.1, 0.1, and 0.8 respectively provide the fleet size of 35 trucks.

Table 5: The best and worst value for each type of objective function

Scenarios	Cost	Environmental	Service Quality	Fleet size
1	0.33	0.33	0.33	7
2	0.50	0.00	0.50	28
3	0.50	0.50	0.00	7
4	0.00	0.50	0.50	28
5	0.80	0.10	0.10	7
6	0.10	0.80	0.10	7
7	0.10	0.10	0.80	35
8	0.70	0.15	0.15	7
9	0.15	0.70	0.15	7
Scenarios	Cost	Environmental	Service Quality	Fleet size
10	0.26	0.26	0.49	21
11	0.29	0.29	0.43	14
12	0.15	0.15	0.70	28
13	0.60	0.20	0.20	7
14	0.20	0.60	0.20	7
15	0.20	0.20	0.60	28
16	0.50	0.25	0.25	7
17	0.25	0.50	0.25	7
18	0.25	0.25	0.50	28
19	0.20	0.20	0.40	28
20	0.28	0.28	0.45	14

In step 8 of methodology, the decision maker selects the best scenario based on preference. The fleet size is provided as the chosen scenario.

Conclusion

This research provides a decision support tool for company to own truck fleet. This tool is developed based on the optimization model which includes three aspects of 1) cost, 2) environmental impact, and 3) service quality. The significant decision variable is the number of truck in fleet. The max-min membership function is developed to integrate three objectives simultaneously and generate the result of fleet size. Based on the data collected, it can be seen that the fleet size is mainly generated from the information of cost and environmental impact. In addition, the value of fleet size depends on time uncertainty of unloading rice at seaport. The more time which truck spending at seaport, the more trucks are required to cover all service demand.

In future work, the continuous data of service quality should be considered. This can provide the diversity of results in fleet size. In addition, the choice of energy consumption like natural gas or biodiesel may be considered to reduce total life cycle cost and environmental impacts.

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A PILOT STUDY ON THE ATTRACTIVENESS OF CONTAINER TERMINAL OPERATORS

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Introduction

There is no independent third party international container terminal operator from Taiwan until the setup of the Taiwan International Ports Corporation Ltd. (TIPC) in 2012. However, many Taiwan ocean container carriers (such as Evergreen Marine Corp.(EMC) and Yang Ming Marine Transport Corp.(YML)) do own their terminal operating subsidiary companies (Taipei Port Container Terminal Corporation of EMC Group and Kao Ming Container Terminal Corp (KMCT) of YML).

After the corporatisation of port operation, Taiwan has set up the TIPC in 2012. After the setup of TIPC, the port administration/regulation is supervised by the Maritime and Port Bureau (MPB) of the Ministry of Transportation and Communication. The port operation is in managed by the TIPC. According to the TIPC incorporation law promulgated on 2012/Nov./09 in Taiwan, Article 8 of the TIPC incorporation law stated that *"The lands used by the TIPC in the port area can be awarded by the government to the TIPC. In return, the TIPC should give part of its company shares to the government. Or the MPB can simply lease the land in the port area to the TIPC. Through the above two alternatives, the TIPC can develop and operate the lands in the port area to generate revenue. However, public facilities and any facilities requested to be installed by the government in the port area should be provided free of charge to the TIPC by the government"*. Put simply, the land ownership and the land management in the international port areas in Taiwan are belonged to MPB and TIPC respectively when the corporatisation of Taiwan international ports is launched in 2012.

As a newly born state-owned third party container terminal operator, the TIPC is working hard to find its way for future growth. The signature of Economic Cooperation Framework Agreement (ECFA) between Mainland China and Taiwan in 2010 and the planning to sign Free Trade Agreement of the Service Industry between the two major economics across the Taiwan Strait in 2013 have pressured the Taiwanese container terminal operators to evaluate their current competitiveness with the other major port operators around the world.

Port Operation Business Models Review

According to the types of ownership, there are six business models in the container terminal operating industry (see Figure 1).

- ✓ Third Party Independent Port Operators (3PPOs model) (e.g. ICTSI of Philippine) – Establishing a port operating company to generate profit from its operation. The 3-P port operators can firstly search for a potential buyer to sell parts of their terminals and even to sell out the companies. Philippine's ICTSI (International Container Terminal Service) sold most of its container terminals in the South America to Hong Kong's HPH when the market during the Asian Financial Crisis and bought another container terminal in the Brazil when the market is low again (Nguyen, 2011). P&O Port is a subsidiary of the P&O Steam Navigation, and the former is sold to the Dubai World Port Holding Corp. in 2006. Dubai Ports World soon resold the P&O Port's American operation to American International Group's asset management division, Global Investment Group in 2006 (King & Hitt, 2006). Terminals are run as profit centres (Drewry, 2010).
- ✓ Ocean Container Carriers' Operators (OCCO model)– MSC, OOCL, and Evergreen Marine Corp. use this business model to handle their container cargoes. Port operating activities are managed by a department or a subsidiary company of the ocean carriers. OOCL was once ranked as the

top 10 port operator in 2006, but was soon out of the top 10 list after it sold out its port operation business in New York and Vancouver to Teachers' Pension Fund in 2007. Mediterranean Shipping Corp. also announced to look for buyers to buy 49% of stakes (at the price on around \$2 billion USD) in its port operation business in 2011. Terminals are often run as cost centres (Drewry, 2010).

- ✓ Non-core subsidiary of a mega carrier (transportation company) (NCD model)- CSX World Transportation (CSXWT) and Sea-Land Service, Inc. are both parts of the CSX group in 1999. The core business of the CSX group is the railway business. Thus CSX group sold the Sea-Land Service, Inc. to Maersk Lines in 1999 and sold the CSXWT to Dubai Ports International (DPI) in 2004 for 1.15 billion USD.
- ✓ A core department of a mega logistics service provider (CD model) – the port operating department of Hamburger Hafen und Logistik AG (HHLA) in Germany.
- ✓ An independent member of an ocean shipping group (IMOSG model)– e.g. Maersk Lines/APMT, Hanjin Shipping/HPC, COSCO/COSCO-Pacific.
- ✓ An independent port operator that take port operation as its core business (IPP model) – e.g. PSA, EUROGATE and Dubai Ports International (DPI) (Le Rossignol, 2007).

Another type of taxonomy of global terminal operators is suggested by Drewry (2000), Global/international stevedores (where Terminal operation is prime focus of their business), Global carriers (Container shipping is prime focus of business), and Global hybrids (e.g. APM Terminals, NYK Line (Ceres), COSCO (COSCO Pacific), CMA CGM (Terminal Link), APL/NOL (APL Terminals)).

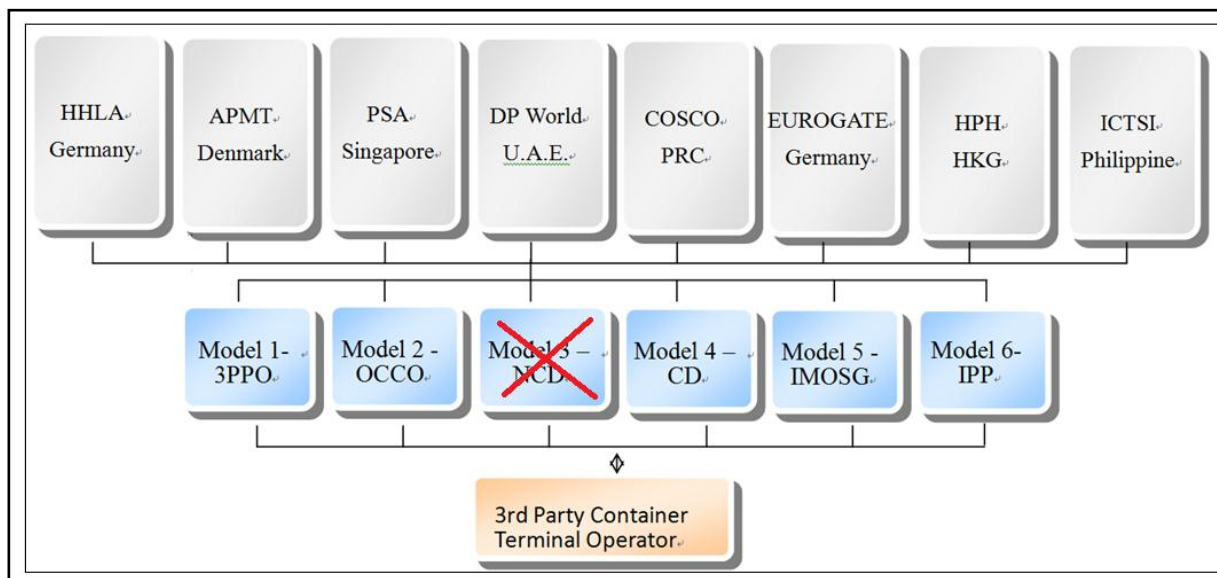


Figure 1 Large Third Party Container Terminal Operators

Note: (1) 3PPO: Third Party Independent Port Operators (2) OCCO: Ocean Container Carriers' Operators (3)NCD: Non-core subsidiary of a mega carrier (4) CD: core department of a mega logistics service provider (5)IMOSG: independent member of an ocean shipping group (6)IPP: independent port operator that take port operation as its core business.

Literatures Review on Attractiveness Attributes

Caschili and Medda (2013) study the port attractiveness index in Africa and define it as 'The capacity of a port to compete in regional and international markets and attract freight traffic'. However, there isn't any research investigate the attractiveness of a container terminal operator to its users with a quantitative methods. This research reviews literatures concerning port competition, port co-opetition, port competitiveness, port selection, and regulation on terminal operators to summarize five major criteria and seventeen subcriteria related with the terminal operators' attractiveness. These subcriteria were classified into five groups after a discussion with two shipping executives who have more than twenty years of working experience in major ocean container carriers. The five groups of subcriteria

are named as fee charged, services, hardware, software, and operator's networking. Each of the first two groups has four subcriteria and each of the latter three groups has only three subcriteria. Eight of the nine literatures are found in academic database. Eight of the nine researches indicated fee charged is important in their researches and five of the nine researches revealed connectivity of terminals is also a very important factor influencing terminal operators' competitiveness and attractiveness (see Table 1).

Research Framework: After the literature review, a hierarchical research structure with five major criteria and seventeen sub-criteria is established as the Figure 2.

Table 1 Criteria/Sub-criteria influencing the attractiveness of port operators

Criteria	Sub-criteria	Criteria/Sub-criteria reviewed in Literatures	Chang et al. (2008)	Gardiner et al. (2007)	Notteboom (2004)	Notteboom (2007)	Pardali & Michalopoulos (2008)	Saeed & Larsen (2010)	Tongzon (2009)	Yap & Lam (2004)	Yeo et al. (2008)
Fee Charged	Storage Cost	Storage fee	✓			✓		✓	✓	✓	✓
	Berthing Fee	Berthing fee	✓			✓		✓	✓	✓	✓
	Cargo Handling Fee	Cargo handling fee, low labour cost	✓	✓		✓	✓	✓	✓	✓	✓
	Miscellaneous Fee	Pilot charge, tug boat fee, tonnage due, inland transport charge, port construction fee	✓			✓		✓	✓	✓	✓
Services	Reliability	Reliable, reputation, accident rate, financial stability	✓			✓			✓	✓	✓
	Friendly Response	Advertisement, port marketing, communicative, understanding of customers, simplified tariff	✓				✓		✓	✓	
	Flexibility	Priority service, flexibility, technical support			✓				✓	✓	✓
	Efficiency	Port operation efficiency		✓					✓	✓	
Hardware	Equipment	Cargo handling equipment				✓				✓	
	Infrastructure	Access to the hinterland via highway and railway				✓				✓	
	Superstructure	Warehouse and office buildings capacity in a terminal				✓				✓	
Software	Information system	Cargo tracking, EDI ability					✓			✓	
	Labour quality	Experienced employees, high quality labours								✓	✓
	Management quality	Manager with in-depth shipping knowledge								✓	
Operator's Networking	Numbers of terminals operated	Total numbers of terminals owned globally (economics of density)		✓							
	Relation with LSPs	Numbers of cooperated LSPs (e.g. ocean freight forwarders), customs efficiency	✓	✓	✓						✓
	Connectivity of its terminals	Frequency of ships served, numbers of ports connected, location of the terminal, close to major navigation routes & hinterland	✓	✓	✓	✓			✓		

Source: compiled by this research

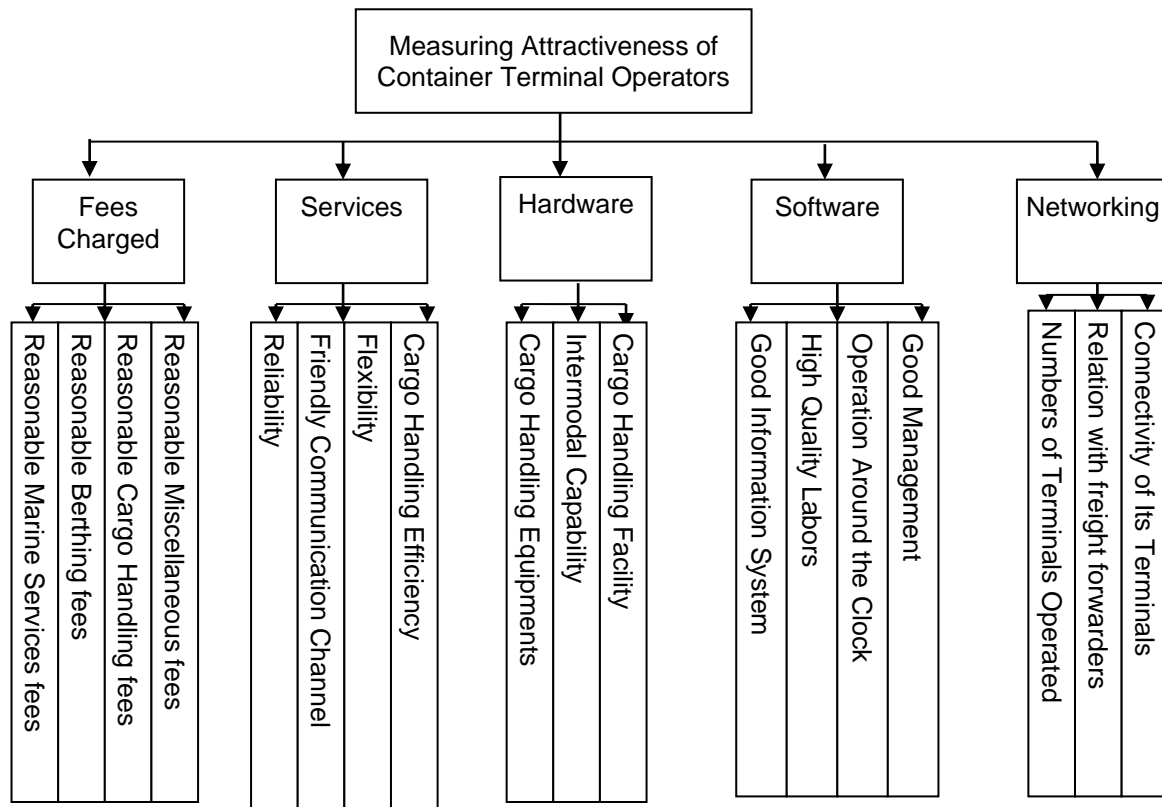


Figure 2 Hierarchical Research Structure

Research Design

Questionnaires were then distributed to the executives who work for ocean container carriers and studied EMBA programme in a leading maritime university in Taiwan. These carriers have their headquarters, branch offices, or agents in Taiwan. Twenty copies of questionnaires were distributed to these shipping executives and thirteen copies of them are successfully returned and valid for further analysis. Respondents' demographic data are shown in the table 2.

Table 2 Demographics Data of Respondents

Job Title	Number of respondents	Seniority	Number of respondents	Departments	Number of respondents
Senior Manager	2	Above 10 Years	8	OP	5
Middle Manager	8	5~10 Years	3	Sales	4
Junior Manager	3	3~5 Years	2	Planning	4

Source: This research

Research Findings

In terms of influencing the attractiveness of container terminal operators, the order of importance of these five major criteria are fees charged (0.420), operators' networking (0.185), services(0.153), softwares (0.148), and hardwares(0.094). No surprising, in a highly competitive market after the deregulation of shipping industry, well-equipped software and hardware with low user's fees are the necessary condition to attract carriers using a terminal operator's service. On the other hand, operators' networking attribute is reported important to influence carriers' port choice behavior by several previous literatures. The degree of importance of subcriteria influencing the attractiveness of container terminal operators are cargo handling fee (0.175), berthing fee (0.161), connectivity of its terminals (0.084), numbers of terminals operated(0.063), and equipments(0.059) (see Figure 3).



Figure 3 Degree of Importance of Service Attributes influencing Port Operators' Attractiveness

Using IPA (Importance-Performance Analysis) matrix and fuzzy semantic wordings technique, three attributes are found in the 'Concentrate Here Quadrant' which implies the importance of these attributes (i.e. berthing fee, connectivity, and the number of terminals operated) are perceived to have the above-average degree of importance and most terminal operators' performance on these attributes are perceived to be below the average. Terminal operators can focus using their limited resources to improve their performance on these three attributes to further enhance their attractiveness to their users (see Figure 4).

Conclusions and Suggestions

A port is a collection of many terminals and each terminal competes with each other and competes with terminals in the other ports as well. Thus a study on the improvement of a port's competitiveness and attractiveness cannot be operationalized without a quantitative research on the attractiveness index of its terminal operators. Some large container terminal operators have managed as many as 205 berths in 50 ports (e.g. HPH). It obtains the cost advantage resulting from economies of scales. The wide geographic service coverage (e.g. HPH serves in 25 different countries) also make large terminal operators achieve high degree of attractiveness resulting from its dense service networking (i.e. economies of density). Future extension of this research is already on its way, the authors have collected the respondents' evaluation on five major global container terminal operators' performance with these seventeen sub-criteria of attractiveness. An Importance-Performance analysis on these seventeen attractiveness sub-criteria can be used to pinpoint out the attractiveness determinants from the seventeen subcriteria for these reviewed container terminal operators. Finally the port operators can invest their limited resources on these service determinants to effectively improve their attractiveness to ocean carriers.

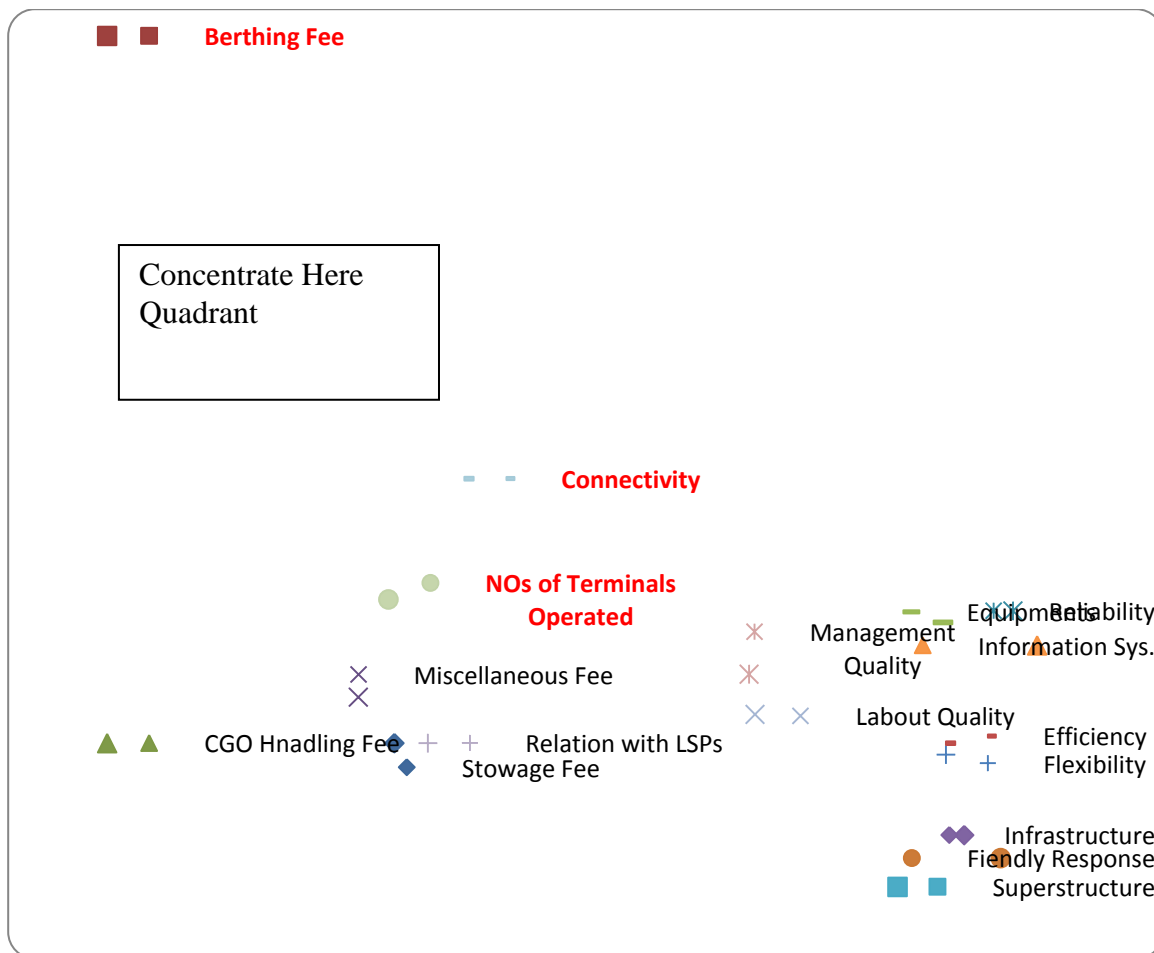


Figure 4 Importance and performance Matrix

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A SUSTAINABLE LOGISTICS NETWORK FRAMEWORK DEVELOPMENT

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1.Introduction/Background

Currently a conceptual framework of sustainable logistics network considering both economic and environmental performances is an important research topic. Increased awareness of environmental issues (Ortolani et al. 2009) acknowledged by enterprises has resulted in sustainable logistics planning. In general the economic costs directly incur debt while the environmental costs have been considerably ignored. Notwithstanding this, a lot of environmental problems have impacted on human health. These reasons make many governments and academics concerned about environmental logistics planning optimization, which accounts for the trade-off between the economic costs and the environmental impacts.

A conceptual framework of sustainable logistics planning typically depends on the current logistics practices in long term objectives. The distribution of commodities in a logistics system generates CO₂ which makes a lot of environmental impacts on the ecosystem. It is difficult to get rid of these factors but these factors can be minimized by the optimization mode based on a conceptual framework. The fundamental idea behind this conceptual framework is to incorporate the economic and environmental issues in the optimization model. In order to address the mentioned problems, this paper attempts to present a conceptual framework for the environmental logistics network. Then this conceptual framework is introduced, there is a demonstration of its relationship and the basic guidelines for model development. The remainder of this paper is organized as follows; Section 2 describes literature reviews. Problem formulation is clarified in section 3. In the following section, a conceptual framework of sustainable logistics network is proposed in order to provide some insights for an environmentally sensitive conceptual model. Then model assumption is defined in section 5. Then the discussion of the guideline from a conceptual framework is presented leading to the guideline for model development. Finally, a conclusion is redrawn and guidelines for further research are suggested in the last section.

2.Literature Reviews

Over the last decade there has been a growing awareness of environmental concerns triggered by climate change and global warming. They have resulted in a green supply chain and environmentally sustainable logistics planning (ESLP). From literature surveys as to logistics planning under environmental considerations, Parajuli, Ferreira & Bunker (2005) stated that in an energy efficiency model that unless the fuel consumption relationships are established, the development and application

of transportation and logistics become computationally prohibitive. This is the origin of transportation & logistics network framework development, which leads to development outlined in several papers. Forkenbrock (1999) generated four types of external cost for a ton-mile of freight shipped by trucks: accidents; emissions; noise; and unrecovered costs associated with operation and maintenance of public infrastructure. The four external costs of Forkenbrock (1999) can be applied with the concept of model development of Parajuli, Ferreira & Bunker (2005). The environmental optimization of supply chain network is initiated by Beamon (1999). His research comprised investigating the environmental factors leading to the development of an extended sustainable supply chain framework. It included something from the extended supply chain with the traditional supply chain. Finally he attempted to develop a general procedure towards achieving and maintaining the green supply chain. Recently over the last five years there are a few papers concerning the green supply chain. Mula et al. (2010) has indicated that a research gap for trading off between CO₂ emissions, fuel consumption, noise levels as well as external factors leading to his extending the traditional logistics network objective function to account for wider environmental factors rather than only the economic cost. Ortolani et al. (2009) attempted to study the environmental impact on the transport sector by dividing the research into transportation cost and environmental cost. This model was applied with the food transport sector and reverse logistics of industrial liquid wastes. Fahimnia et al. (2013) employed the concept of Forkenbrock (1999) and Ortolani et al. (2009). They selected a medium size automotive chemical provider as a case study in Australia in order to investigate the cost implication and carbon reduction potentials of the carbon-pricing scheme in Australia. A nonlinear programming model is improved in the trade-off between transportation cost, carbon emission cost and fuel consumption cost. These associated costs are expressed as functions of vehicle speed. Then piecewise function (Gujarati 2003) is adopted to linearize the improved model. The obtained results found that a minor increase in overall logistics costs may be inadequate to drive an important shift in transport behaviour in Australia. In addition to the chemical area in the green supply chain, the green supply chain was conducted in other areas such as the aluminium green supply chain of Ferretti et al. (2007) etc. Wang et al. (2011) supported Fahimnia et al. (2013) and were concentrating on the environmental investment decision but they focused the multi objectives of the optimization model, which captures the trade-off between economic cost and environmental influence.

The literature survey as described found that there were few papers attempting to provide the conceptual framework, which can be a guideline for the basis of a sustainable logistics network model development. Consequently, to the best of our knowledge, this is the first paper attempting to establish a conceptual framework, which provides the fundamental guideline for the development of a sustainable logistics network model. This guideline for model development will be very useful for model development in the environmental logistics network field in the future.

3. Problem formulation

It is known in the environmental problem on logistics planning that each truck emits a certain amount of carbon dioxide. Carbon emission depends on speed under unchanged characteristics (See model

assumption). A speed function improved by the European Commission (1999) and Jost et al.1994) is employed in this study as shown in figure 1, which explains the relationship between CO₂ emissions versus speed.

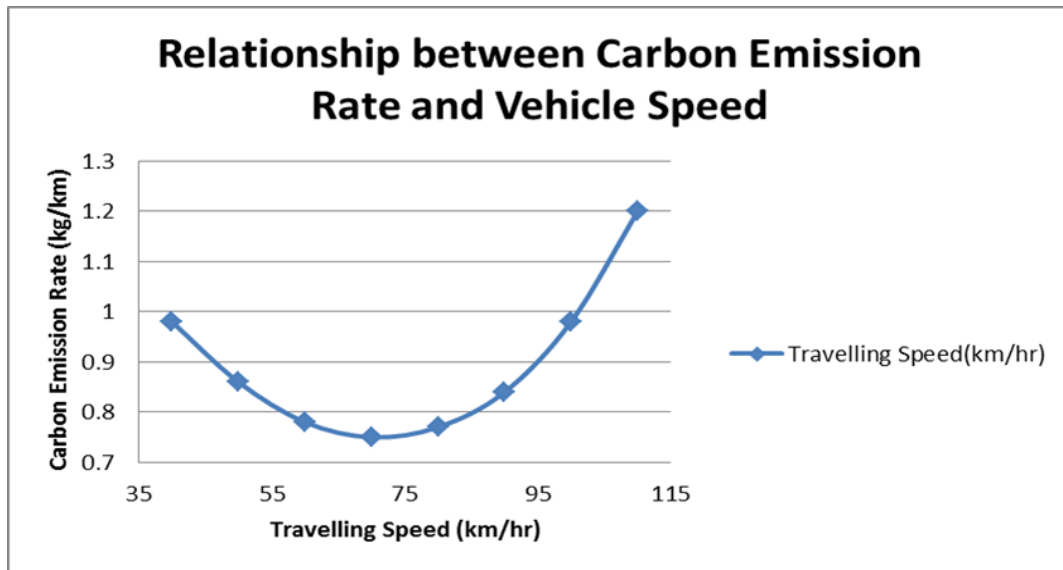


Figure 1: Relationship between carbon emission rate and vehicle speed for a light truck. (Adopted from European Commission 1999 and Jost et al.1994).

Meanwhile each truck consumes diesel oil, which depends on speed similar to the case of CO₂ emissions. This study employs the study of the relationship between consumed fuel (L/100km) versus speed (Km/hr) of Bektas and Laporte, (2011) as shown in figure 2.

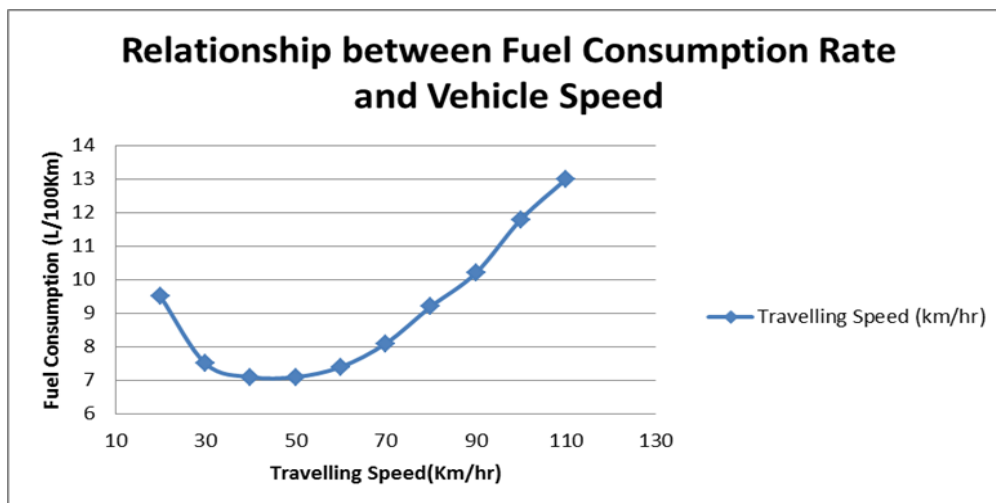


Figure 2: Relationship between fuel consumption rate VS speed (Adopted from Bektas and Laporte,2011)

From both figures above, the fuel consumption cost element and carbon emission cost are expressed as a nonlinear function of vehicle traveling speed (Fahimnia et al. 2013). Two graphs are merged into the optimization model based on the concept of sustainability focusing on the incorporation of the major economic cost elements and the environmental responses. Logistics structure typically incorporates several suppliers, manufacturers and customers during multiple time periods to satisfy deterministic market demands at customer location, which must be satisfied by the end of the planning

horizon. The model output in each period of planning horizon comprises transportation quantities, storage quantities, fuel consumption, carbon emission.

4. Model assumptions

From the concepts and the problem formulation as described above, the conceptual framework involved is complex and there is a need to simplify the model assumptions so as to arrange the conceptual framework in an easier way. The Model assumptions can be stated as follows

- 1) The number of locations and capacity of suppliers , customer , distance , initial inventory ,restriction on maximum and minimum of speed including customer demand are known.
- 2) There is only a traveling trip from suppliers to distribution centres and from distribution centres to the customers in the logistics structure at time t. (Two sequential echelons of Material flow)
- 3) The transportation cost is proportional to distance and the quantity of commodity.
- 4) The fuel consumption and carbon emission are defined and expressed as a nonlinear function of vehicle traveling speed.
- 5) Unchanged Traveling characteristics (e.g. road gradient, altitude, road roughness, ambient temperature and degradation of pollution controls etc.)

5. Conceptual Framework

In a conceptual sustainable logistics framework, the relationship between the variables with its optimal logistics cost, is proposed according to the proposition of the ecological-economical integration (Helmig et.al. 2011). Based on the nonlinear function of speed, nonlinear programming (NLP) is employed in this framework. All independent variables such as CO₂ emission, fuel consumption as well as amount of both transportation and storage under model constraints are encapsulated in the overall framework. This conceptual model represents the trade-off between transportation cost and carbon emission cost which are expressed as nonlinear function of vehicle speed. In order to solve the optimal solution, piecewise function (Gugarati 2003) is adopted to linearize. Then mixed integer programming (MIP) model (Taha 2003) is applied to solve the optimal solution. All independent variables within proposed conceptual model are optimized simultaneously so as to minimize logistics cost. Finally the principle of the fundamental development of this environmental conceptual framework is discussed in detail, and this will be a guideline for model development in the future. The conceptual framework can be demonstrated as in figure 3.

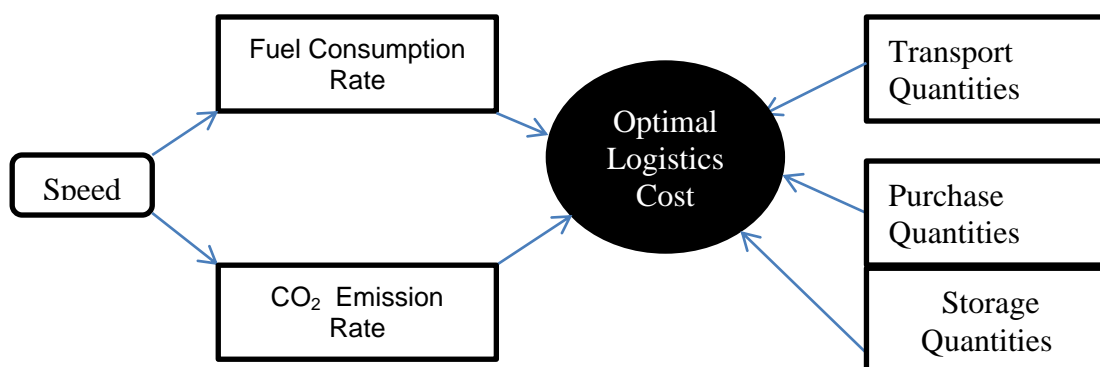


Figure 3: Conceptual Framework of sustainable logistics network

6. Discussion of the guideline for model development from the conceptual framework

Based on the proposed conceptual framework and literature review, the discussion about the guideline for model development found that the significant feature of the environmental logistics network research is the consideration of the trade-offs between operational and environmental factors for transporting products. A nonlinear programming model approach is adapted to the logistic network problem in a realistic situation.

The environmental conceptual framework of logistics network, based on literature surveys, shows that there are some gaps on the application of both carbon emission based models and fuel based model in sustainable logistics network optimization problems. Both models are expressed as the nonlinear function of vehicle speed (Fahimnia et al 2013). Indeed, there were several sustainable logistics network frameworks in literature reviews that fail to appropriately incorporate environmental factors such as CO₂ emission and the more traditional operational and economic objectives. Over the last decade, there were few studies of green supply chain optimization models merging sustainability variables directly or indirectly into their conceptual model or their mathematical models.

The important issue of sustainable logistic model development is to link both operational cost and carbon emission's reduction through their relationship with vehicle speed (Parajuli, Ferreira & Bunker 2005). There are several factors from the general green optimization model such as fuel consumption, carbon emission, transportation cost, pollutions etc. and some factors from unchanged traveling characteristics of model assumption such as vehicle load, road roughness etc. These factors are considered as important factors in the development of sustainable logistics network models. These factors are related to comprehensive objective function and model constraints. The objective function is measured and minimized the emission cost along with the operational costs of transportation, fuel consumption, storage, distribution, noise etc. Consequently this concept, based on model development from these factors, will lead to various environmental model developments of sustainable logistics networks. This conceptual framework development is meant to environmentally support long term logistics decisions. It will serve as a framework prototype to suggest minimal cost flow and environmental damage under the economic and ecological points of view. This paper provides an outline of the great benefits and increased efficiency in ongoing logistics planning so providing managerial insights on economic savings of environmentally conscious logistics management.

7. Conclusion and further research

Currently logistics enterprises need more effective approaches to address CO₂ emission problems together with high operational cost problem. Hence, this paper proposes and generates the guidelines for model development about a sustainable logistics network framework. The aim of this paper is to present and discuss a conceptual model development including demonstrating the relationship among

all independent variables within this framework. The rationale for this model development is based on attempts to decrease both operational costs and carbon emissions through the nonlinear relationship of vehicle speed. The different speed scenarios, each have their own CO₂ emissions, fuel consumptions and associated costs. In addition, all important variables, which are focused on each individual interest for model development, from general supply chain model or from model assumption are considered as the critical keys for model development under the relationship between the comprehensive objective function and its model constraints

The obtained results from the fundamental guideline for model development are not just to decrease the cost of CO₂ emission and the economics cost, it is also to develop the conceptual framework of a sustainable logistics network for solving various issues, either economic or ecological. . Finally future research could take place to improve and to apply the model to realistic logistics problems. In fact, the previous scant attention that has been paid to how logistics network can now be developed and this will affect other useful aspects for human such as environmental or social logistics planning(Manzini et al. 2008).

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AN EMPIRICAL INVESTIGATION ON THE IMPLEMENTATION OF GREEN PRACTICES IN THE LOGISTICS SERVICE INDUSTRY

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ABSTRACT

Purpose: Due to the increasing demand for advanced logistics services, third-party logistics service providers (3PLs) are increasingly requested to provide more 'green' services. This development provides 3PLs business opportunities but also challenges on how to translate green initiatives into practise. The purpose of this paper is to investigate the implementation of green initiatives and influencing factors.

Research approach: The research methodology used in this paper is based on two-phases approach. Firstly, a systematic literature review on sustainability in 3PLs has been carried. Subsequently, a case study investigation on a 34 Italian 3PLs allows to address research objectives.

Findings and Originality: The research results indicate a different degree of involvement of 3PLs in green initiatives in relation to the different breadth of service offered. The adoption of "point" initiatives focused on one or few logistics functionalities is prevalent. Main drivers and inhibitors affecting the adoption of green initiatives were identified.

Research impact: This paper provides a deeper knowledge on how 3PLs respond to changing market conditions driven by sustainability pressures. It provides a broad base for further research on 3PLs strategy development to facing future green requirements both from customers and government.

Practical impact: The paper describes the level of implementation of 3PLs' green initiatives. Furthermore, the study provides a deeper understanding on how green logistics services can be approached and what drives and inhibits that process.

Keywords: logistics service providers, green initiatives, drives and inhibitors, Italian logistics market, case study analysis

Paper type: Research paper

Introduction

In the 21st century, greening of the supply chain has become an increasing concern for many businesses as well as a challenge for logistics management (Zhu et al., 2008). However, most studies on environmental issues have focused on manufacturing sectors and little attention has been paid to the service sectors, as in the case of the logistics service industry (Lin and Ho, 2011). Third-party logistics service providers (3PLs) are under pressure to improve their customer relationships and continually expand the range of value-added services offered including environmental sustainable related services. In the transport and logistics sector, environmental concerns have become more stringent due to the demand for mobility of goods that has grown considerably in recent decades and will continue to grow in the coming years. In response, an increasing number of 3PLs have started to transform their operations and strategies to be more effective from a green perspective. This transformation may provide benefits but, simultaneously, it should presents challenges and concerns. From this point of view, 3PLs are called to drastically reduce their externalities through effective actions. This is particularly relevant for Italy that is one of the European countries with the highest density of internal traffic with more than 60% of freight shipments moved by road transport. The main aim of this paper is to explore environmental practices in a sample of 34 Italian 3PLs. This research assumes the 3PL perspective and it specifically examines the type of green initiatives implemented and factors (barriers and drivers) affecting the adoption of such initiatives. The section following this introduction presents a systematic literature review on sustainability in the logistics service industry. The results of the literature review allow to identify three research objectives. The third section

provides the methodology used to conduct a case study analysis. The summary of main findings obtained from the case study investigation has been presented in the fourth section. Finally, conclusion and implications deriving from the study have been drawn in the fifth section.

Literature review and research objectives

In order to provide an understanding of existing body of knowledge in the field of environmental sustainability in the logistics service industry, this section provides a systematic literature review. It was conducted using two selected databases (Scopus and Web of Knowledge) and the keywords “green” and “sustainab*” were used in combination with “logistics service providers”, “third-party logistics”, “3PL” and “LSP”. A total of 146 papers were initially identified. Narrowing the search to only include items in the social sciences of the two databases, the number of papers decreases to 94. The output obtained from the two databases were analysed and compared. This allowed the elimination of 34 duplicate papers leaving a total of 60 works. Subsequently, two inclusion/exclusion criteria were established. The first criterion relates to the inclusion of peer-reviewed journals articles published in scientific journals only. The second involved the inclusion of papers with a management focus only. Taking the two criteria into account, 23 articles were selected. A further seven articles were added using cited references, leaving 30 articles in the final sample. The content analysis of the 30 articles resulted in the identification of four different topic areas used to classify the papers (see tab. 1).

Topic area	No. of papers
1: Factors affecting the adoption of 3PLs' green initiatives	8
2: Innovation and ICT tools supporting 3PLs' green initiatives	4
3: Green initiatives and 3PLs' performance	12
4: Buyer's perspective and collaboration	6
Total	30

Table 1: Categorisation of the literature by topic areas

Considering that the specific focus of this research is on the logistics service provides perspective, the paper belonging to the fourth topic area (Buyer's perspective and collaboration) have not been considered in this review of the literature. As result 24 articles have been considered only.

Factors affecting the adoption of 3PLs' green initiatives

The first topic area contains eight articles related to the analysis of factors (drivers and barriers) influencing the adoption of green initiatives in logistics service companies. In an early work Wong and Fryxell (2004) examined how stakeholder influenced the effectiveness of environmental management practices in fleet management in Hong Kong. The study found that environmental management practices among fleet managers appeared to be modestly influenced by stakeholders. The two mirroring papers of Lin and Ho (2008) and Ho et al. (2009) analysed the factors influencing logistics companies' attitudes toward environmental management practices in a sample of Taiwanese logistics companies. The research results indicate that the diffusion of knowledge about green practices can help the transfer of technological knowledge within the organisation and, consequently, can raise the willingness to adopt green actions. The work of Maas et al. (2012) explored the relationship between environmental management capabilities and differentiation advantage in a sample of 202 German 3PLs using environmental communication as a moderator in this relationship. The evidences show that environmental communication capabilities positively moderate the relationship between pollution prevention and competitive advantage based on differentiation. The survey conducted by Lieb and Lieb (2010a) on a sample of 20 CEOs of large logistics companies operating in the North American market emphasises the importance of a mix of both internal and external factors. The findings indicate that the most important factors triggering their involvement have been “the corporate desire to do the right thing” and “customer pressures”. Similarly, the survey carried out by Lin and Ho (2011) on a sample of 322 Chinese 3PLs revealed that different types of factors, both internal and external, influence green practice adoption. Their analysis indicates that regulatory pressure, governmental support, organisational support, quality of human resources have significantly positive influences in driving green practice. Other studies highlight a number of other influencing factors. The paper of Jumadi and Zailani (2010) argued that 3PL customer relationships may have a positive influence on the adoption of green action in the logistics service sector in Malaysia. Beskovnik and Jakomin (2010), in discussing the challenging role of green logistics in Southeast Europe, identified long-term contracts as an important driver of the implementation of green measures by logistics companies.

Innovation and ICT tools supporting 3PLs' green initiatives

Few studies have been published on the role of innovation and ICT in supporting the adoption of sustainability initiatives by logistics service companies (four articles). The survey conducted by Zailani et al. (2011) on a sample of 70 Malaysian 3PLs addresses the importance of green innovation in logistics outsourcing. The results show that the vast majority of the surveyed companies consider information technology as an important tool in mitigating the environmental impact of transport and logistics activities. Similar conclusion was reached by Ho and Lin (2012) who analysed the factors that affected willingness to implement green innovations in a sample of 162 logistics companies in Taiwan. The paper of Ferguson (2011) investigated corporate social responsibility and sustainability activities within the Asia-Pacific branch of DHL. The result evidenced the positive impact of the three main company programmes on the eco-efficiency management of fleet and warehousing energy use. In addition, advantages have been achieved in terms of increasing the awareness of employees and improving the alignment and commitment of both staff and managers. Finally, the paper of Lai et al. (2011) examined the environmental awareness and measures adopted in the shipping industry. The authors propose a new conceptual framework for evaluating green shipping initiatives based on a six-dimensional measures for green shipping actions.

Green initiatives and 3PLs' performance

There are also relatively few studies dedicated to green initiatives adopted by 3PLs (10 articles, four of which are focused on reverse logistics measures and programmes). Surprisingly, very few papers explored the impact of sustainability initiatives on 3PLs performance (two articles). The papers included in this area show that the research efforts in studying 3PLs' sustainability initiatives have followed two main paths. The first is based on the discussion of a single green initiative, while the second discusses the adoption of multiple measures by 3PLs and their possible classifications. Two of the papers belonging to the first approach emphasize the role of multimodal transport to minimise the environmental impact of 3PLs' operations (Rondinelli and Berry, 2000; Lammgard, 2012). Facacha and Horvath (2005) shown that outsourcing of logistics has a higher potential to reduce energy use, global warming potential and fatalities in comparison with the management of logistics in-house. In relation to the second path, the study of Lieb and Lieb (2010) presented the results gained from two annuals surveys carried out on 40 CEOs of large US 3PLs in 2008 and 2009. The authors clustered the initiatives undertaken by the surveyed companies into four categories: i) administrative, ii) analytical, iii) transportation-related; and a broadly defined "other" category. Pieters et al. (2012) investigate how changes in the 3PLs' sustainability strategy influenced the development of new types of physical distribution networks in the Dutch market. To this aim the authors surveyed 145 logistics companies that adopted 608 initiatives directly related to physical distribution that were grouped into the following four categories: i) internal approach (actions organized by the logistics service provider/shipper), ii) external approach (initiatives which need cooperation with others outside organization (e.g. shippers, governments, competitors, stakeholders etc.), iii) innovating (initiatives previously unknown to the logistics service provider/shipper) and iv) optimizing (initiatives for improving efficiency). Isaksson and Hüge-Brodin (2013) investigated how logistics service offering is affected by green initiatives in a sample of six case study 3PL companies operating in the Swedish market. The result of the analysis indicated that initiatives to address green issues are in a different state of development among the case companies. The work of Perotti et al. (2012) explores the relationship between green supply chain practices (GSCP) implementation and company performance in the Italian 3PL market through investigating 15 case study companies. The authors identified eight different categories of GSCP (green supply, distribution strategies and transportation, warehousing and green building, reverse logistics, cooperation with customers, investment recovery, eco-design and packaging and internal management) and three different levels of performance (environmental, economic and operational). The results indicated that the impact on performance is limited although environmental and economic performance are the areas predominantly influenced by green initiatives. A similar study was conducted by Colicchia et al. (2013) that classified the environmental practices into two macro categories: "intra-organizational" and "inter-organizational" practices. The results show that initiatives related to distribution strategies and transportation activities are the most widely implemented, while initiatives involving internal management are not so used. It was found the lack of a standard methodology for environmental performance measurement. Most of the papers dealing with reverse logistics are focused on methods for selecting the appropriate logistics service providers that may be able to manage reverse logistics flows in an effective way and in line with customer demand (Min and Ko, 2008; Efendigil et al., 2008; Kannan et al., 2009). The work of Bai and Sarkis (2013) identified the most information rich flexibility performance measures to use for evaluating 3PLP performance.

Assessment of literature and research objectives

The review of literature described above allows a critical assessment for each of the four topic area identified. The literature on factors affecting the adoption of 3PLs' green initiatives (topic area 1) highlights that there is not a clear picture of factors influencing green practices in 3PLs. Furthermore, the papers analysed indicate that there is no linkage with theory that may help explaining why certain factors are more influential than other. It looks also important to investigate the impact of particular factor on decision to undertake specific initiatives. The awareness of the importance of environmental sustainability is considered an important pre-requisite for the adoption of green initiatives (see Lin and Ho, 2008 and Ho, Lin and Chiang, 2009) but it has not been widely investigated. Finally, most of the papers in this area are based on questionnaire survey and there are no works using case study or other qualitative techniques. The scarcity of papers in the area of innovation and ICT supporting 3PLs' green initiatives (topic area 2) let believe that green innovation and the role of ICT tools may be a promising field of study that will increase in the near future having the potential to provide significant benefits to logistics companies. There are no specific research works in this area aimed at assessing the potential of specific ICT tools on environmental and operational performance of 3PLs. Most of the papers are based on questionnaire survey with no studies using case study or other qualitative techniques. In relation with green initiatives adopted by 3PLs (topic area 3), the extant literature is quite limited and offers a fragmented picture about of initiatives undertaken by 3PLs. In particular there are papers focused on one single measure (e.g. intermodal transport) while other provides classifications of green initiatives adopted by 3PLs. The classification provided by Lieb and Lieb (2010) is empirically derived on the basis of few interviews carried out with 3PLs' CEOs. On the other side, the classification proposed by Perotti et al. (2013) define as green supply chain practices initiatives that are implemented within the boundaries of the firm (see for example warehousing, green building and internal management). Almost the same measures have been classified by Colicchia et al. (2013) using the "intra-organizational" and "inter-organizational" dimensions that seems more appropriate. Nevertheless, there is a clear lack of a comprehensive taxonomy of green initiatives adopted by 3PLs. In addition, most of the papers analysed are based on questionnaire survey while only recent works used case study or other qualitative methods. Moreover, the analysis of the impact of green initiatives on 3PL's performance is in an early stage and needs to be assessed more in-depth. On the basis of the critical points and gaps emerged from the literature review, the following three research objectives have been identified: A) to analyse the implementation of green initiatives by 3PLs; B) to identify drivers affecting the adoption of green initiatives by 3PLs; and, C) to identify barriers to the adoption of green initiatives by 3PLs.

Case study methodology

In order to achieve the above objectives a research design based on two main steps has been adopted. The first step was based on the literature review that has been summarised in the previous section. In the second step, a multiple case study analysis involving a set of 34 Italian logistics service providers has been carried out. The specific methodology used to conduct the case study analysis has been organised into the following four stages: 1) case study selection and classification; 2) interview protocol; 3) data collection; and, 4) analysis and interpretation. Table 2 displays the main characteristics of the case companies. All the companies involved in the survey have a number of green initiatives in place.

3PL provider type		Full Haulage Providers (11)	Basic Logistics Providers (14)	Advanced Logistics Providers (9)
Size	Micro (4)	3	1	0
	Small (17)	3	9	5
	Medium (8)	3	2	3
	Large(5)	2	2	1
Geographical reach	Local (2)	1	1	0
	Regional (3)	2	1	0
	National (8)	3	2	3
	International (21)	5	9	7
ICT used	Location based technology (EDI, GPS, bar code, RFID)	x	x	x
	Connectivity technology (LAN, WLAN)	x	x	x

	Relational technology (ERP, CRM)		x	X
For the definition of different company size see European Commission (2005). Full Haulage Providers: transport activities represent 100 percent of turnover; Basic Logistics Providers: transport and warehousing together comprise over 50 percent of turnover; and Advanced Logistics Providers: more than 50 percent of the total turnover is generated by value added logistics and SCM services (Evangelista et al. 2013).				

Table 2: Profile of the 34 case study companies

Results

This section provides a short summary of case study findings due to space limitation. It is organised into three parts concerning green initiatives adopted, barriers and drivers affecting the adoption of such actions.

Implementation of green initiatives

The magnitude of the green logistics actions undertaken by 3PLs may be variable in terms of their potential impact on the supply chain. Therefore, in Table 3 it was possible to distinguish between “point” initiatives (those acting on one or few activities mainly within companies, such as the use of vehicles) and initiatives that affect multiple levels of the supply chain (involving multiple supply chain actors and requiring collaborative efforts with them, such as the joint green logistics programs).

Area	Initiatives	Full Haulage Providers	Basic Logistics Providers	Advanced Logistics Providers
Vehicle use	Alternative fuels		●	●
	Vehicle specification		●	●
	Eco-driving	●	●	●
	Empty running	●	●	●
	Improving loading phase	●	●	●
Modal shift and intermodality	Low energy transport modes	●	●	●
	Intermodality	●	●	●
Energy efficiency	Renewable energies		●	●
Certification	ISO 14001		●	●
Recycling and packaging	Recycling		●	●
	Packaging		●	●
Training and information	Employee training		●	●
	Information on carbon footprint			●
	Customer/supplier training			●
Supply Chain re-organization	Transport planning		●	●
	Changes in logistics system		●	●
Supply Chain collaboration	Customer collaboration			
	Other 3PLs collaboration			●
Planning and environmental control	EMS			●
	Off-setting			●
	GHG target			●

Table 3: Typology of green initiatives implemented

Following this approach, were identified 9 areas each of which concern a number of actions that may be able to offer benefits from the environmental sustainability point of view. Moving from the top to the bottom of the table, it is possible to shift from areas concerning “point” actions towards initiatives having a wider impact on the supply chain. It is interesting to note that the upper part of the table is much more populated than the bottom part. This means that most of the actions undertaken by the case companies relate to “point” initiatives rather than “supply chain” initiatives (for example “supply chain reorganisation” and “collaborative planning and environmental control” are rarely adopted). This shows that a tactical approach to environmental sustainability is prevalent taking into account mainly internal logic that is reflected in the adoption of actions involving some logistics areas with limited impact on the entire supply chain. The table clearly shows that Full Haulage Providers adopt a smaller number of actions aimed primarily at improving the use of vehicles and shift the movement of cargo from road to other transport modes with lower environmental impact. On the other hand, Basic Logistics Providers adopt a larger number of actions (e.g. vehicles use, energy efficiency, environmental certification, recycling materials and packaging, training and information for staff), but

very few initiatives involve other supply chain levels. Advanced Logistics Providers show the wider portfolio of initiatives adopted with an emphasis on actions involving areas of supply chain collaboration and collaborative environmental planning and control. It is interesting to note that all case companies adopt initiatives to reduce the number of empty trips and improve modal shift towards low energy transport modes.

Barriers to the adoption of green initiatives

The respondents were asked to provide a judgment about the importance of barriers and drivers affecting the adoption of green initiatives. These judgments were then appropriately categorized using the following scale: L = Low, M = Medium, H = High. Table 4 summarizes the results concerning the barriers hindering the adoption of green initiatives in the surveyed companies. Such barriers have been divided into two categories: internal barriers (concerning obstacles mainly originated within the firm) and external barriers (concerning inhibiting factors mainly originated outside the firm).

Barriers/3PL Provider types		Full Haulage Providers	Basic Logistics Providers	Advanced Logistics Providers
Internal barriers	Investment costs	H	H	H
	Financial issues and doubtful payback	H	H	M
	Human resources	H	L	L
	Internal knowledge	H	L	L
	ICT skills	L	L	L
External barriers	Customers awareness	H	L	L
	Suppliers awareness	L	M	L
	Financial incentives	H	H	H
	Regulations and standards	H	H	H
	ICT vendors	M	M	L
L= Low importance M= Medium importance H= High importance				

Table 4: Barriers affecting the adoption of green initiatives

In relation with the internal barriers, the table shows that financial issues (such as investment costs, financial resources and doubtful investment payback period) are the barrier considered extremely important by almost all provider types. Surprisingly, the personnel skills (namely ICT skills) are not considered a relevant barrier. Considering external barriers, it emerges that existing legislation is considered an inhibiting factor by all provider types. Regulatory uncertainty and the lack of incentives are factors increasing the difficulties connected with sustainability investments.

The analysis of the importance of barriers by provider types shows interesting differences. The Full Haulage Providers indicate the lack of government incentives and a well defined regulatory framework together with the lack of customer's awareness as the most important external factors inhibiting the adoption of sustainability initiatives. These factors increase the impact of internal barriers concerning financial and human resource dimensions. The specific business conditions in which road haulage companies operates (with customers demanding higher service levels combined with lower service price) do not allow of Full Haulage companies to consider sustainability as a priority. This means that sustainability is considered by these companies as a source of additional costs rather than a strategic driver to differentiate their business. The barriers slowing down the adoption of green initiatives by Basic and Advanced Providers is characterised by a similar profile. Two are the main problematic areas. The first concerns financial issues as the most relevant internal barriers. On the other hand, the lack of a well defined regulatory framework and government incentives are the main external barriers. The customers of these companies show a higher level of sustainability awareness (both type of 3PLs have not indicated customers awareness as a relevant barrier) and the provision of more green service is an expected dimension of the service offering. This results in the need to incorporate in a more explicit way environmental sustainability in the service offering through specific investment in this area. This may explain why governmental financial incentives are considered extremely important by these companies.

Drivers influencing the adoption of green initiatives

Regarding factors stimulating the adoption of sustainability initiatives, information reported in Table 5 show that all firms have indicated the influence of government actions as one of the drivers that have most influence on the decision to adopt initiatives to green logistics. This indicates that companies are

aware that changes in legislation may have a primary role in influencing their green efforts. In addition all provider type indicated that customer may have a positive impact on the decision to adopt green initiatives as this may improving the company's reputation on the market and provides some cost advantages for customers. The role that the management and the entrepreneur may have in stimulating the adoption measures is also considered critical by all provider types.

Drivers/3PL Provider types	Full Haulage Providers	Basic Logistics Providers	Advanced Logistics Providers
Competitors	H	L	L
Customers	H	H	H
Suppliers	L	M	L
Entrepreneur/owner	H	H	H
Management	H	H	H
Employees	L	L	H
Government	H	H	H
Experts and trade bodies	L	L	M
Insurers	L	L	L
L= Low importance; M= Medium importance; H= High importance			

Table 5: Drivers influencing the adoption of green initiatives

In addition to the above factors, the actions undertaken by competitors are also a further stimulation to adopt more sustainable initiative by Full Haulage Providers reflecting the fact that these companies provide a service in a very competitive environment. On the other hand, the Advanced Logistics Providers are much more aware that employees play an important role in disseminating knowledge about sustainability within the company in comparison with Full Haulage and Basic Logistics Providers. Both Basic and Advanced Logistics Providers consider that their support to the customer's sustainability efforts may result in cost advantages and then it is considered a strong sustainability driver. These companies need to maintain and improve relationships with customers and for this reason are paying increasing attention to the customer's sustainability programmes. No stimulating effects are associated with the role of experts and insurers.

Discussion and conclusion

The research results indicate that the surveyed companies adopted initiatives to reduce the environmental impact at different level of involvement due to the different level of awareness and perception of the importance of the environmental aspects. More advanced companies (such as Basic and Advanced Logistics Providers) show a higher level of awareness toward sustainability. These companies undertake actions where the management plays a substantial supporting role committing human and organizational resources. Due to the fierce competition in the road haulage sector, Full Haulage Providers do not attribute an important role to environmental sustainability. The low level of awareness shows that the competitive potential of sustainability is underestimated. This is reflected in the adoption of "point" initiatives that highlights the lack of a strategic vision of environmental sustainability. In fact, this provider type show a poor understanding of the link between actions aimed at reducing the environmental impact of business activities and the achievement of better financial and economic performance. Investing in sustainability initiatives may allow to achieve both better company performance and higher environmental benefits. However, it is not possible to achieve this objective without breaking down the existing barriers. What are the options that 3PL may exploit to overcome obstacles that slow down sustainability investment? For smaller companies, the negative effects of the economic crisis and the lack of (financial and human) resources tend to delay the adoption of sustainability measures. For these companies it seem necessary to set-up support programs that are able to stimulate sustainability initiatives through facilitating the access to both financial resources for making initiatives less expensive (e.g. the EU Marco Polo programme) and appropriate training interventions for human resources. Other interventions may consist in reducing tax charged on the costs companies incurred to develop green initiatives. For larger companies, the success of sustainability initiatives adopted depends primarily on the ability of the management to develop an approach involving customers. The research results show that the customer is often considered as an obstacle for the development of sustainability initiatives. One way to overcome this barrier would be to convince customers to pay extra price for green logistics solutions offered. Another option may be to obtain longer outsourcing contracts in order to ensure a certain return on sustainability investment. The perspective of longer contracts could encourage the development of collaborative initiatives

between customer and 3PL supplier to achieve shared environmental goals. These options can help to overcome barriers and increasing sustainability investments and, at the same time, promote the environmental dimension of the services offered.

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AN EMPIRICAL STUDY OF TRUCK PAYLOAD ALLOCATION

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Abstract:

This study estimates the number of trucks by type and the level of service on the Interstate highway 15 (I-15) located in Utah. Since an increasing number of trucks affect the efficiency of the highway, providing the trips by truck types, body types and commodity types can be more clearly analyzed the relationship between density and delay on the highway. The predicted commodity flow data from the Freight Analysis Framework version 3 of the United States Department of Transportation in the year 2015 is derived. The truck allocation factors are modified to convert the commodity flow data to the annual average daily truck traffic (AADTT). The results have shown that the degree of saturation on the I-15 highway for the year 2015 approaches a full capacity, requiring a short-term transport solution.

Keywords: Freight analysis frame work, Truck trip allocation, Freight flow estimation, Average daily truck traffic, Highway network performance, Truck payload allocation

1. Introduction

The objective of this research is to represent a practical application to estimate the Annual Average Daily Truck Traffic (AADTT) in Utah, the United States. Because of Freight Analysis Framework FAF³, the national commodity flow data does not provide AADTT directly, instead it is used for Vehicle Inventory and Use Survey (VIUS, 2002) to estimate AADTT by using commodity flows. According to the Federal Highway Administration (FHWA) and U.S. Department of Transportation (USDOT), the freight flow model was first released in 2002 based on 1998 commodity flow data. The FAF has been applied to a variety of transportation analysis including highway capacity and bottleneck assessments. In addition, the truck size and weight studies have applied the FAF for the evaluation of investments in transportation infrastructure, impacts of changes in road pricing policies, multimodal freight policy analysis, , and impacts on national freight movement of natural and manmade disasters. The current version is FAF version 3.

The commodity flow data was updated and enhanced by Oak Ridge National Laboratory (ORNL) for FHWA to estimate the dollar value and tons of shipments between freight origin-destination (O-D) including 123 regions 8 international zones 7 transport modes and 43 Standard Classification of Transported Goods (SCTG) in 2007, and those commodity flows were classified by the commodity types and modes of transport. The FAF³ 2007 is benchmarked as a base year and forecasted for every 5 years through 2040. The FAF³ database is used to support various Federal needs related to policy and legislative issues for transport planning. In addition, the FAF³ is used for several projects prepared for FHWA, State DOTs and metropolitan planning organizations (MPOs), and is also used to serve many public and private sectors for transportation planning proposes.

Battelle (2011) conducts a national highway freight analysis to estimate the base year 2007 and the 2040 forecasted FAF truck flow, and studies the congestion related to the highway network. The freight traffic analysis covers 7 areas is used to determine truck trips, payload and passenger car equivalent factor. According to a current truck payload equivalent factor, there is no direct source of information on the number of truck trips between origin and destination. For development of FAF² truck O-D matrix, they provide the procedures to convert the commodity flows (in tons) into the equivalent number of annual laden and empty trucks by using truck allocations with specified distance ranges and truck equivalent factors. The 2002 Vehicle Inventory and Use Survey (VIUS) data is used for estimation.

Gillett (2011) calculates a delay cost for long haul single unit and combination trucks to assess the highway performance by identifying the congested locations where current or future delay are likely to occur. An Interstate-75, 160 miles from Macon to the Georgia-Florida border is studied. The delay cost is calculated by taking speed, volume, distance, types of truck, and types of commodity into account. In order to obtain the value of freight by truck and commodity types, the FAF³ is used as the data source together with the average truck speed surveyed by American Transportation Research Institute (ATRI) and traffic volume collected by Georgia Department of Transportation (GDOT). To calculate the delay cost, the commodity values moved by truck from 43 SCTG commodities are grouped into 3

categories: high, moderate and low time sensitive. The tons of commodities are converted to the number of trucks by the truck equivalent factors similar to Battelle (2011), in order to estimate the number of trucks by single and combination types moved through the corridor. In the study area, the range of 101-200 miles travel distance is considered. Truck trips derived from the above database are assigned to freight transportation network. The critical links are then identified and prioritized for the future improvement scheme. Virginia Department of Transportation (VDOT, 2005) studies the freight trucks from I-81 that are diverted to rail by using the Intermodal Transportation and Inventory Cost model. The truck movement in I-81 is forecasted using Truck Trip Analyzer (TTA) model. Two types of survey questionnaires are compared with freight forecasting model. The truck trip estimation is developed using a variety of data sources including 1997 VIUS, 1998 TTA and 1998 VDOT freight flow data. The standard commodity flow data is allocated to traffic analysis zones. Then, sets of different load factors are used to convert tonnage to truck trips. They also create the adjustment factor that reflects empty truck movement. The economic input-output techniques are used to identify link production and supply center with local consumption. Mesa-Arango *et al.* (2010) evaluate the economic impact of disruption for transportation policy decisions. The study areas include: the northeastern part of Illinois, the northern part of Indiana, and the small part of southwestern Michigan, resulting to 467 zones. The consequences of network disruptions are in various forms including fatalities, infrastructure destructions, and economic losses. To quantify the consequences of disruption, they evaluate the economic impact from the commodity movement data. The proposed model is based on the state of the art in economic concepts that quantify the impacts at a regional level. A framework is based on four input data sources: FAF³, Transportation Analysis Zones (TAZs), a disruption scenario, and vehicle operational cost and value of time. Jin (2011) uses 2007 CFS (Commodity Flow Survey) data of Utah's state highway network for predicting truck freight flow on state truck routes. A state-wide truck freight demand model is developed for estimating truck traffic at any point on its highway. The assumption and the developed model are set that freight trips are the same behavioral mechanism as passenger trips. The county-level multiple regression models are developed using GIS and statistical data: a physical distance, Euclidean distance, and population and employment data. The commodity flow are also converted to truck trips using the FAF^{2.2} estimation method (FHWA, 2006), and assigned to Utah's truck routes using all-or-nothing assignment in TransCAD together with a modified genetic algorithm. The results indicate that using freight flow and land use data could be practical for modeling truck traffic demand on a state-wide truck route.

ULTRANS (2011) develops a model to forecast long-haul commercial vehicles (greater than 50 miles on travelling distance). The development of the Long Distance Commercial Vehicle Model is based on California spatial economic data: Production, Exchange and Consumption Allocation System (PECAS) modeling framework. It uses an aggregate, equilibrium structure with separate flows of exchanges, i.e. goods, service, labor and space going from production and consumption based on coefficients and market prices conversion of the year 2000 PECAS commodity flow to weekday truck flow. The 2002 FAF data is a primary source of factors to convert PECAS from dollar flows to truck flows. The appropriate weight derived from IMPLAN data is also used to convert the truck flows classified using Standard Transportation Commodity Classification (STCC) codes to PECAS commodity categories. The estimated ranges of truck trip by commodity are compared with the observed trip lengths. To convert the commodity flow data to ADTT, it requires the number of truck trips passing through a particular highway section between freight O-D pairs. Currently, the indirect method to estimate the truck trips between state-wide O-D pairs is provided by FHWA (Alam, 2010) and a truck payload equivalent factor is introduced by using 2002 VIUS database.

In our study, the process to convert FAF³ commodity flow data to ADTT is shown in Figure 1. To allocate ADTT by commodity types and percentage share in Utah, the driving distance of trucks is determined. The truck movement within Utah is limited to 201-500 miles, and from-to Utah commodity flow is greater than 500 miles. Once the distance ranges have been specified, the ADTT by truck and body types can be allocated. Table 1 and 2 show FAF³ truck configuration (Truck types) and truck body types. For the truck allocation factors, we follow the VIUS2002 as shown in Table 3.

To obtain the number of truck trips from FAF³ commodity in tonnage on highway for a specific O-D pair, the distance range is defined. For example, if O-D travel distance is 245 miles, the distance range 201-500 miles is considered. Then, each commodity type is proportioned to each type of truck using the allocation number in Table 3. After that, truck equivalent factors will be used to allocate the commodity weight to the number of trucks by specific body type.

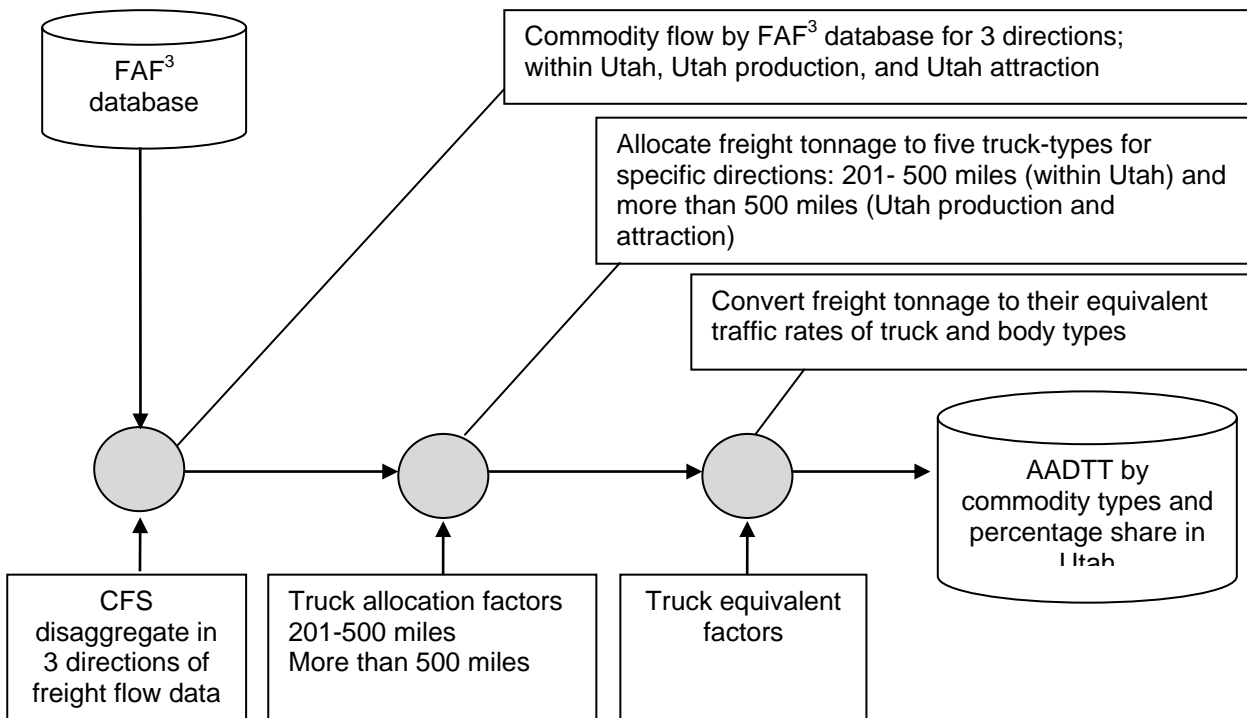


Figure1 Truck payload allocation diagram (Battelle, 2011)

Table1 FAF³ truck configuration

Group	Abbreviation	Description
1	SU	Single unit truck
2	TT	Truck plus trailer combination
3	CS	Tractor plus semi-trailer combination
4	DBL	Tractor plus double trailer combination
5	TPT	Tractor plus triple trailer combination

Table 2 FAF³ truck body types

Body	Truck Fleet	Description
1	37.72%	Dry van
2	24.37%	Flat bed
3	14.73%	Bulk
...
9	2.33%	Others

Table 3 FAF³ truck allocation factors

Min. Range (miles)	Max. Range (miles)	SU	TT	CS	DBL	TPT
0	50	0.793201	0.070139	0.130465	0.006179	0.0000167
51	100	0.577445	0.058172	0.344653	0.019608	0
101	200	0.313468	0.045762	0.565269	0.074434	0.000452
201	500	0.142467	0.027288	0.751628	0.075218	0.002031
501	10000	0.064660	0.014900	0.879727	0.034143	0.004225

2. Data collection

The state of Utah is a case study of our research; it is bordered by Colorado on the east, Wyoming and Idaho on the North, Arizona on the South and Nevada on the west as shown in Figure 2. In Utah, the freight transport demand has been rising steadily and the forecast shows the continued growth for the next two decades (Jansuwan *et al.*, 2010). According to FAF³ the top five commodity tonnages in 2007 are: non-metal, mineral products, gravel, coal waste/scrap, and gasoline, and these commodities account for almost two-third (i.e. 63.48%) of total commodity flow in the State of Utah.



Figure 2 The U.S. Interstate-15 in the study area (i.e., red line)

According to FAF³ database, we can derive a percentage share of transport modes in Utah. The largest modal share in Utah is truck (63.67% in base year 2007) and its trend has been increasing continuously (See Figure 3). Considering freight tonnage by the direction of truck movement, the commodity flow within Utah is accounted for 105.49 million tons, from Utah to other states (Utah production) is 18.21 million tons, and from other states to Utah (Utah attraction) is 20.89 million tons as shown in Figure 4.

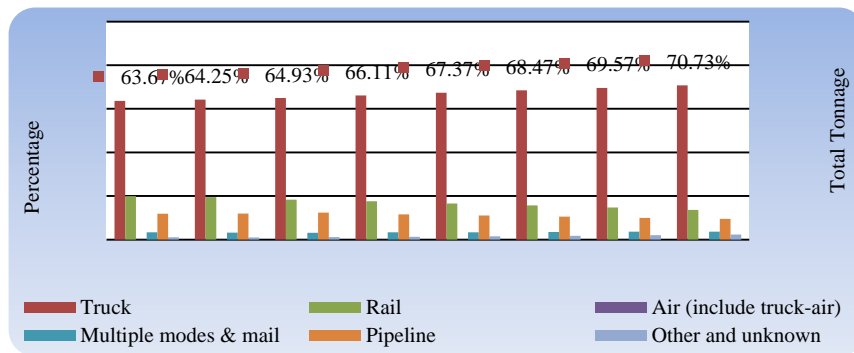


Figure 3 Projection of commodity flow and modal share by volume in Utah from 2007 to 2040

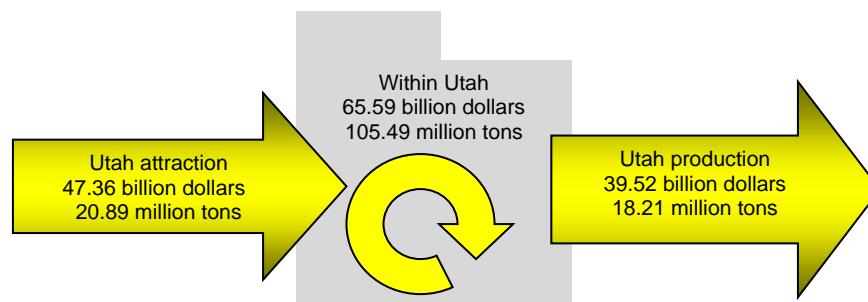


Figure 4 Direction of truck movement in Utah by dollar value and tonnage (2015)

Table 4 FAF³ Utah commodity flow survey attraction (2015)

Ranking No.	SCTG Code	Commodity Type	Tonnage 2015 (x1000 tons)			Total
			Within Utah	Utah Production	Utah Attraction	
1	31	Nonmetal min. prods.	16,442.38	947.49	1,164.71	18,554.57
2	15	Coal	18,181.49	156.36	3.67	18,341.52
3	41	Waste/scrap	12,338.83	88.19	1,293.09	13,720.10
...	
43	09	Tobacco prods.	7.70	0.05	1.99	9.74
		Total	105,489.95	18,214.08	20,889.02	144,593.95

Table 4 shows the commodity survey (CFS), forecasted to the year 2015 and extracted to specific areas, using FAF data tabulation tool.

3. Truck payload allocation

In our paper, the AADTT by truck types, body types, and commodity types is estimated using the FAF³ freight analysis framework. The VIUS 2002 with Truck Payload Equivalent (TEP) is also used for model calibration as described in equations below:

Notations:

Y_j : the number of trucks in type j , where $j=1, 2, \dots, 5$

X_i : tonnage of commodity i , where $i=1, 2, \dots, 43$

β_{ijk} : fraction of commodity i moved by truck type j with body type k , where $k=1, 2, \dots, 9$

ω_{ijk} : mean payload of moving commodity i by truck type j with body type k

$X_i \beta_{ijk}$: tonnage of commodity X_i carried by truck type j and body type k

$X_i \beta_{ijk} / \omega_{ijk}$: the number of trucks j with body type k required to move $X_i \beta_{ijk}$ tons

For example, the number of trucks, type $Y_{j=1}$ (i.e., Single unit truck: SU) and $Y_{j=2}$ (i.e. Trucks plus trailer combination: TT) used to move $X_i \beta_{ijk}$ tons of commodity disaggregate direction $X_{i=1}$ (i.e. Live animals/fish, Cereal grains, etc.) by all body types (i.e. Dry van, Flat bed, Bulk, etc.) are calculated as:

$$Y_{j=1} = \frac{X_i \beta_{i11}}{\omega_{i11}} + \frac{X_i \beta_{i12}}{\omega_{i12}} + \frac{X_i \beta_{i13}}{\omega_{i13}} + \dots + \frac{X_i \beta_{i19}}{\omega_{i19}} = \sum_{k=1}^{k=9} \frac{X_i \beta_{i1k}}{\omega_{i1k}} \quad (1)$$

The total number of trucks assigned to move commodity X_i and the total number of trucks assigned to move all commodities are given by equations

$$Total_Trucks = \sum_{i=1}^{i=43} X_i \sum_{j=1}^{j=5} \sum_{k=1}^{k=9} \frac{\beta_{ijk}}{\omega_{ijk}} \quad (2)$$

The tonnage to truck conversion factor or truck equivalent factor is therefore given by:

$$TEF_{ijk} = \frac{\beta_{ijk}}{\omega_{ijk}} \quad (3)$$

where: TEF_{ijk} is the factor that converts tons of commodity to equivalent number of trucks classified by truck type (configuration), body type, and commodity type.

Example: Truck conversion 2015

The example for converting FAF³ data uses the largest commodity flow (type 31- nonmetal min. prod) within Utah in the year 2015. The result shows the number of trucks in a single unit type ($Y_{j=1}$).

Table 5 FAF³ calculation data

Data	Value
Direction of commodity	Within
SCTG code-Commodity	31-Nonmetal mineral products
Tonnage ($X_{i=31}$)	16,442,376.06 Tons
Distance range	201-500 miles

Table 6 Tonnage Allocated to the five truck types of range 201-500

		Allocation Factor (ω_{ijk})	Value (tons)
Single unit	SU	0.142467	2,342,495.99
Truck trailer	TT	0.027288	448,679.56
Combination semitrailer	CS	0.751628	12,358,550.23
Combination double	DBL	0.075218	1,236,762.64
Combination triple	TPT	0.002031	33,394.47

Table 7 Truck equivalent factor for nonmetal min. products, $i = 31$

Body Type (k)	Truck Equivalent Factor (β_{ijk})				
	SU	TT	CS	DBL	TPT
Dry van	0	0	0	0	0
Flat bed	0	0	0	0	0
Bulk	0.00404	0.0194	0.00288	0.00429	0.02181
...
Other	0.01456	0.01178	0	0	0

Table 8 Annual truck traffic within Utah for nonmetal min. products

	SU	TT	CS	DBL	TPT
Dry van	0	0	0	0	0
Flat bed	0	0	0	0	0
Bulk	31.55	29.01	118.64	17.69	2.43
...
Other	113.69	17.62	0	0	0
Total truck (Y_j)	227.85	72.16	1,410.52	95.81	2.43

$$Y_{j=1} = ((16,442,376.06)(0.142467)(0) + (16,442,376.06)(0.142467)(0) + \dots + (16,442,376.06)(0.142467)(0.01456)) / 300 = 227.85 \text{ SU trucks}$$

To calculate all types of trucks for commodity nonmetal mineral products, We follow the processing steps as shown in Table 5 to 8. The results of AADTT allocated by truck types, body types, and commodity types are presented in the following section.

4. Empirical results

Apart from FAF³ database that shows only freight tonnage, our results represent 2015 AADTT allocated by truck types, body types, and commodity types (see Table 9 - 11). In Utah, a majority of truck type used to transport the top five products is a tractor plus semi-trailer combinations (CS) as shown in Figure 5, along with the direction of freight movement shown in Figure 6. The AADTT by body types and commodity types is shown in Table 12. The projected commodity flow data in Utah for the year 2015 is estimated to 5,429 thousand trucks. The percentage share of single unit truck (SU) within Utah is the largest proportion accounted for 16.70% while the SU for production and attraction

are more or less the same, about 10%. The average percentage share of single and combination trucks in all three directions is approximated 12.90% and 87.10%.

Table 9 AADTT by truck and commodity types within Utah

SCTG	Commodity	AADTT within Utah (trucks/day)				
		SU	TT	CS	DBL	TPL
1	Live animals/fish	0.28	3.77	30.46	2.53	-
2	Cereal grains	74.26	15.93	370.81	28.05	-
3	Other agricultural products	47.97	15.13	181.23	16.00	-
...
43	Unknown	89.15	26.82	200.72	21.35	0.33
		2,141.24	771.95	9,134.06	772.20	5.14

Table 10 AADTT by truck and commodity types for Utah production

SCTG	Commodity	AADTT for Utah Production (trucks/day)				
		SU	TT	CS	DBL	TPL
1	Live animals/fish	4.74	2.11	36.62	1.18	-
2	Cereal grains	0.23	0.06	2.99	0.09	-
3	Other agricultural products	0.85	2.60	66.69	2.28	-
...
43	Unknown	0.28	0.10	1.62	0.07	0.00
		267.60	148.99	1,953.91	104.53	0.40

Table 11 ADTT by truck and commodity types for Utah attraction

SCTG	Commodity	AADTT for Utah Attraction (trucks/day)				
		SU	TT	CS	DBL	TPL
1	Live animals/fish	0.30	0.13	2.34	0.08	-
2	Cereal grains	8.00	2.06	103.00	3.02	-
3	Other agricultural products	4.35	1.65	42.42	1.45	-
...
43	Unknown	0.74	0.27	4.28	0.18	0.01
		283.08	154.82	2,261.06	96.94	0.48

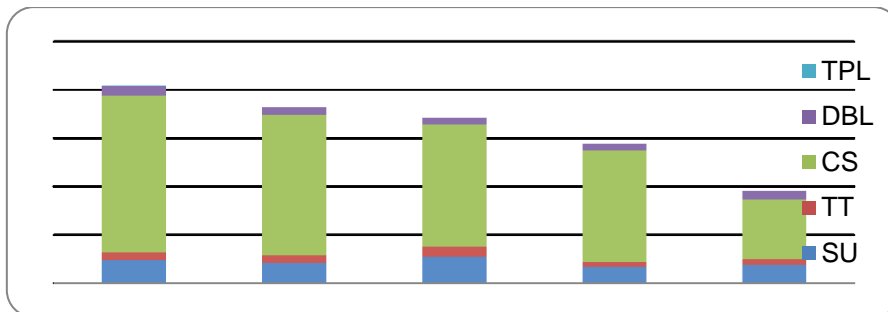


Figure 5 Top five commodities allocated by truck types

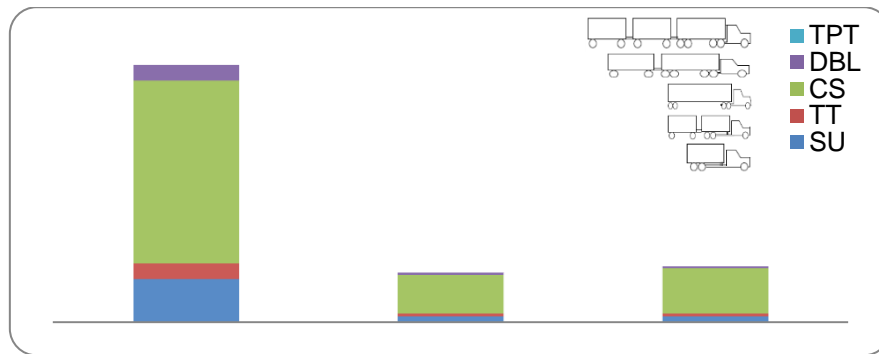


Figure 6 Utah freight flow allocated by truck types

Table 12 Utah commodity flow allocated by truck types

Direction Flow	Truck trips (trucks/day)					Total Trucks	Percentage (%)	
	SU	TT	CS	DBL	TPT		SU	Combination
Within	2,141.24	771.95	9,134.06	772.20	5.14	12,824.59	16.70	83.30
Production	267.60	148.99	1,953.91	104.53	0.40	2,475.42	10.81	89.19
Attraction	283.08	154.82	2,261.06	96.94	0.48	2,796.38	10.12	89.88
Total	2,691.91	1,075.76	13,349.04	973.66	6.01	18,096.39	12.90	87.10

Table 13 Percentage changes of truck trips within Utah from 2007 to 2015

Year	Truck trips within Utah (trucks/day)						Degree of Saturate
	SU	TT	CS	DBL	TPT	Total Trucks	
2007	1,875.98	676.36	8,110.24	678.78	5.45	11,346.81	0.8832
2015	2,141.24	771.95	9,134.06	772.20	5.14	12,824.59	0.9982
(%)change	14.14%	14.13%	12.62%	13.77%	-6.10%	13.02%	

From Table 13, the I-15 corridor has substantially increased in almost all truck types except the tractor plus triple trailer combinations (TPT), which the number is not significant. The percentage change classified by truck type is useful to analyze the capacity of highway network. The degree of saturation delay is estimated by (Akcelik and Roupail, 1993)

$$x = q / c$$

where: x is the degree of saturation related to truck volume and capacity of lane, q is the demand flow rate during the specified period in vehicles per hour, c is the capacity of truck under the specified flow conditions in vehicles per hour.

Attempt to find out the vehicle capacity on highway according to Arizona Department of Transport (2012) estimates 2,000 vehicles per hour per lane. Combining with truck average volume in urban areas studied by Daigre (2011) states that the average percentage of truck traffic on I-15 in Utah is accounted for 22% of total vehicles, i.e. 440 vehicles per hour. The total trucks are then divided by 365 days per year and 24 hours per day to obtain the volume of demand per hour. The degree of saturation delay in year 2007 and 2015 is: $x_{2007} = (3,404,040 / 365 * 24) / 440 = 0.8832$, and $x_{2015} = (3,847,380 / 365 * 24) / 440 = 0.9982$, almost exceeding a capacity of highway network.

5. Conclusions

An increase in the number of trucks will affect traffic volume on a transportation network and due to capacity and infrastructure of pavement. Identifying the type of truck-specific commodity raises the awareness to construct the critical link. Although this study shows illustrative example, it will be used for applying in the further step of study in delay time cost referred to the percentage of single unit and total combination unit of truck. The findings can be useful for other studies to get more information clearly point of view with the number in specific type of trucks. To more accurately calculate the delay, the disaggregate type of truck along I-15 in Utah and the volume of truck by UDOT can be combined with FAF³ commodity flow data in percentage type of truck to obtain the truck profiles along the corridor. In addition, to correct the distribution of FAF³ volumes by truck type on specified links in the

next study, the U.S. DOT data will be used to split the truck volume for each link while the proportion of FAF³ volumes by truck type could be determined the split for each type of truck on each link.

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AN EXPLORATORY STUDY OF THAI SMES SUPPLY CHAIN MANAGEMENT PRACTICES

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1. Introduction

Supply chain management (SCM) study has been of substantial importance since mid 1980s (Cooper et al., 1997) and recently has become a topic of increasing interest to practitioners and academic researchers. The SCM study includes the management of inter-organisational operations, system integration, partnership model and information sharing. While the goal of business is to meet customer needs better than competitors with lower resource usage, supply chain management is designed to help business to achieve this goal. In order to implement SCM concept, the number of firms involved in the supply chain and the activities and functions have to be identified in advance. This leads to three major components of supply chain management concept (Jespersen and Skjott-Larsen, 2008) which includes network structure, business processes and management.

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

According to the SCM studies on the relationship between SMEs and their performance in various countries (Thakkar et al., 2008b, Koh et al., 2007, Vaaland and Heide, 2007, Quayle, 2003), it can be observed that: (1) SMEs were lacking proper SCM implementation such as technology and system application that resulted in losing their competitive performance, (2) focusing on strategic supply chain can improve SMEs' operational efficiency which leads to competitive advantage, (3) relationship management can be built by appropriately employing SCM practices. On the other hand, some literature argued that SCM is not suitable to SMEs (Arend and Wisner, 2005) as SCM may lead to lower firm's performance and return on investment.

In the same way, most of Thai SMEs have been left behind the advancement of SCM implementation because of they lacked of adequate empirical knowledge on supply chain performance measurement such as cost, time and reliability (Bhanomyong and Supatn, 2011). Thai SMEs are mostly reluctant to change and invest. Supply chain management is considered to be an important tool to help Thai SMEs to improve their business performance. This study aims to determine the relationships among antecedents of SCM practices, which are SCM driver, SCM facilitator and SCM impediment and SCM practice. Then, define the associations of SCM practices and firm's performance, which is the consequence of SCM practice, in the context of SMEs in Thailand. The result of the study can be adapted to other developing countries.

Research methodology

To achieve the research objectives, i.e. developing the SCM practices for Thai SMEs, 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

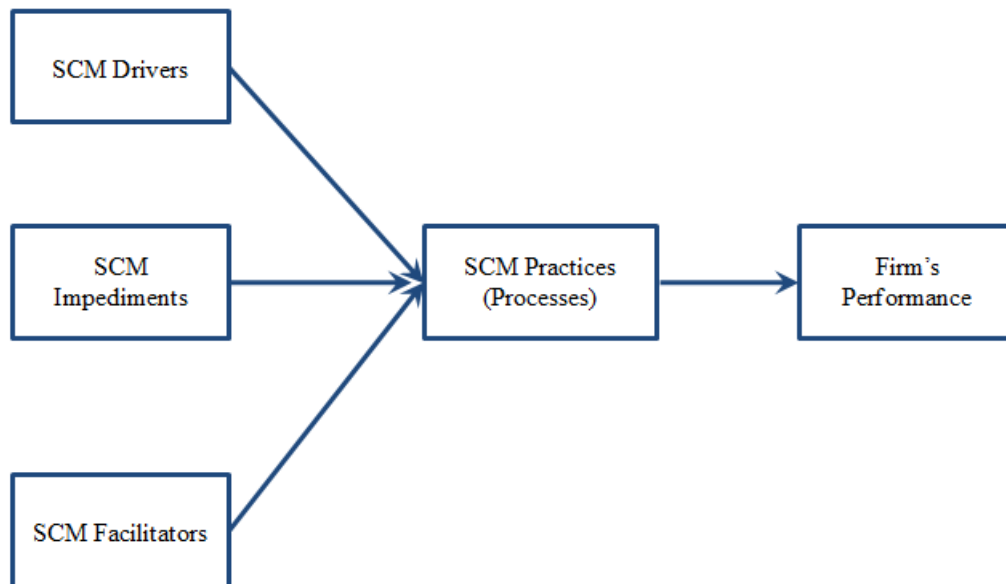


Figure 1: The Supply chain management practices model with constructs

The sample was selected from members of The Federation of Thai Industries (FTI). We selected only firms that fit the criteria of small and medium size firms' definition, which have been classifying by the number of full time employee of the firms. 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). Pilot test has been done with the SMEs who participated in food supply chain seminar with the ministry of industrial. The volunteer respondents have completed 30 sets of questionnaire, which was suitable with research scale ([Saunders et al., 2007](#)). The results showed that the respondents have no problems in answering the questions in the questionnaire.

After four weeks of sending out the questionnaires, we got 129 responding answered questionnaires. Then we sent out two waves reminding letters in the following months at four weeks interval. Finally, the survey produced 311 valid responses, resulting in a response rate of 11.5 per cent. This response rate was comparable to the previous study of SMEs in Thailand context, supply chain management – SMEs approach ([Udomleartprasert et al., 2003](#)) and provide adequate data for further analysis.

We examined the nonresponse bias by testing for statistically significant difference between early and late responses. The questionnaires returned after the last remind were considered the proxy for non respondents, while the early returned questionnaires were appraised as proxy for respondents ([Arend and Wisner, 2005](#)). The statistical *t* tests based on two groups showed non-significant results for the means of independents and dependents variable. The characteristics of respondents and their businesses are summarised and presented in table 1.

Demographic characteristic of the business	Number of firms	Percentage
Type of industry		
• Leather and shoes	8	2.6%
• Agricultural processing	14	4.5%
• Health care and pharmaceutical	10	3.2%
• Motor and spare parts	31	10.0%
• Appliance and furniture	21	6.8%
• Pulp and paper	12	3.9%
• Metal and machinery	16	5.1%
• Rubber products	14	4.5%
• Clothing and textile	22	7.1%
• Plastics and chemical	16	5.1%
• Electronics	11	3.5%
• Food processing and animal nutrition	48	15.4%
• Ceramic	15	4.8%
• Mass merchandising and retail	15	4.8%
• Services	58	18.9%
Number of employee		
• Micro (Less than 25)	95	30.5%
• Small (25 to 50)	71	22.9%
• Medium (51 to 200)	145	46.6%
Total	311	100.0%

Table 1: Characteristics of respondents and their businesses

2. Literature reviews

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 (Yardpaga et al., 2013). They may be termed SCM antecedents (Mentzer et al., 2001). As SCM may be implemented in different practices and have different impacts on firms' performance (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. While supply chain management 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. Supply chain management impediments 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).

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 such as

- Customer relationship management
- Supplier relationship management
- Manufacturing flow management
- Product development and Commercialisation (Cooper et al., 1997)

In each process, this study will examine the supply chain flows including material flow, information flow and resources flow (Mangan et al., 2008).

Firm's performance can be identified as the process of measurement the effectiveness and the efficiency of firm's activities (Bhanomyong and Supatn, 2011). The firm's performance can be measured as cost, time and reliability of its processes to produce product and services. Li et al., (2006) classifies organisational performance into short-term and long-term objectives. In short-term objectives are mostly related to increase productivity and reduce inventory and cycle time, while long-term objectives are associated with increasing market share and profit. In firm's financial aspect, market share gaining and higher profit reflects higher asset utilisation of a firm.

3. Empirical findings

Factor analysis

In factor analysis we are interested in finding common underlying dimensions within the data. According to Field (2009), the total variance for a variable consists of two components; common variance which sharing with other variables and unique variance that specific to its. The proportion of common variance is known as communality. Therefore, a variable that share none of its variance with any other variables would have communality of 0 while a measure that has no specific or random variance would has a communality of 1. To reduce dimension of the variables is to transform our observed data into part of linear component which known as principal component analysis technique. For this technique, the initial common variance for each variable is assumed to 1. Therefore after grouping the variables into factors the common variance for each variable will be calculated. Table 2 illustrates the communality of each variable after extraction by the principal component analysis extraction method. The communality also a measure of the proportion of variance explained by the extracted factors. The principal component analysis extraction method gives each component the eigenvalues. Generally, Kaiser (1960) recommends to retain all factors that have eigenvalues greater than 1. Then in our study we propose two extraction factors that can explain total variance 62.22%. The result of factor analysis is illustrated in table 3.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %	Total	% of Var.	Cum. %
1	3.283	46.90	46.90	3.283	46.90	46.90	2.287	32.67	32.67
2	1.073	15.32	62.22	1.073	15.32	62.22	2.068	29.55	62.22
3	0.812	11.60	73.82						
4	0.607	8.67	82.49						
5	0.558	7.98	90.47						
6	0.386	5.52	95.99						
7	0.281	4.01	100.00						

Note: Extraction Method: Principal Component Analysis.

Table 2: The result of Total Variance Explained for supply chain management drivers

Supply chain management drivers	Factor 1	Factor 2	Communalities
• Global competition	0.705	0.051	0.500
• End-customer needs	0.652	0.260	0.493
• Process integration	0.772	0.276	0.672
• Network collaboration	0.789	0.252	0.686
• Cost reduction	0.196	0.758	0.613
• Process improvement	0.135	0.878	0.789
• Internal collaboration	0.300	0.717	0.604

Note: Extraction Method: Principal Component Analysis, Rotation Method: Varimax with Kaiser Normalization.

Table 3: The result of factor analysis for supply chain management drivers

Four variables; global competition, end-customer needs, process integration, and network collaboration are loaded into the first factor. Thus the first factor can be called as external supply chain management driver. The second factor includes cost reduction, process improvement, and internal collaboration, which relates to internal company activities so it can be labeled as internal supply chain management driver.

Then we applied factor analysis to every group of measurements and resulting that supply chain management facilitator, supply chain management impediment, supply chain management practice and firm's performance each group has only single component. According to the factor analysis technique, the composite score, mean score, standard deviation and alpha coefficients from the summated scales for external supply chain management driver, internal supply chain management driver, supply chain management facilitator, supply chain management impediment, supply chain management practice and firm's performance are calculated and displayed in table 4.

	Composite score	Mean score	Standard deviation	Alpha coefficient
• External SCMD	0.730	4.007	0.912	0.742
• Internal SCMD	0.784	4.317	0.823	0.747
• SCMF	0.731	4.106	0.820	0.855
• SCMI	0.689	3.866	0.928	0.815
• SCMP	0.831	3.591	1.011	0.959
• FP	0.788	3.565	0.840	0.912

Table 4: Factors analysis summary

Multiple regression analysis

To examine how antecedents of supply chain management impact on the supply chain management practice, regressions analysis techniques were conducted based on the factors standardisation score of each antecedent and the composite score of supply chain management practice. In the analysis of sample data we would like to study the dependence of supply chain management practice on the supply chain management antecedents according to our proposed supply chain management practices model. The antecedents of supply chain management in our model consist of supply chain management driver, supply chain management facilitator and supply chain management impediment. From our factor analysis, we categorised supply chain management driver into two factors; external supply chain management driver and internal supply chain management driver. Then we have four antecedents acting as independent variables. Supply chain management practice is identified as dependent variable. To predict the level of supply chain management practice of the firm we applied multiple regression technique to fitting a model to the data. The results of multiple regressions are presented in table 5. A simple regression model was conducted to examine whether supply chain management practice impact on firm's performance with result as shown in table 6.

Model Correlation Coefficient R = .542 R ² = .293	Standardized Coefficients		t	Sig.
	B	Std. Error		
(Constant)	.000	.048	.000	1.000
External SCM Driver	.260	.059	4.392	.000
Internal SCM Driver	.023	.062	.377	.707
SCM Facilitator	.165	.076	2.182	.030
SCM Impediment	.243	.061	3.991	.000

Note: Dependent Variable: SCM Practice

Table 5: Supply chain management practice regression model coefficients

Model Correlation Coefficient R = .558 R ² = .311	Standardized Coefficients		t	Sig.
	B	Std. Error		
(Constant)	.000	.047	.000	1.000
SCM Practice	.558	.047	11.821	.000

Note: Dependent Variable: Firm's performance

Table 6: Firm's performance regression model coefficients

Next, the respondents were classified into three different groups based on their level of performance. The composite score of firm's performance is calculated by sum of score for measurements according to firm's performance. In total we had 8 questions according to performances then the score ranges from 8 (answer 1 to each question) to 40 (answer 5 for all questions). From our questionnaire, score 1 and 2 implied that firm's performance was worse than competitors, score 3 indicated performance was comparable to competitors while score 4 and 5 showed that firm's performance was better than competitor. Then, we calculated a range of low performance as total score from 8 to 23, medium performance score from 24 to 31 and a score higher than 31 accounts for high performance respectively. Finally, an ANOVA was conducted to investigate the differences of firm's performance and supply chain management practice among groups of firms that have different level of performances. The results are displayed in table 7.

	Firm's Performance				Significant (<i>p</i> - value)			
	Low (45)	Medium (172)	High (94)	Total (311)	Overall	L - M	L - H	M - H
SCM Practice Average Standard Score	-5826	-2286	.6972	0.00	0.000	0.017	0.000	0.000
Network Relationship Management								
• Joint inventory management	3.16	3.47	4.22	3.65	0.000	0.037	0.000	0.000
• IT Coordination	3.33	3.53	4.26	3.72	0.000	0.183*	0.000	0.000
• Long-term relationship enable	3.09	3.45	4.18	3.62	0.000	0.017	0.000	0.000
• Clear vision of SCM	3.13	3.33	4.10	3.53	0.000	0.199*	0.000	0.000
Manufacturing Flow Management								
• JIT / Lean implementation	3.00	3.30	4.13	3.51	0.000	0.061*	0.000	0.000
• S&OP implementation	3.04	3.37	4.11	3.54	0.000	0.048	0.000	0.000
• Benchmarking and performance measurement	2.93	3.22	4.11	3.44	0.000	0.094*	0.000	0.000
• Quality policy established	3.22	3.50	4.22	3.68	0.000	0.069*	0.000	0.000
Product Development and Commercialisation								
• Material strategy alignment	2.98	3.42	4.17	3.58	0.000	0.006	0.000	0.000
• Customer requirement information sharing	3.04	3.38	4.15	3.56	0.000	0.043	0.000	0.000
• Design for supply chain concept	3.07	3.35	4.17	3.56	0.000	0.056*	0.000	0.000
• Customer's feedback as input to design	3.22	3.48	4.32	3.69	0.000	0.105*	0.000	0.000

Note: *Indifferences of firm's performance for supply chain management practices

Table 7: Differences in SCM practice among groups of firm's performance

4. Findings and discussion

Table 5 explains the importance of each predictor to the dependent variable. The standardised coefficients (beta) indicate that external supply chain management driver has more important than internal supply chain management driver. The external supply chain management driver and supply chain management impediment have a comparable degree of important in the model. From the t-statistics, concludes that the internal supply chain management driver has no significant to the model. The beta also explains to us that the increase in one score of important external supply chain management driver will increase score of implementation of supply chain management practices of an organisation 0.26 score. Also the increase in one score of important supply chain management impediment will increase score of implementation of supply chain management practices of an organisation 0.243 score. Finally, the increase in one score of important supply chain management facilitator will increase score of implementation of supply chain management practices of an organisation 0.165 score. When firms realised with the important of the external supply chain management driver, supply chain management facilitator and supply chain management impediment ones will implement the supply chain management in their organisation.

Table 6 gives us the valuable information about the importance of predictor to the dependent variable. From the t-statistics, the supply chain management practice has significant to the model. This can be concluded that the increase in one score of implementation supply chain management practice will increase score of advantage of firm's performance compare to competitors 0.558 score. This leads to conclusion of supply chain management practice is leading to higher firm's performance.

From table 7, an overall supply chain management practice had radically influenced to difference level on firm's performance. The higher level of supply chain management practices resulted in higher firm's performance. This confirmed the correlation between supply chain management practice and firm's performance. The differences level of supply chain management practice had highly impacted between medium performance firms and high performance firms. While the low performance and medium performance firms had moderate impact. Some of supply chain management practices had resulted indifference to performance of low and medium performance firms i.e. IT coordination, clear vision of supply chain management, JIT/Lean implementation, benchmarking and performance measurement, quality policy established, design for supply chain concept, and customer's feedback as input to design.

5. Conclusion and limitation

The study examined the causal relationship of supply chain management practices in Thai SMEs context. The model was developed from literature review and confirmed by supply chain executive experts through interviews. In general, data from the self-responded questionnaire survey provided empirical evidence supporting the causal model. This study appears to confirm that the antecedents of supply chain management, which include driver, facilitator and impediment, have a significant relationship to supply chain management practice for Thai SMEs. It also concludes that the supply chain management practice can improve firm's performance in comparison with firm's competitors.

This research attempted to enhance the understanding of how Thai SMEs perceived with supply chain management. These findings have a number of managerial implications. Some of Thai SMEs have resisted implementing supply chain management because they believed that supply chain management practice led them to lower profit. This research provides conclusion against that belief. This study, like others, has limitation. The list of members of The Federation of Thai Industries (FTI) was used as representative of Thai SMEs; thus, the results are generalizable only to the extent that FTI members resemble the population of Thai SMEs.

The response rate was also somewhat low; however given the subject matter and complexity, this is reckoned acceptable. Another limitation of this study is the use of respondents from various industries. It should be accepted that different supply chain environments in each industry could impact the respondent's answer to the questionnaire differently. The focus research from particular industry may solve this issue but it makes the results less generalizable.

The extension of this study can be conducted by doing sample case analysis within Thai SMEs to achieve higher understanding of how supply chain management practices are implemented, which exact drivers, facilitators and impediments are involved by these practices, and what are the performance outcomes.

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AN INVESTIGATION INTO THE FREIGHT PICK-UP DELIVERY ACTIVITIES IN CITY CENTER OF JAKARTA

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Introduction

As experienced by many big cities in the world, currently Jakarta has the same crucial problem in its road transport. The number of road users (i.e. passenger cars, public vehicles and freight cars) are increased steadily, while the growth of road transport infrastructure could not anticipate the negative impact of this situation. Goods vehicles and passenger vehicles, as well as pedestrians compete for space and priority. City center deteriorates at the most due to its lack of space. For the response, most of local authorities give more priority to people movements rather than freight ones. Consequently, almost all the rules regarding the freight vehicle activities are punitive instruments. Those cars are restrained in space or time to access city centers. There are no sufficient supportive instruments to facilitate their flows and pick-up delivery operations. Previous research works show that there seems to be very little understanding at the local authority to the existence of freight transport in urban areas. Despite the relevance of freight movements in the support of economic life in urban areas, it is often found that urban freight operations play a secondary role in city planning priorities (Lindholm, 2010; Munuzuri et al, 2005). Indeed, freight vehicles should be treated like other road users because even they contribute to the negative impacts to the city, they are the major contributors in economic and social development of the city.

As the concerns of contemporary transportation planning is to move as many as possible people and goods instead of cars, local authorities should essentially give more priority to public vehicles and freight cars rather than passenger cars. For that reason, local authorities should recognize the local characteristics of the people movements as well freight movements in order to balance the attention to both road users. Knowing local characteristics become important to avoid inappropriate policies in solving the problems. The overall policies or instruments which are applied in wide-ranging of objects or areas without taking into account the specific behavior of the local area may cause vain or even adverse impacts which actually could be avoided.

The common problems of freight movement in general are occurred when they travel the route (en route) and at the end points of their trips at which they must park their car, make loading unloading and also goods delivery (Ogden, 1992). This study is aimed to investigate the current operations of freight transport in one important end point of freight movement in Jakarta, that is Jatinegara Wholesale Shopping Center (JWSC). Results of the investigation will illustrate the characteristics of parking and pick-up delivery operation and lead to the raise of the important issues which have to be considered by local authority to improve the existing condition.

This study will identify the characteristics of pick-up delivery process through field survey, and measures are proposed to maximize the utilization of parking space. Interview to the stake holders will be carried out to confirm the field survey and the proposed measures.

Survey on Parking and Pick-up Delivery Operation

Jatinegara is one of the famous shopping centers in center of Jakarta. It is a wholesale shopping center so as the traffic flow surrounding the area is dominated by freight vehicles all the day. In addition, its location is on the major arterial road in which Bus Rapid Transit system is operated, though it is not in the exclusive lane due to the lack of space. Hence, it has made the BRT has to compete with freight vehicles and other road users for having space, while on-street parking takes place illegally due to limited space of parking building in this area.

The freight movements in city centers essentially includes activities related to parking, loading unloading, goods conveyance and inside building delivery (Shimizu et al, 2008). Investigation which

will be carried out is in accordance to those activities (Figure 1). Since loading unloading is highly related to parking operation, we emphasize our investigation to the parking issues at this site.

In order to identify and analyze the characteristics of freight movement in JWSC, we conducted parking volume counting, patrol survey, loading and unloading survey, as well as questionnaire survey amongst shop keepers and porters who are engaged in pick-up and delivery services. In addition, physical inventory of the parking facilities was also carried out to represent the supply side of the parking facility.

Analysis of the Existing Condition

Parking Vehicle Characteristics

JWSC has one parking building. Currently, due to the over capacity of the existing building, people park their cars illegally on the street. Figure 2a shows the situation at the entrance of JWSC, at which the street traders occupy almost half of the access road to the parking building. They also inhabit the sidewalks, so pedestrians must walk at the roadside, together with the cars. Figure 2b shows the situation of illegal on-street parking which are dominated by public transports and loading unloading trucks. Figure 2c illustrates the porter who convey the goods to the shops on the car corridor due to the absence of pedestrian sidewalk within parking building.

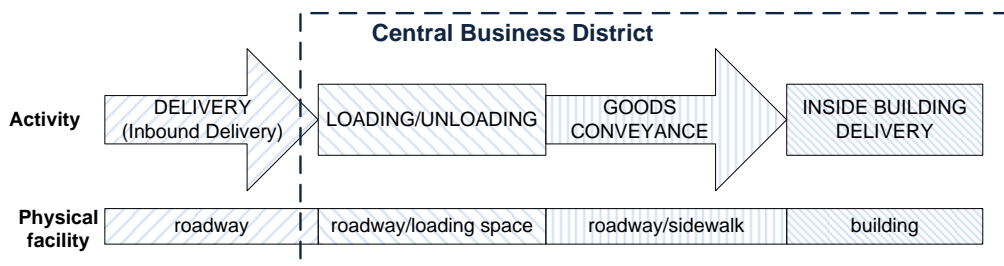


Figure 1 The activities related to freight movement in city center



Figure 2a The entrance of Jatinegara Shopping Center



Figure 2b Illegal on-street parking



Figure 2c Goods conveyance

Identification to the parking characteristics is carried out through the traffic counting and patrol survey. We classified the vehicles into freight cars (trucks), passenger cars and motor cycles. The composition of total volume of vehicles parked are 21.06% for freight cars (FC), 26.90% for Passenger Cars (PC) and 51.18% for motorcycles. The number of motorcycles is spectacularly almost double the PC or FC. This fact indeed becomes common phenomenon in Jakarta, in which motorcycles dominate the road traffic. However, since in JWSC motorcycles have their own parking spaces so they do not compete for space with other types of vehicles, in this research we just take into account the existence of FCs and PCs. Figure 3 ~ Figure 6 illustrate the basic characteristics of parking usage, those are parking inflow, parking outflow, parking accumulation and parking volume for the three types of vehicles during period of survey.

Based on *t-test* for significance level $\alpha=0.5$ it is found that the trends of the inflow and outflow of both PC and FC are similar. With such trends of movement, it is quite difficult to utilize the parking spaces as shared facilities, i.e. to take advantage from different peak/off-peak characteristics of volume in order to utilize the space more efficiently. However, from the observation, one important issue comes up, that is the existence of PCs which are functioned as freight vehicles (for simplicity, we name this type of car as PC+). PC+ could not be identified from volume counting. Traffic counting, which is

conducted at the entrance gate of parking building, could not distinguish if the PC bring common people (as buyer) or it bring also goods for commercial purposes. The vehicle type of PC+ usually is Multi Purpose Vehicles (MPV) and they have no licence for bringing commercial goods. We notice their existence as they do loading unloading in a quite big volume and also they occupy the parking spaces for quite long time. Our presumption regarding the existence of PC+ is strengthened by the result of patrol survey (Table 1).

From table 1 it can be seen that the parking duration of FC and PC are almost similar, i.e. 4.87 hours and 4.17 hours, respectively. Whereas intuitively we believe that their characteristics supposed to be not similar. From that point, we try to scrutinize the result of patrol survey by separating the PCs whose parking duration is more than 5 hours and add them to FC (namely Modified FC).

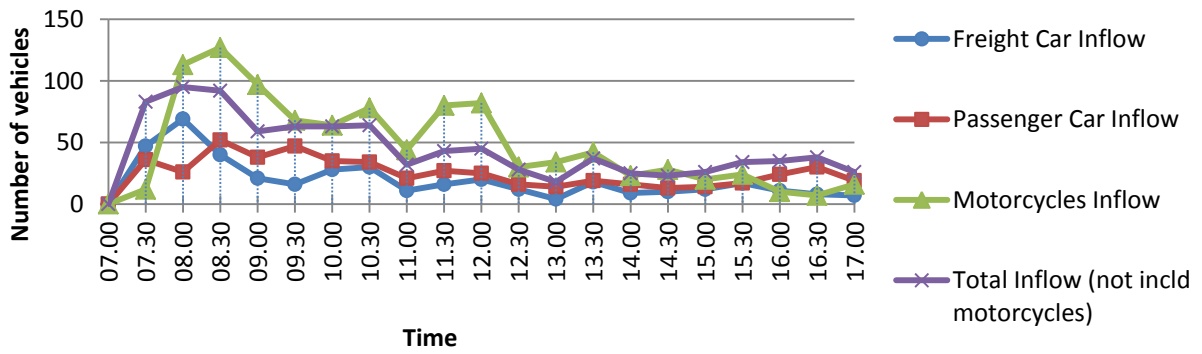


Figure 3 Parking Inflow

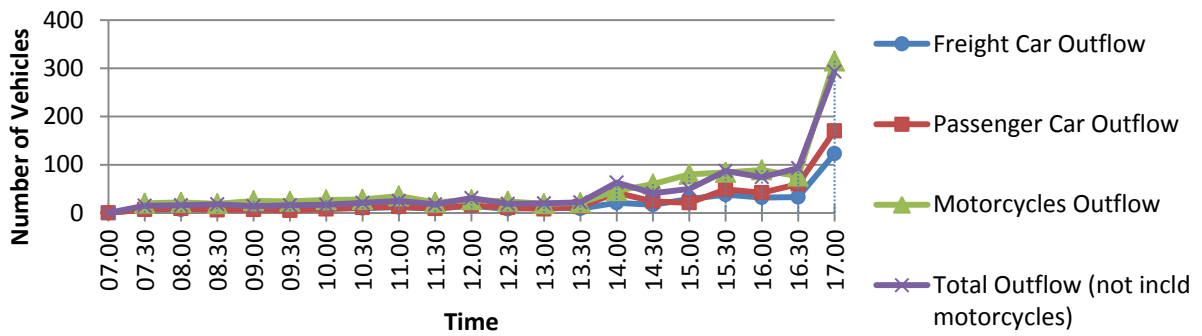


Figure 4 Parking Outflow

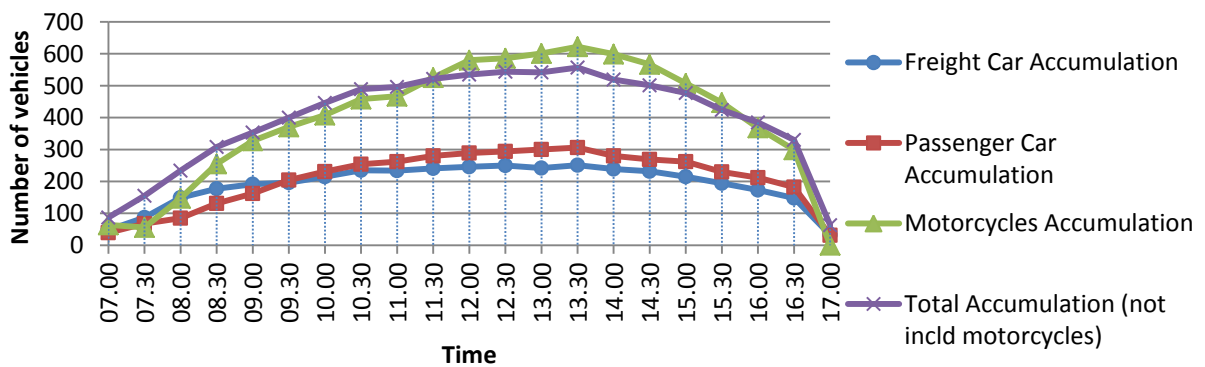


Figure 5 Parking Accumulation

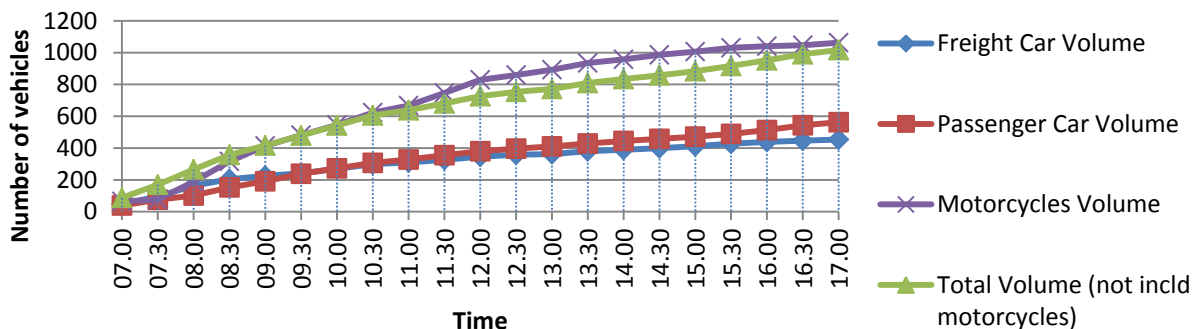


Figure 6 Parking Volume

Types of car	Total car parked hours	Total car	Duration (hour)
Total car	2,944	665	4.43
FC	1,188	244	4.87
PC	1,756	421	4.17
Modified FC (i.e. FC plus PC+) *)	2,085	330	6.32
Modified PC (i.e. PC minus PC+) *)	859	335	2.56

*)

*) If PC which functioned as FC is considered as FC

It is found that the parking duration of modified FC becomes 6.32 hours, while duration of modified PC becomes 2.56 hours. We ensure that the latter numbers represent the real characteristics of both freight and passenger movements, regardless the type of the vehicles they use. Since the numbers of PC+ is quite big (around 26% of Modified FC or 12.93% of total car), it is required to take into account explicitly the existence of PC+ as freight car in the analysis (even though it is illegal). It is realized that the difficulty will take place when the traffic counting surveyor has to distinguish the PC and PC+ while their appearances are almost similar. It can be solved by applying video camera-based traffic counting survey which enable the surveyor to observe the plate numbers (and it is then cross-checked with patrol survey) and the appearance of the car in longer time.

The other important issue is the existence of cars which are functioned as warehouse (i.e. mobile warehouse). Most of them belong to the shop owner, but some belong to suppliers. Such vehicles stay for long time and the drivers or porters make loading unloading repeatedly to serve the shops. It is occurred since their warehouses are full or even they do not have any warehouse inside the building. This activity is suspected as another cause of high parking duration.

Furthermore, the other important issue concerns with the Parking Index (PI). The parking building provide 160 parking space units, excluded the areas for motorcycles. They are used for both PC and FC, and no specified areas for each of them. Figure 7 illustrates the Parking Index during time period of survey. PI at almost all the day are greater than 1. It denotes that the 160 parking space units are fully occupied all the day. Even at the midday it reaches the maximum point 3.48. It can be occurred since the cars occupy almost all the available areas (not only the parking areas), including the car corridor.

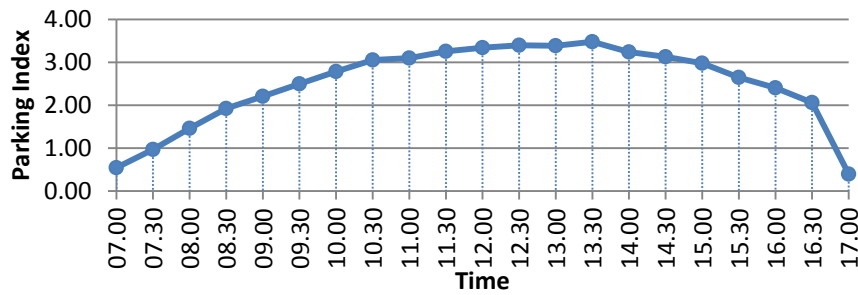


Figure 7 Parking Index

Loading Unloading and Delivery Characteristics

A survey related to loading unloading activities were conducted to 59 samples of freight cars. It reveal that majority (57.63%) spent 30 minutes for loading unloading process, while 22.03% take 60 minutes and 15.25% need 15 minutes. The remain (5.08%) need longer time, i.e. up to 90 minutes. The time required for loading unloading includes the time for conveying the goods to/from the shops. The more the shops to visit, the longer the time required for the whole process of loading unloading.

Interview to shopkeepers and porters were also carried out to identify some aspects related to goods delivery and order management. Interview was addressed to 41 shopkeepers for the representation of shop owners and 52 porters for the representation of goods suppliers. It is found that almost all the shops take their own car and 75.6% of them have right for monthly paid parking space. 41.46% of shop owners park their car whole the day, while only 30.77% of suppliers do the same thing. Regarding the mobile warehouse, it is found that 17.3% of shop owners make use of their car to keep their goods along with their warehouse, even though 90.24% of the shop owners have their own warehouse inside the building. In association to the order management, 43.9% of the shops have their own suppliers who deliver the goods periodically and most of shops engage with 1-3 suppliers. The 56.1% of the shops are goods producers so they do not deal with suppliers frequently. The delivery frequency of the suppliers is 1-3 times a week (44.4%), but 55.6% of the suppliers deliver the goods daily.

The Improvement of the System

From the above explanation, we have identified some important issues which are related to the off-street parking and pick-up delivery activity in JWSC. We identify that the very high PI is the most crucial issue in this area. Moreover, the existence of passenger cars which are functioned as freight cars and also the use of car as warehouse (mobile warehouse) are the other important issues which have made the parking condition worse. As the PI is characterized by total car inflow and total car outflow and also the total parking space units provided, in order to reduce the PI we focus to two points, those are increasing the number of parking area units and reducing the parking accumulation. Based on the notion that we need to give more priority to freight movements rather than to people movement (due to the fact that in Jatinegara people movement has been served by the BRT), we divide the parking area into two groups, those are the areas for PC and the areas for FC, and accordingly we have two PIs, those are PI_{FC} and PI_{PC} . The area provided to each group embodies the total parking space units which can be used by each group. Our proposed measure to reduce the PIs dynamic in nature as PI at certain time may be changed as the inflow cars or outflow cars changed. Accordingly, in our proposed measures the parking area units of PC or FC at time t could be increased or decreased at time $t+1$ depend on the PI at time t . Moreover, the measures to reduce the parking accumulation could be carried out by controlling both car inflow and outflow based on the level of PIs. The following mathematical programming will explain the idea of reducing the PI.

$$\text{Min } Z(\alpha; \beta) = \alpha (PI_{FC})_t + \beta (PI_{PC})_t \quad \forall t \in T$$

subject to : $(R_{FC})_t + (R_{PC})_t = 1$

$$(PI_{FC})_t \leq PI_{FC_{max}}$$

$$(PI_{PC})_t \leq PI_{PC_{max}}$$

where $(PI_{FC})_t = \frac{(ACC_{FC})_t}{(R_{FC})_t \cdot Cap}$

$$(PI_{PC})_t = \frac{(ACC_{FC})_t}{R_{PC} \cdot Cap}$$

$$(ACC_{FC})_t = (ACC_{FC})_{t-1} + (Fin_{FC})_t - (Fout_{FC})_t$$

$$(ACC_{PC})_t = (ACC_{PC})_{t-1} + (Fin_{PC})_t - (Fout_{PC})_t$$

$(PI_{FC})_t, (PI_{PC})_t$: Parking Index of freight car and passenger car, respectively, during time t
 $(ACC_{FC})_t, (ACC_{PC})_t$: Accumulation of freight car and passenger car, respectively, during time t

Decision variables : $(R_{FC})_t$ and $(R_{PC})_t$

where : $(R_{FC})_t, (R_{PC})_t$: Proportion of area of freight car parking space and passenger car parking space, respectively, during time t

Input Variables :

α : Weight of Freight Car

β : Weight of Passenger Car

Cap : Total number of parking space unit

PI_{FCmax}, PI_{PCmax} : Maximum allowable Parking Index of freight car and passenger car, respectively

$(Fin_{FC})_t, (Fin_{PC})_t$: Freight car inflow and passenger car inflow, respectively, during time t

$(Fout_{FC})_t, (Fout_{PC})_t$: Freight car outflow and passenger car outflow, respectively, during time t

We divide operation time of parking building (T) into some time interval. The proposed model is aimed to minimize the total Plof PC and FC during time t , while the proportion of area for both types of cars becomes its decision variables. The coefficient α and β are used to make weighting of both types of cars. When the authority intend to give more priority to freight cars, it is able to use any number for α and β provided that α is greater than β . The bigger the difference between both coefficients, the bigger the difference of priority given to both types of cars. The objective function is constrained by the total number of parking space unit, and also the maximum allowable PI. The case of Jatinegara shows us that PI as 3 may be occurred, but the parking authority indeed has right to limit it in order to give satisfaction to the customers.

Figure 7 shows an example of the optimization of Z -value in order to find the best ratio of area of FC parking space to PC parking space with two sets of α and β values, those are $Z(1;1)$ and $Z(7;3)$. In figure 7 we can see that as the ratio area of PC to FC increased, PI of freight cars would be increased due the smaller area provided for them. The Z -value helps us to find the best ratio to provide parking area for both types of cars. It can also be seen from two $Z(\alpha;\beta)$ curves that the bigger the α , the more satisfied the freight cars. When we use $Z(1;1)$, we found that ratio area 1.00 is the absis of the point at which the Z value is minimum. At that point, PI_{FC} and PI_{PC} are 2.68 and 3.23, respectively. Whereas, when we use $Z(7;3)$, we found that the minimum point is at the absis 0.67 and the associated PI_{FC} and PI_{PC} are 2.23 and 4.03, respectively. The value of α and β values are determined by the policy maker, and it depends on its policy concerning with the freight and passenger movement.

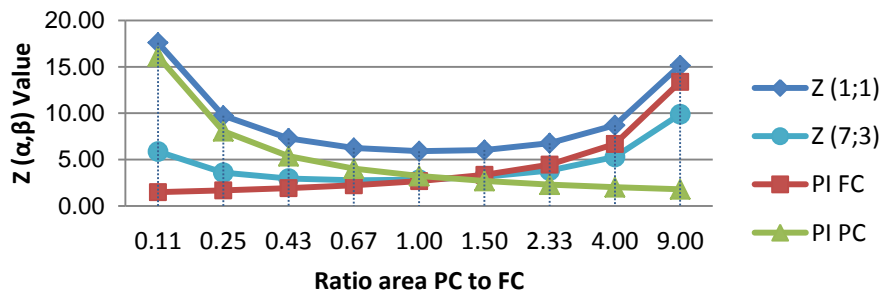


Figure 7 An illustrative example of the optimization curve of Parking Index

From such explanation it can be seen that this mathematical programming is used to optimize the proportion of the parking space of freight cars and passenger cars during time t . It is realized that the area of parking space indeed has to be defined prior to the flow comes in. For that reason, we use the optimum area proportion of time t to manage the parking area of time $(t+1)$. Due to the limited total parking area and the unlimited car inflow, some conditions may prevail and violate the constraints.

The huge inflow, for FC or/and PC, may cause maximum allowable PI is violated. In this case, it is required to restrain the inflow (by utilizing parking lot next to this area or on-street parking) or to increase the parking space unit for one of the two types of car. The following straightforward algorithm (Figure 8) shows the steps which may be applied to comply with the constraints. The proposed technique to control performance of parking serviceability may be implemented through the use of parking guidance and information systems display configurations (Thompson et al, 2001). This information system could be utilized to simulate dynamically the real time situation of parking system.

Regarding the existence of PC+ and its relation to the effort of reducing the PI, it is essential to forbid PC+ so as the proposed measures could assign the parking space efficiently and PI could be minimized. It is realized that the unreliable input data produced by the illegal PC+ may cause the underutilized or overutilized parking space. The other effort which has to be taken into account in order to reduce the PI is the restriction of mobile warehouses and also limiting the duration time of loading unloading activity. These efforts are expected to increase the car outflow, hence the parking accumulation will be decreased. Lastly, the improvement of the access road and also pedestrian facilities should be included into the parking improvement so as the access road capacity could be fully utilized. It is expected that the searching time will be reduced, and the parking turn over will become higher.

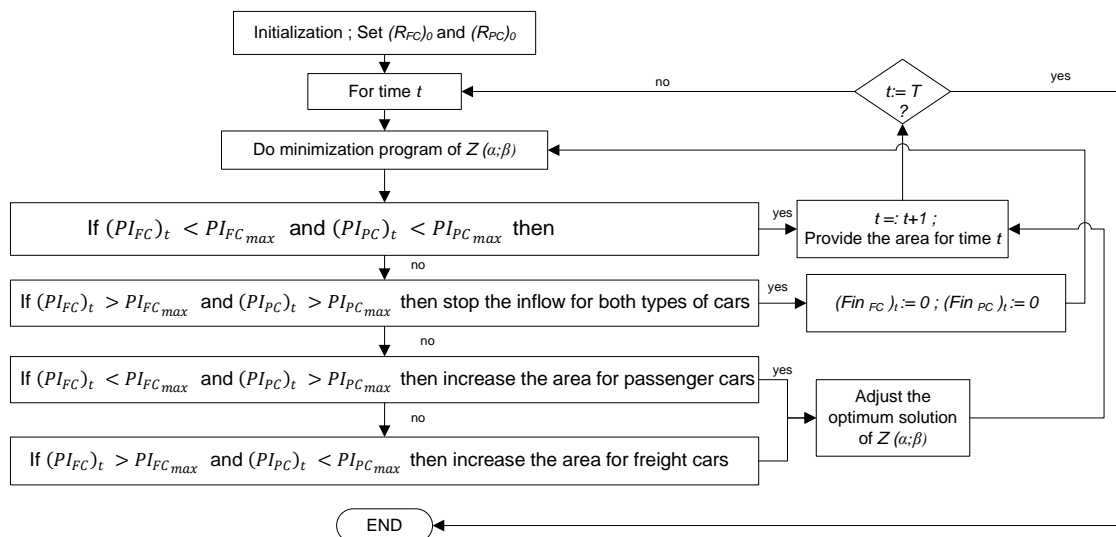


Figure 8 The algorithm of Parking Index Improvement

Conclusion

The freight pick up delivery activities in city center of Jakarta, which is represented by Jatinegara shopping center, is highly dominated by parking problems. Lack of parking space, the existence of illegal passenger cars which are functioned as freight cars and also the existence of cars which are functioned as warehouses contribute to the severe parking service. The insufficient access road and pedestrian facilities have also made it worse. This condition is not appropriate to be occurred at a prominent shopping center such as JWSC. Some measures are proposed in order to improve current condition. They are aimed to give more priority to freight cars for using parking spaces rather than to passenger cars, in respect to the fact that in Jatinegara people movement has been served by the BRT. Local authority should identify seriously the local characteristics of parking usage and parking supply, as well as pick-up delivery process, and also conduct the holistic study prior to apply the punitive instruments to freight movements. It is to avoid the unnecessary adverse impact to them and also to the city. The methodology of this study, as well as the proposed measures could be applied to other locations in city center, and local authority is expected to consider them in their city transportation planning. Lastly, law enforcement takes the major role in its implementation.

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ANALYSIS OF OPTIMAL NUMBER OF MANUAL AND E-TOLL SERVICE GATES AT LAEM CHABANG PORT

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Introduction

Transportation is a major component that affects to supply chain competitiveness. Traffic situation, especially at Laem Chabang port (LCP), is also very important for export since LCP is Thailand's largest port. The major transportation mode in LCP is truck which is approximately 90 percent. Based on the volume of haulage trucks and cars at the LCP in year 2000, average daily traffic is about 7,000 vehicles (Laem Chabang port, 2010). These vehicles cause a serious traffic jam that a queue is sometimes occurred at the front of entrance gates around 3 kilometres as Figure 1.



Figure 1: Traffic jam around the entrance gates

The attention of management and operations analysts for this queueing problem has considered for a number of years. To reduce the length of queue, there are many methods such as increasing the market share of other transportation modes, increasing the efficiency of the Tolls. However, the effective methods to be implemented in LCP are still challenged since the number of vehicles is moderately increasing. Statistics of Import-Export Cargo Containers through Laem Chabang Port, Fiscal Year 2008-2012 is illustrated in Figure 2.

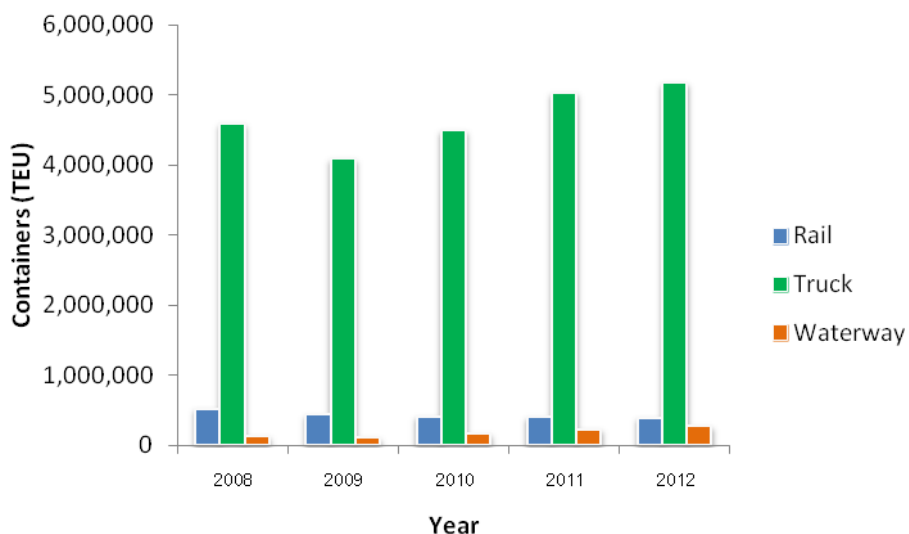


Figure 2: Statistics of Import-Export Cargo Containers through Laem Chabang Port, Fiscal Year (Modified from Laem Chabang Port, 2013)

In this paper, we propose a simulation for analysing the toll systems at LCP as the main contributors. We aim to determine the suitable number of manual toll collections and electronic tolls (e-toll) collections.

Literature Review

There are many existing researches that consider the queueing problems for improving both management and operations. Several attempts involve analytical treatments (Heindl and Telek, 2002; Kim, 2005; and Rabta, 2009). However, the more sophisticated mathematics models will increase the more difficult in analyst to the real world queueing problems. Rabta (2013) pointed out that there are no general accurate formulas for computing the mean waiting time in general multiple server queues.

Simulation is one of the most popular approaches to measure the performance of complex systems as discussed in Cruz, Smith, and Medeiros (2005). Niea, et al. (2012) also utilized a simulation-based optimization to assign passengers for designing selectee lane queueing. Woensela, et al. (2008) applied the queueing theory approach to analyse the travel times due to traffic congestion. They illustrated the appropriateness of the approach to capture travel times. Therefore, this research utilizes the advantage of the simulation to determine the optimal number of both manual and electronics toll collections.

Methodology

The procedures for using simulation in this research are described as Figure 3. There are 7 toll gates in this case study as depicted in Figure 4. We firstly collect data on October, 2012 and then we attempt to focus on the most vehicle volume.

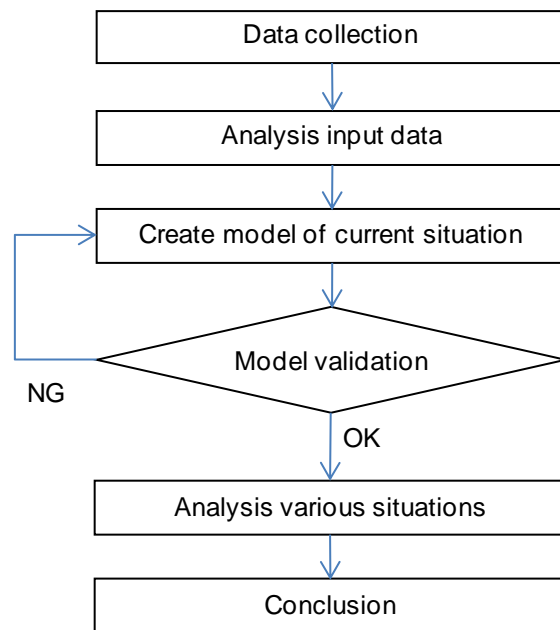


Figure 3: Methodology



Figure 4: Current operations (manual toll collections)

Nevertheless, in this paper, we do not restrict our analysis for processing time at the toll collections to the exponential distribution. We also consider the queueing model as illustrated in Figure 5. All arrival

vehicles are sequentially assigned into the the several toll collections or based on a first come, first served basis.

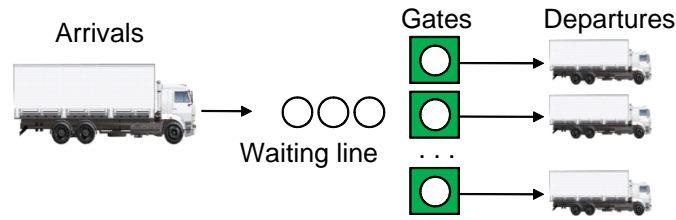


Figure 5: Characteristics of a queueing model

From Figure 5, the current processes of manual toll collections are presented as Figures 6.

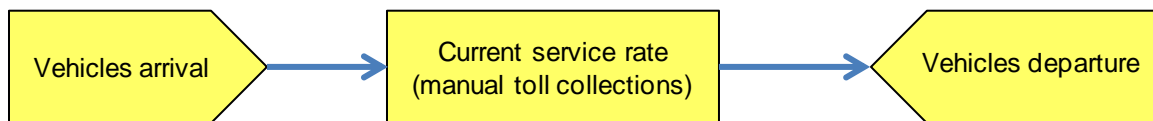


Figure 6: Simulation model for manual toll collections

The model is validated by comparing a number of arrival vehicles, a number of departure vehicles, and a number of vehicles in the queue, respectively. To find the optimal solutions of improvements, various approaches of toll collections are simulated and modelled as Figure 7. The proposed model considers both manual toll and e-toll collections.

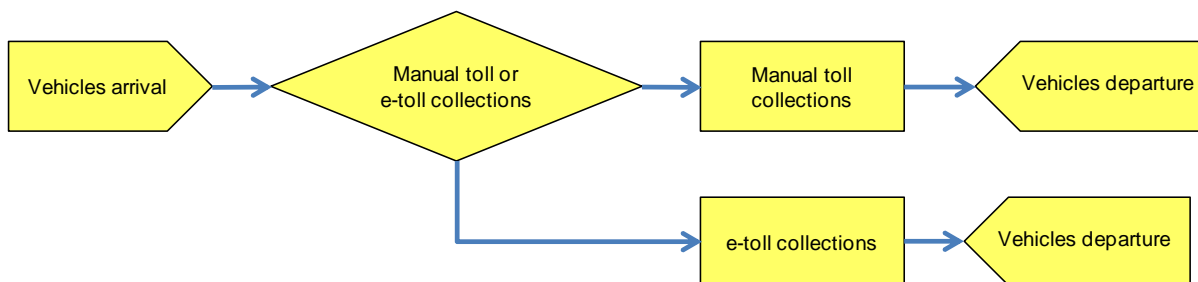


Figure 7: Simulation model for both manual tolls and e-toll collections

Improvement approaches for finding the optimal number of both manual toll and e-toll collections are proposed and simulated as Tables 1 and 2. Table 1 only considers the operations of the manual toll collections. Table 2 consider the case of increasing the number of e-toll whereas decreasing the number of manual toll collections. However, possible solutions from Table 1 may face some difficulties in implementation because of limitation in space requirements.

Approach	Existing manual toll (gates)	Manual toll increasing	Total manual toll (gates)
Current	7	0	7
1	7	1	8
2	7	2	9
3	7	3	10
4	7	4	11
5	7	5	12

Table 1: Increasing the number of manual toll collections

Approach	Existing System (gates)		Proposed system (gates)		Total tolls (gates)	
	Manual toll	e-Toll	Manual toll decreasing	e-Toll Increasing	Manual toll	e-Toll
Current	7	-	-	-	7	-
1	7	-	1	1	6	1
2	7	-	2	2	5	2
3	7	-	3	3	4	3

Table 2: Increasing the number of e-toll whereas decreasing the number of manual toll collections

Moreover, we also proposed to apply the e-toll collections without any using manual toll collections although this approach may not be flexible for the users and operators. In this case, all stakeholders have to change their working processes and require more time for both training and learning.

Finally, the paper performed a questionnaire survey about possible difficulties of e-toll collections implementation. We applied a face-to-face interview to two focused groups of stakeholders that are some staffs from both terminal operators at LCP and truck carriers. There are 10 people responded to this interview.

Results and discussions

Current situation

The sampling data based on October 2012 were collected at the main entrance gate as shown in Figure 8. The periods of high volume of arrival vehicles are focused for performing simulations.

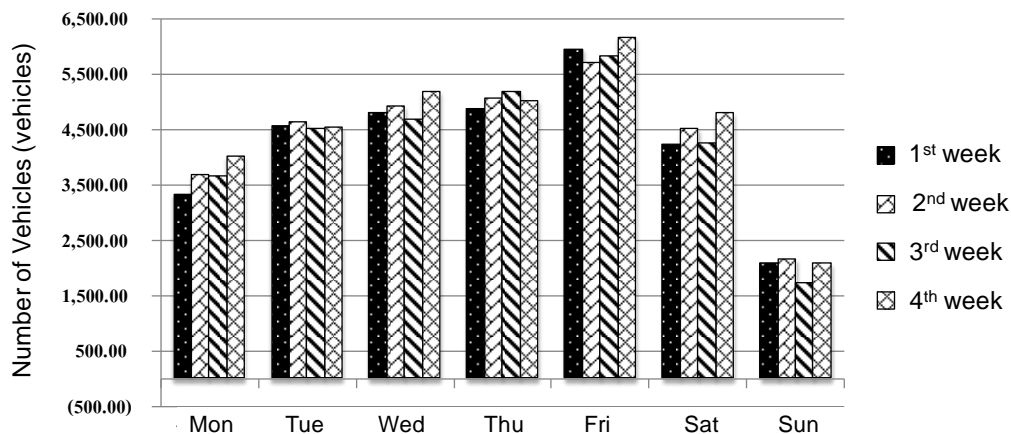


Figure 8: Distribution of sampling data

Based on Figure 8, most of the cars come to the LCP on Friday. Then, this research focused on every Friday to select the most impact periods. The result of distribution of vehicles is illustrated as Figure 9.

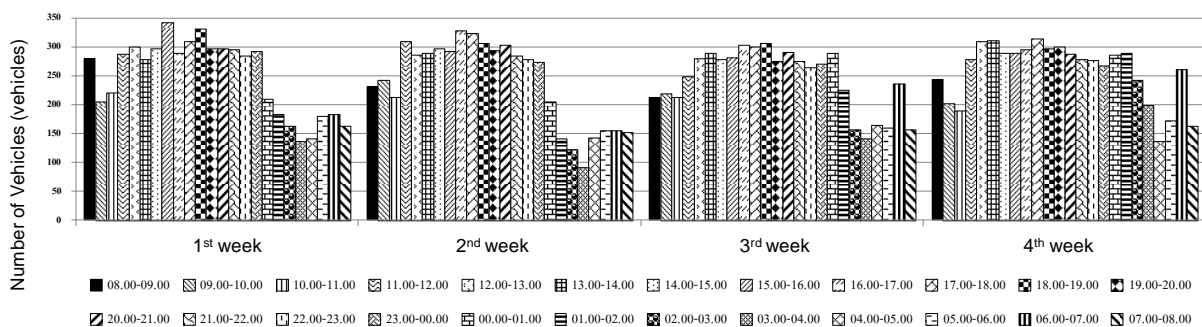


Figure 9: Distribution of vehicle on every Friday

From Figure 9, it illustrates that most of the trucks came during 11:00 A.M. to 01:00 A.M. as shown in Table 3.

Time	Arrival rate (vehicles)	Passing Vehicle (vehicles)	Cumulative Queueing (vehicles)
11:00-12:00	316	280	36
12:00-13:00	330	295	71
13:00-14:00	343	320	94
14:00-15:00	322	308	108
15:00-16:00	410	316	202
16:00-17:00	430	332	300
17:00-18:00	383	313	370
18:00-19:00	368	316	422
19:00-20:00	317	295	444
20:00-21:00	366	294	516
21:00-22:00	348	295	569
22:00-23:00	370	298	641
23:00-24:00	249	287	603
24:00-01:00	207	318	492

Table 3: Distribution of vehicles arriving during 11:00 A.M. to 01 A.M. interval time

From Table 3, the maximum cumulative vehicles in the waiting line were 641 vehicles. That means the length of queue was around 3 kilometres occurred at the front of the entrance gates. Then, the schedule of the arrival vehicles was assigned in the simulation model during 11:00 A.M. to 01 A.M. period as Figure 10.

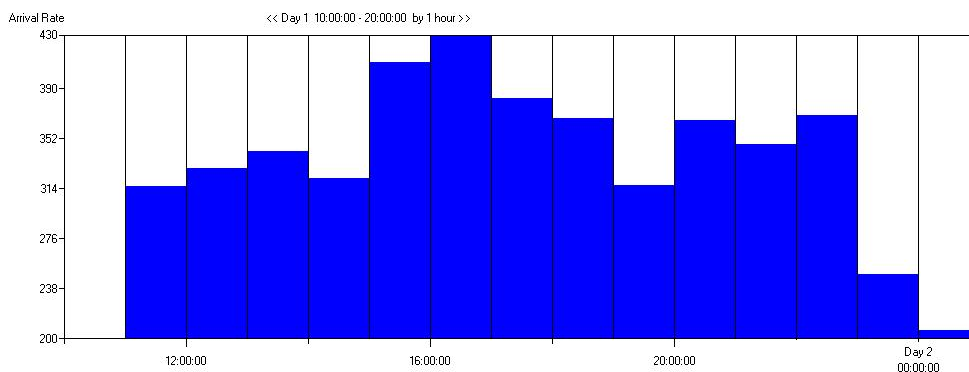


Figure 10: Vehicles arrival schedule in the situation model

The operation time for e-toll collection is around 25 – 30 seconds/vehicle. Then, the distribution of this operation is assigned as a uniform distribution. The minimum and the maximum values of service times at the gates are approximately 25 and 30 seconds, respectively. On the other hand, the operation times for all manual gates are collected to calculate the average operation times.

Model validation

This paper found that a triangular distribution can represent the distribution of current arrival rate at 95 percent significance level or $tria(46,75,127)$ in the simulation program. This distribution is then utilized in the simulation to perform validation analysis. Therefore, the result of model validation was demonstrated as Table 4 by comparing the number of arrival vehicles, the number of departure vehicles and the maximum number of vehicles in the queue, respectively.

Factors	Actual (vehicles)	Model (vehicles)	Difference (vehicles)	Difference (%)
The number of arrival vehicles	4,759	4,759	0	0%
The number of departure vehicles	4,267	4,247	20	0%
Maximum number of waiting vehicles	641	676	-35	-5%

Table 4: Model validation

Results from Table 4 demonstrated the satisfied results of the model since all different values were less than 10 percent. Additionally, the maximum error from the proposed model was around 5 percent. Consequently, the proposed model can be utilized to evaluate other situations.

Results of the simulation model

This research attempts to improve the service rate of the manual toll collections by increasing a number of tolling gates. The maximum additional tolling gate is five gates. Therefore, the results of the simulation model are demonstrated in Table 5 to Table 7.

Factors	Total manual tolls (gates)						Unit
	7	8	9	10	11	12	
The number of arrival vehicles	4,759	4,759	4,759	4,759	4,759	4,759	veh
The number of departure vehicles	4,247	4,759	4,759	4,759	4,759	4,759	veh
Average total time in the system	66.85	27.29	4.83	1.75	1.53	1.48	min/veh
Average waiting time	65.58	25.91	3.45	0.38	0.15	0.10	min/veh
The average number of waiting vehicles	211	82	11	1.20	0.48	0.31	veh
Maximum Waiting Time	130.13	49.54	13.42	4.00	2.18	1.82	min/veh
Maximum Number of Waiting	676	291	90	32	20	18	veh
Utilization	100	97.97	87.08	78.37	71.25	65.31	Percent

Remark: veh is vehicles and min is minute

Table 5: Results of improvement by increasing the number of manual toll collections

From Table 5, the simulations show that the current system or 7 manual toll collections cause the average waiting time and the average number of waiting vehicles around 65.58 minutes/vehicle and 211 vehicles, respectively. The optimal number of manual toll collection should be at least 9 gates because both waiting time and number of waiting vehicles are only 3.45 minutes/vehicle and 11 vehicles, respectively. Increasing two manual toll collections can reduce a large amount of average waiting time. However, the users may prefer 10 manual toll collections because the average waiting time is around 0.38 minutes/vehicle whereas utilization of the service provider is 78.37 percent.

In case of using the e-toll collections together with the manual toll collections, the single e-Toll collection and 6 manual toll collections provided a satisfied result as revealed in Table 6. Therefore, the remaining average waiting time of vehicles is 5.26 minutes/vehicle and the average queue length is only 5 vehicles. Additionally, two e-toll collections provide a better average waiting time or around 0.96 minute/vehicle whereas utilization of the service provider is 72.40 percent.

Factors	Current system	Change manual toll collections to be e-toll collections (gates)			Unit
		1	2	3	
Number of vehicles arriving	4,759	4,759	4,759	4,759	veh
Number of vehicles departure	4,247	4,759	4,759	4,759	veh
Average total time in the system	66.85	6.33	2.07	1.85	min/veh
Average waiting time	65.58	5.26	0.96	0.95	min/veh
Average number of waiting vehicles	211	5	2	1	veh
Maximum waiting time	130.13	20.12	4.39	2.02	min/veh
Maximum number of waiting vehicles	676	45	17	7	veh
Utilization	100	84.40	72.40	56.72	Percent

Table 6: Results of increasing the e-Toll collections whereas decreasing the manual toll collections

Factors	e-Toll collections (gates)							Unit
	1	2	3	4	5	6	7	
Number of vehicles arriving	4,759	4,759	4,759	4,759	4,759	4,759	4,759	veh
Number of vehicles departure	1,831	3,655	4,755	4,759	4,759	4,759	4,759	veh
Average total time in the system	257.58	115.78	2.86	0.54	0.48	0.46	0.46	min/veh
Average waiting time	257.27	115.38	2.40	0.08	0.02	0.01	0.00	min/veh
Average number of waiting vehicles	895	388	7.61	0.27	0.08	0.02	0.01	veh
Maximum waiting time	534.08	238.59	9.94	1.57	0.63	0.37	0.33	min/veh
Maximum number of waiting vehicles	2,964	1,267	65	14	7	6	4	veh
Utilization	100	100	100	81.43	51.93	43.28	37.10	Percent

Table 7: Results of using e-Toll system only

From Table 7, it can notice that four e-toll collections can service all arrival vehicles with a very satisfied waiting time. The average waiting time is only 0.08 minute/vehicle whereas the utilization of the system is 81.43 percent. Therefore, it seems that the e-toll collection is one of the best alternatives to increase the efficiency of the service time at the entrance gates. However, the e-toll collection implementation is still not successful. Thus, this paper surveys some opinions of two groups of stakeholders as summarized in Table 8. The minimum positions for the responders are assistant managers or equivalent positions.

Stakeholders	Opinions
Terminal operators	- Lack of sufficient enforcement for using e-toll collections - Insufficient of collection gates
Truck carriers	- Insufficient of public relationship accomplishment - Less flexibility for making payment such as the users have to prepaid every 1,000 baht as the minimum payment - High risk in spending more waiting time i.e. if some companies do not use the e-toll system or some error at e-toll collections occurs, the trucks in waiting lines have to spend more time - Need more details in using report because the users have to make a financial report to their customers and related stakeholders

Table 8: Summarized of important opinions from two groups of stakeholder

Conclusion

The simulation method is a good tool for evaluating the optimal number of manual and e-Toll collections. However, this approach has some limitations because it is based on several assumptions especially the distributions of arrival vehicles, departure vehicles and service time. In case of loose approximations, output of our simulation can significantly deviate from actual performance values. This research attempts to improve the service time at the entrance gates at LCP. The first approach is to increase the number of manual toll collections. The second approach is to change some manual toll collections to be e-toll collections. The last approach is to utilize only e-toll collections. Based on the minimum utilization at 80 percent, simulation results show that we should use 9 manual toll collections for the first approach. The second should implement 6 manual toll gates together with an e-toll collection. The last approach is to use only 4 e-toll collections. However, this research still does not consider the behaviour of the drivers and the effect of traffic from other area that should be focused for the future research.

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APPLICATION OF RAMP-UP MANAGEMENT METHODS FOR JOB PRODUCTION

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Abstract

Ramp-up management is a management approach that is both well-known and frequently applied in series production. Its application to job production appears promising, but has not been researched so far. This research paper discusses the possibilities of ramp-up management methods for job production and presents the current state of application, combining a theoretical approach with the practitioners' view. Special focus is placed on supplier management as logistics-related management method. An overview of the most important and most effective methods as well as their specific application fields is provided. Furthermore, a ranking in which order the researched methods should be implemented and general advice on the implementation of ramp-up management methods is given.

Ramp-up Management

For all series producers, the necessity for innovation has marked the past two decades, as well as an orientation on customer demands and the shortening of product life cycles. This has led to increasing numbers of production ramp-ups for series producers. (cf. Voigt and Thiell, 2005, p. 11) The automotive industry was especially affected by this development with a dramatic increase in the number of ramp-ups over the past years, cf. Figure 1.

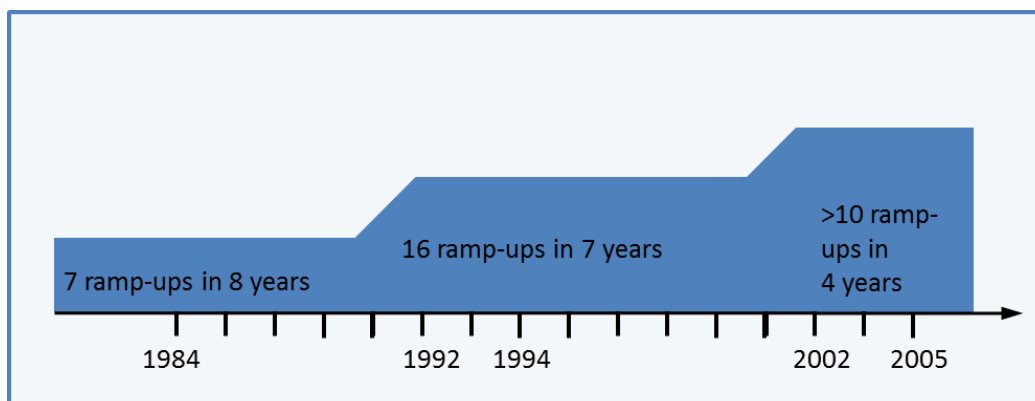


Figure 1: Increasing no. of ramp-ups at Daimler (cf. Romberg and Haas, 2005, p. 11)

The accompanying shortening of the product life cycle becomes especially apparent in the automotive industry as well, where in the 1980s the product life cycle averaged around 11 years and already in the 2000s had nearly halved to six years (Romberg and Haas, 2005, p. 10). This development can also be observed in various other industry sectors, despite the dependencies between the typical product lifespan, the applied technology and the respective branch of trade. In the electro-technical industry 60 percent of all products and in the medical technology sector even 75 percent of all products are younger than five years (Burghard, 2000, p. 12). These shorter life cycles directly influence the time for the amortization of design and investment costs, making time a strategic competition factor, essential for the existence of companies at the market. The development of the three main business objectives – costs, quality, and time – is displayed in the magical triangle in Figure 2. The development pictured is best described by the following statement: “Once time was money. Now it is more valuable than money.” (House and Price, 1995, p. 243)

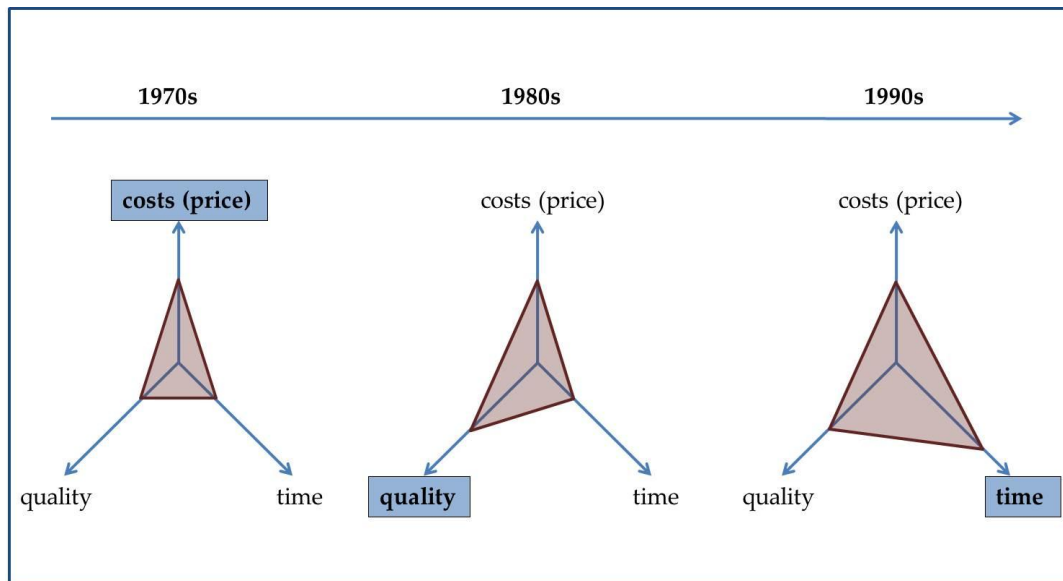


Figure 2: Magical triangle over time (cf. Kaluza, 1995, p. 1064)

The development and application of ramp-up management is based upon the need to react to the increasing importance of the factor time and the increasing number of ramp-ups. Reducing coordination efforts during the development phase, efficient control of the transfer phase between development and production, on-time market introduction and reaching and maintaining set quality levels are key challenges during new product introduction. Ramp-up management, with the objective of reducing the two stages time-to-market and time-to-volume, is seen as an adequate means to achieve these tasks and cope with the accompanying challenges.

Ramp-up management has moved into the spotlight of the scientific discussion in the recent years. First approaches to the topic date back to Schieferer (cf. Schieferer, 1957) in the 1950s followed by only few discussions in the following years and then a growing interest in the 1990s (cf. e.g. Fritsche, 1998; von Wangenheim, 1998). Since the beginning of the 2000s, the number of scientific research papers on this topic has increased rapidly. However, the recent discussion leads to a variety of different definitions and understandings of the relevant terminology. In particular the time-span of ramp-up management and the ramp-up phase are not clearly defined. Almost as many different views concerning the time span exists as there are authors – no terminology has yet been settled upon. In this research the time span covered by ramp-up management is defined as beginning with the product development phase and ending when the planned production output level is reached. The time-to-market covers the development phase and ends when the product enters the market, while the time-to-volume depicts the time span from the start of production (SOP) until the planned production volume is reached (cf. Terwiesch et al., 1999, p. 3). The focus of most researchers is clearly on the automotive industry and with almost no exceptions series production is the considered production type of ramp-up management research so far.

Research Field

The starting point for this research is the hypothesis that the application of ramp-up management adds a benefit to job production, which so far has not been recognized. A detailed literature analysis on the topic of ramp-up management showed that it has neither been widely discussed nor applied for job production (cf. Strubelt et al., 2013).

Job production, sometimes also single production or customer order production, in general produces goods according to customer specifications. The starting point for job production is usually a customer enquiry, answered with an offer which in turn hopefully leads to an order. Only one article unit is produced per planning horizon. This leads to individually planned and carried out production processes and demands a high degree of flexibility of the workforce as well as of the manufacturing tools, machines and plants. (cf. Zahn and Schmid, 1996, pp. 131-133) Due to the specifics of each customer order and the necessary planning steps for production, every customer order can be thought to start a new ramp-up process. This actually implies that job producers are experiencing exceedingly more ramp-ups than series producers. Furthermore, job producers possibly run into situations with

simultaneous ramp-ups, up to the point where all operational facilities are utilized with ramp-up products. Considering the resulting high number of ramp-ups for job producers, the possibilities of ramp-up management for job producers become obvious. This research paper therefore analyses which ramp-up management methods can contribute to the success of ramp-ups in job production. The objective is to determine the current state of application, identify best practices and recommend an implementation order for ramp-up management methods for job producers.

In a previous research project an extensive literature analysis was conducted, analyzing over 100 literature sources, to identify the management methods associated with ramp-up management. (cf. Strubelt et al., 2013). It needs to be said that ramp-up management itself is not a straight forward method. Methods are defined as planned, systematic, and rule-based procedures, with a prescriptive character, according to which certain activities are performed in order to accomplish a specific goal (cf. Kosiol, 1976, p. 34; Lindemann, 2009, p. 58) The literature analysis showed that ramp-up management in contrary comprises several different methods, concepts, tools and measures. Additionally, some scientific literature may discuss a specific approach, terming it method, while in another source the same approach may be described as a tool, and yet another source defining it as a concept.

After collecting and clustering all methods associated with ramp-up management, the literature analysis revealed that a total of 82 methods can be associated with ramp-up management. These 82 methods were then subject to an expense-utility analysis to evaluate the most suitable and most promising methods for the application in job production companies. The resulting ten most relevant methods for job production are displayed in Table 1.

Methods
Employee Qualification, Measures for
Auditing
FMEA
Process Planning & Analysis
Supplier Evaluation & Selection
Project Definition & Organization
Project Controlling
Standardization, Modularization
Engineering Change Management
Knowledge Management

Table 1: Ramp-up management methods for job production

Questionnaire Study

An empirical study in form of a questionnaire study was developed to identify the current status of application and to evaluate the benefits of these ten ramp-up management methods for job production. Furthermore, a ranking for the implementation order of these methods is determined. The questionnaire study encompasses up to 3,000 German job production companies. After sending out the survey to all 3000 potential participants, a total number of 133 participants opened the questionnaire, out of which 82 completed the entire questionnaire. This corresponds to a response rate of 4.4% and 2.7% respectively. Even though these numbers seem quite small, they are well in the range to be expected for this type of survey.

In a first step the questionnaire gathers general data about the participants. The production type and industry sector of the participants are checked to ensure the desired group of participants. Further such data as company size and location are collected to evaluate the specific data on these criteria and to secure an adequate cross sectional representation. The classification of the participants into small, medium and large size enterprises is done according to their number of employees and their turnover in 2012. Following the recommendation of the European Union for SME small enterprises have less than 50 employees and not more than 10 million Euros turnover per year. Medium size enterprises have less than 250 employees and not more than 50 million Euros turnover per year and

large size enterprises are defined as having 250 or more employees or a turnover of more than 50 million Euros per year. (cf. European Commission, 2003)

The questionnaire begins by determining the participants' awareness of the researched methods. The majority of participants know the methods of Employee Qualification and Auditing, while only about a third of the participants are aware of Engineering Change Management and Knowledge Management, cf. Table 2.

Ranking awareness of methods (n=82)	
Method	Percentage
Employee Qualification, Measures for	90%
Auditing	85%
Project Controlling	63%
Process Planning & Analysis	63%
FMEA	62%
Supplier Evaluation & Selection	61%
Standardization, Modularization	60%
Project Definition & Organization	59%
Engineering Change Management	36%
Knowledge Management	29%

Table 2: Awareness of methods

The awareness of the methods varies with the company size. Larger companies are more aware of the researched methods than smaller companies. This finding is particularly pronounced with Engineering Change Management, which is known to 65 percent of participants from large companies but only to 18 percent of participants from small companies, and with Supplier Evaluation & Selection, known to 82 percent of large companies and 46 percent of small companies. It can be assumed that larger companies in general are more aware of management methods due to their larger and more complicated structures and to a higher number of employed managers.

In the next step the application of the methods is researched. The participants were asked to rate their use of the methods in five degrees from never to very often. The number of evaluable replies to each method is lower than the total number of participants, due to the fact that they were only asked to rate the application of methods for which they had previously indicated awareness and due to participation declining during the course of the questionnaire. The two methods that are applied most frequently (those that received a rating of often or very often) are Engineering Change Management and Project Definition & Organization. The two methods that are applied least frequently are FMEA and Knowledge Management, cf. Figure 3. While Knowledge Management, the method showing the least awareness, is also only rarely applied, FMEA is known to more than 60 percent of the participants but is nevertheless not applied very frequently. This could be a first indication that FMEA is not seen as a useful method for job production. Interestingly Engineering Change Management, of which only about 36 percent of all participants are aware, receives the highest marks of application by those participants who know the method. Therefore, it can be assumed that a potential for the application of Engineering Change Management in job production exists.

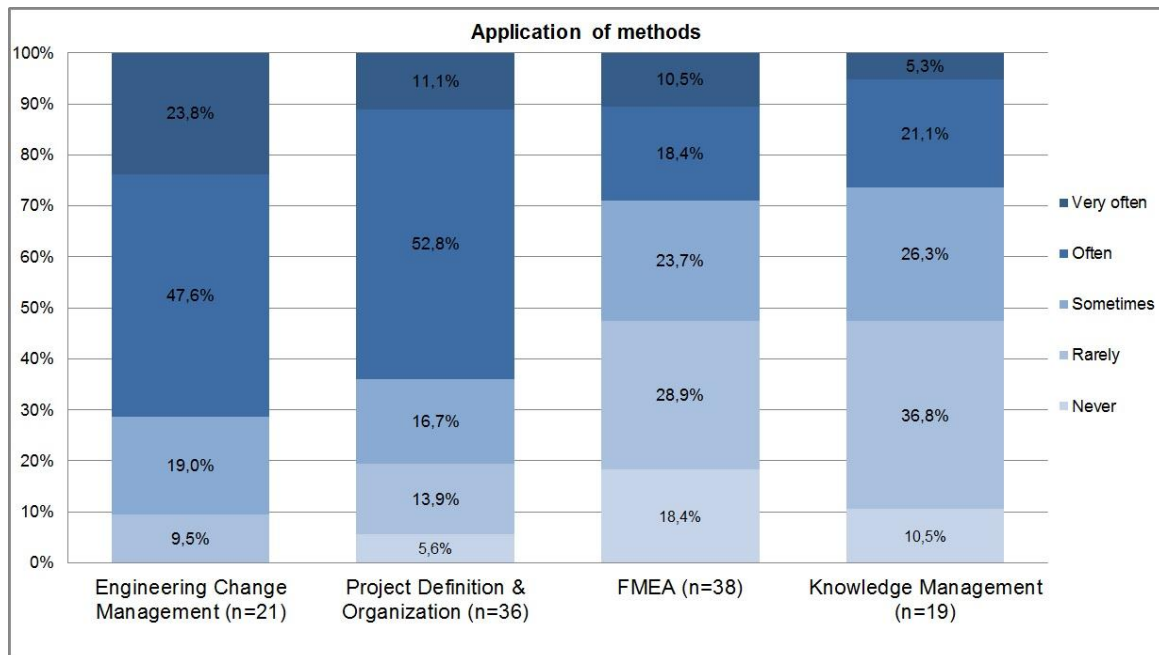


Figure 3: Application of methods

To analyze the potentials of the researched methods for job production the participants were asked to rate the methods on cost-benefits. To increase the validity of the questionnaire study this was done in two different ways, the results of which were later compared to another. The participants were given five questions per method which all indirectly questioned the benefit of the method. All of these questions were tailored specifically to each method. To show an example, for the method Supplier Evaluation & Selection one of the questions was, whether the participants could agree with the statement that Supplier Evaluation & Selection facilitates long-term fulfillment of material requirements. Similar questions were used to identify the costs of the methods. The results to these individual questions are used to calculate a cost-benefit factor, which then allows a ranking of the methods. The other approach to rate the cost-benefits of the method was quite bluntly a direct rating conducted by the participants. The result of the calculation, comparison and evaluation of both approaches is displayed in Table 3.

Cost-benefit ranking (n=60)	
Method	Rank
Employee Qualification, Measures for	1
Project Definition & Organization	2
Standardization, Modularization	3
Process Planning & Analysis	4
Engineering Change Management	5
Supplier Evaluation & Selection	6
Project Controlling	7
Knowledge Management	8
FMEA	9
Auditing	10

Table 3: Cost-benefit ranking

From a cost-benefit viewpoint Measures for Employee Qualification receive the highest ranking, followed by Project Definition & Organization, and Standardization. Knowledge Management, FMEA and Auditing receive the lowest ratings. For Knowledge Management and Auditing this confirms the low application results for these methods. Apparently both methods are not very important for job

producers. The high rating of Employee Qualification can possibly be attributed to the point that it is becoming increasingly difficult for German small and midsize job production companies to hire qualified personnel.

Interestingly, when asked for the implementation order of the methods, the participants did not recommend Employee Qualification as number one priority but Project Definition and Organization (Overall). They also recommended the implementation of Project Controlling (7th in cost-benefit ranking) earlier than Engineering Change Management (5) and Supplier Evaluation & Selection (6), both of which are ranked higher in the cost-benefit ranking. Knowledge Management, FMEA and Auditing are in the last three places both in the cost-benefit rating and the implementation order, cf. Table 4.

Implementation order				
	Overall (n=60)	Small ENT (n=24)	Medium ENT (n=16)	Large ENT (n=20)
Method	Rank	Rank	Rank	Rank
Project Definition and Organization	1	1	↓ 3	↓ 2
Employee Qualification, Measures for	2	2	↑ 1	↓ 3
Standardization, Modularization	3	↓ 4	3	↑ 1
Process Planning & Analysis	4	↓ 6	↑ 2	↑ 3
Project Controlling	5	↑ 3	↑ 3	5
Engineering Change Management	6	↓ 8	6	6
Supplier Evaluation & Selection	7	↑ 5	7	7
Knowledge Management	8	↑ 7	8	8
FMEA	9	9	↓ 10	9
Auditing	10	10	↑ 9	↑ 9

Table 4: Implementation Order

For the implementation order the participants were asked to name their top three priority methods and rank them in the order they should be implemented. The results of the implementation ranking need to be viewed with a bit of caution as all participants were asked to conduct this rating and as previously already discussed not all methods were known to all participants. This influences the rating and helps the better-known methods to receive higher ratings. Nevertheless, the results of the cost-benefit ranking are comparable to those of the implementation order and thereby support the meaning of this ranking.

In conclusion, a closer look is taken at the results of Supplier Evaluation & Selection. First of all, following the general definition in literature, supplier (relationship) management is divided into two separate fields, Supplier Evaluation & Selection and Supplier Development & Integration (cf. Boutellier and Wagner, 2000, pp. 27-30). In a previous research project Supplier Development & Intergration, where suppliers have a more active role and conjoined goals are defined, has been determined to be less beneficial for job production and it is therefore not researched further in this context. The questionnaire results considering Supplier Evaluation & Selection show, that the method is fairly well known (61% overall). Large size companies are especially aware of the method (83%), but as with most methods the awareness decreases with the company size (67 % medium size ENT, 46% small size ENT). The same applies for the application: while 57% of large size enterprises apply Supplier Evaluation & Selection only 23% of small size enterprises do. Interestingly, it is ranked higher by small size enterprises than by medium and large size enterprises in the implementation order. When it did get recommended to be implemented it was often ranked as second method to be implemented in combination with Project Controlling, Project Definition & Organization, and Employee Qualification. It appears that for Supplier Evaluation & Selection no general recommendation for its use in job production companies can be made.

Application Fields and Implementation

Several scientific studies have identified different application fields for ramp-up management, so far (cf. Kuhn et al., 2002, p. 17; Romberg and Haas, 2005, pp. 53-54). Based on these differing

approaches a new concept is developed extending the existing approaches by the connecting elements information flow and documentation, cf. Figure 4. The Ramp-up Strategy and the Project-Matrix-Organization, representing the most common organization form for ramp-up organization, represent the basic application fields. They are long-term in character and are supposed to remain constant over several ramp-ups. They are also to be understood as provider of management methods to improve the ramp-up, meaning they provide all management methods as included and defined in the company strategy.

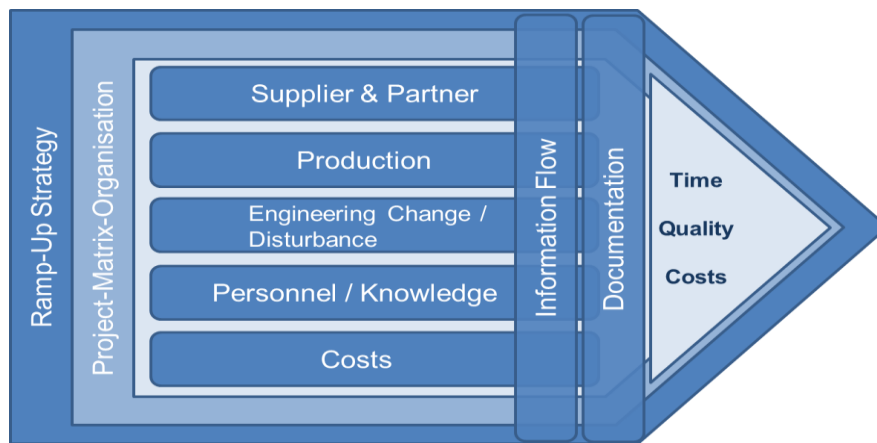


Figure 4: Ramp-up Management Application Fields (adapted from Schuh et al., 2008, p. 4)

Together with the five other application fields, this allows for a holistic view of the ramp-up process as the application fields are coupled and interacting with each other. All application fields can be influenced through the application of the discussed methods in different ways. In general all of the discussed methods are appropriate to improve the ramp-up process and they all influence at least one application field directly, while influencing others indirectly. While the qualitative influence of the methods on the application fields can simply be assigned, their quantitative impact depends on several different factors, such as company strategy, company structure, extent of method implementation, or employee structure, to account just for a few of them. The objective is to find the best methods and the best combination thereof to reach or surpass the main business objectives time, quality, and costs.

Considering the implementation of ramp-up management methods it needs to be pointed out that simply following the implementation order provided by the questionnaire study is inadequate. The implementation of methods should always be complementary to a company-specific production system, following the company's strategy. It is the task of the production system to define the company's internal and external general conditions for production and it should always be adapted to the company's needs. Production systems describe the production process and include concepts, methods and tools, which in combination account for the effectivity and efficiency of the entire production process (cf. Zwanzig, 2010, p. 61). The definition of production systems and necessary planning steps for the implementation of production systems is extensively discussed in scientific literature. To give an example, the REFA-method is suitable for the implementation of production systems (cf. Bergmann, 2010, p. 38).

Conclusion and Outlook

The results indicate that Knowledge Management and FMEA are the researched methods least important for job production and should not be primarily considered for implementation. Auditing is considered a well-known method for job producers, but apparently has a poor effectiveness and cost-benefit ratio. The best-known method Employee Qualification is at the same time the method with the best cost-benefit rating. It is also placed second in the implementation ranking, but when looking at the application level of the method compared to its rankings, it seems it could be applied more often. Project Definition & Organization is rated second on cost-benefits, first in the implementation order, and it is applied quite frequently by the participants. Together with Employee Qualification, Project Definition & Organization should be implemented and applied in most job production companies. Probably the most interesting results of the questionnaire study are provided with regard to Engineering Change Management. Following the questionnaire results, only a handful of job producers are aware of this method, but those that are aware appreciate and frequently apply the method.

Therefore, it is assumed that this method can offer further optimization potential to job producers and more attention should be called to it.

It can be concluded that the implementation and application of ramp-up management methods can open up additional opportunities and benefits to job production companies. The cost-benefit ranking and the implementation order give a first overview and orientation. However, the selection for and implementation of suitable methods should always be made while considering the specific company structure, strategy, and production system.

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CHALLENGES IN DELIVERY FULFILMENT OF ONLINE SHOPPING

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ABSTRACT

Purpose: Online shopping has grown rapidly with the pervasive use of the Internet, advancements in Information and Communication Technologies and availability of online payment options. This paper investigates the importance of delivery fulfilment for online shopping and the challenges faced by online retailers as well as the effectiveness of delivery fulfilment models from the Singapore perspective.

Design/methodology/approach: Qualitative and quantitative data were collected through self-completion questionnaires. A business survey was targeted at online retailers to provide insight into the delivery fulfilment processes offered, issues encountered and criteria considered important when choosing a delivery service provider. A consumer survey targeted at online shoppers was conducted to find out perceptions of online shoppers towards delivery fulfilment.

Findings: Online retailers relied heavily on outsourcing for delivery fulfilment usually by means of registered mail and courier services. They had different perceptions of service performance towards different service providers. Online retailers and shoppers reported that they were most concerned with late delivery issues in delivery fulfilment. Online retailers considered lead time as the most important factor when choosing a delivery service provider. They attributed the reasons for late delivery to delivery service providers, expectations of shoppers and limited delivery options. Online shoppers felt that they could cope with longer delivery times if there was an online tracking system in place to provide up-to-date delivery information.

Research limitations/implications: This study focuses on the perceptions of online retailers and shoppers in the fashion apparel industry.

Originality/value: The study provides insight into opportunities for online retailers and delivery service providers to improve their service offerings and bring about a better online shopping experience.

Keywords: delivery fulfilment, online shopping, retailer perceptions, customer perceptions

Introduction

E-commerce has become one of the fastest growing sectors in today's digital 21st economy. According to A.T. Kearney (2013), global e-commerce has grown 13% annually over the past five years from 2006 to 2011. Both retailers and consumers have entered the online space with increasing Internet accessibility, advances in Information and Communication Technologies and availability of online payment options. E-retailing, defined as the selling of goods and services via the Internet or other electronic channels for personal or household use by consumers (Dennis *et al.*, 2004), has become important as businesses understand the need to maintain a strong online presence.

The online shopping model presents opportunities for alternative delivery modes unlike conventional shopping where the product is purchased and often collected by the consumer at the shop. With online shopping, the buyer places a certain element of trust in the retailer's ability to deliver the ordered product in a timely fashion. Hence, an efficient distribution channel becomes a critical success factor in online shopping where online retailers are expected to deliver the products to customers when and where they want it. This is an exploratory study to investigate the logistics challenges of online retailing in the area of delivery fulfilment in Singapore. This paper examines the perceptions of online retailers and shoppers as well as the effectiveness of delivery fulfilment methods.

Literature Review

Online shopping is increasingly getting popular in tech-savvy Singapore. In 2011, Paypal commissioned a study that sampled 407 Singapore shoppers for their online and mobile transactions over the past 12 months (MediaBUZZ, 2013). The study showed that the size of the online shopping market in Singapore reached S\$1.1 billion in the year 2010 and is forecast to reach S\$4.4 billion in

2015. A significant portion of online retail purchases were domestic with nearly 40% spending (about S\$420 million) on local websites. Six shopping categories accounted for 80% of the total online spend:

- Travel (S\$307 million or 28%)
- Fashion/beauty (S\$146 million or 13%)
- Entertainment/lifestyle (S\$143 million or 13%)
- IT/electronics (S\$117 million or 11%)
- General insurance (S\$83 million or 8%)
- Gifts/collectibles (S\$75 million or 7%)

Ricker and Kalakota (1999) noted that while all companies wanted a piece of the e-commerce action, not all have laid the necessary groundwork for success. They mentioned one frequently overlooked activity was order fulfilment. Bayles (2002) pointed out that fulfilment differs from delivery in that delivery relates to the physical unloading of goods at a specific location. Fulfilment refers to the integration of people, processes and technology to meet customer expectations which involves a provider serving the last-mile between vendor and customer. According to a Bain/Mainspring survey of online buyers, accurate delivery was one of the critical customer concerns related to order fulfilment (Rigby *et al.*, 2001). Tsiriktsis and Keller-Birrer (2010) stated that customers have high expectations of delivery, flexibility and accuracy in delivering the goods, particularly in the online grocery market.

Collier and Bienstock (2006) examined how customers evaluated quality with online retailing by surveying customers who had engaged in an online retail transaction. Respondents were asked to respond to questions related to the interactivity of the customer with the online retailer's website, evaluate online retailers based on delivery of the product purchased, respond to questions on failures that occurred during online transactions, and address overall customer satisfaction with the online retailer. Their findings showed that customers' perceptions of quality and satisfaction with online purchases depended on interaction with the website, delivery of the product and how prepared retailers are to address problems when they occur. Of the three factors, they found that the delivery of the online transaction had the strongest impact on satisfaction.

Cao and Zhao (2008) studied how business buyers evaluated the delivery performance of online retailer and identified four key attributes, namely logistics/inventory system, online retailer's structure, product price and order-tracking system. They found that price and order-tracking system had a significant impact on the buyers' evaluation of an online retailer's delivery fulfilment. Interestingly, low price was so effective that buyers were willing to tolerate long delivery times, even longer than what was promised. In addition, a positive inventory policy and an integrated hybrid online retailer received significantly more positive evaluations from buyers. However, the study considered delivery fulfilment from the business buyer's perspective may not be generalised to individual consumers.

These studies have shown that delivery performance had a strong influence on customer satisfaction levels and their perceived quality of the online shopping experience. For the case of Singapore, the infrastructure and policies necessary to support e-commerce and delivery are in place. However, there are few studies done to uncover the challenges faced by online retailers in terms of delivery fulfilment.

Methodology

This study looked at the perceptions and views of delivery fulfilment of online shopping from the perspective of both the retailer and customer in Singapore. As mentioned earlier, there is a wide range of goods sold online and delivery requests may depend on the type of products purchased. Within the resources available, the scope of this study focussed on fashion apparel products which contribute to the top six major categories of online purchases in Singapore. Products within this category include clothing, footwear, sporting goods and accessories. Order fulfilment for these goods would require the delivery of small to medium-sized packages which would bring about challenges for delivery fulfilment.

Qualitative and quantitative data were collected through self-completion questionnaires. The surveys were administered through online survey tools (SurveyMonkey.com and FreeOnlineSurveys.com). The online surveys were opened for a 1.5-month period from mid-February to end-March 2013 for data collection.

Online retailer survey

A survey was designed for online retailers to provide insight into the delivery fulfilment processes offered, issues encountered and criteria considered important when choosing a delivery service provider. The questionnaire covered the following areas:

- Respondent profile: gender and age group
- Business profile: pure online business or online business with physical shop; types of products sold
- Delivery fulfilment: own delivery, outsourced, self-collection, others; if outsourced, the delivery company that is engaged
- Level of satisfaction with delivery fulfilment (Likert scale): 1 = very dissatisfied; 5 = extremely satisfied
- Frequency of delivery issues encountered (Likert scale): 1 = never; 5 = always
- Causes of delivery issues
- Perceptions on delivery service providers (Likert scale): 1 = very poor; 5 = very good
- Perceived importance of attributes when choosing delivery service providers (Likert scale): 1 = unimportant; 5 = very important
- Preferred delivery option: standard delivery (letterbox), collection point delivery (registered), time-slot delivery (pre-arranged), convenient delivery (using neighbouring stores), others
- Attitudes towards delivery process

The email addresses or contact details of online retailers were obtained from the www.emall.sg online shopping directory as well as from blog shops. The invitation to participate in the survey was sent out to around 150 selected online retailers via email, of which 30 responded.

Online shopper survey

A survey was conducted for online shoppers to find out perceptions of online shoppers towards delivery fulfilment. The questionnaire covered the following areas:

- Respondent profile: gender, age group, annual income range
- Online shopping frequency (Likert scale): 1 = never, 5 = always
- Average spend per item
- Types of products purchased
- Reasons for purchasing online
- Perceived importance of attributes associated with quality of online retailing (Likert scale): 1 = unimportant; 5 = very important
- Perceived importance of attributes associated with delivery performance (Likert scale): 1 = unimportant; 5 = very important
- Delivery locations: letterbox, self-collection, self-designated location, courier, registered mail
- Frequency of delivery issues encountered (Likert scale): 1 = never; 5 = always
- Perceived satisfaction on delivery of product (Likert scale): 1 = very dissatisfied; 5 = extremely satisfied
- Preferred delivery option: standard delivery (letterbox), collection point delivery (registered), time-slot delivery (pre-arranged), convenient delivery (using neighbouring stores), others
- Attitudes towards delivery process
- Overall purchasing experience online retailers (Likert scale): 1 = very dissatisfied; 5 = extremely satisfied

For online shoppers, the social media platform and email was used to send the invitation to participate in the survey. At the close of the survey window, 124 individuals responded to the invitation, of which five responses were deemed not usable. The final sample was 119 respondents.

Results and Discussion

Respondent profiles

Table 1 shows the demographic profile of respondents who participated in the surveys. The respondents from the online retailer survey were mainly aged between 21 to 30 years. The vast majority of the respondents were female; the male/female split was 17%/83%. Over 90% reported that they operated their business purely online without a physical shop space. Anecdotal evidence suggests that many online businesses operate from home to save on the cost of renting commercial space. About half of the respondents indicated that they sold more than one item online which included clothing, shoes, bags and accessories.

Age Group (years)	Online Retailers		Online Shoppers	
	Frequency	%	Frequency	%
Under 21	1	3.3%	2	1.7%
21 - 30	22	73.3%	76	63.9%
31 - 40	6	20.0%	37	31.1%
41 - 50	0	0.0%	4	3.4%
Over 50	1	3.3%	0	0.0%
Total	30	100.0%	119	100.0%

Table 1: Demographic profile of respondents

The respondents from the online shopper survey were also mainly aged between 21 to 30 years old. The male/female split was 31%/69%. Most of respondents indicated they shopped online fairly often. Slightly more than half of the respondents (55%) spent between S\$21 to S\$50 on average per item. Male respondents indicated they spent more compared to female respondents, which is in line with MasterCard Worldwide (2010) that reported that men were bigger spenders when it came to online shopping in Singapore.

Delivery fulfilment methods

Table 2 summarises the various delivery fulfilment methods and their combinations reported by the respondents from the online retailer survey. The majority of respondents (53%) indicated they used a combination of own delivery, outsourced delivery and self-collection for the delivery fulfilment of the goods. About 17% of respondents mentioned they only outsourced the delivery to a third-party, usually by means of registered mail and courier services. Another 10% indicated they delivered the goods themselves.

Delivery Fulfilment Method	Frequency	%
Own Delivery + Outsourced + Self-collection	16	53.3%
Outsourced Only	5	16.7%
Own Delivery Only	3	10.0%
Own Delivery + Outsourced	3	10.0%
Outsourced +Self-collection	2	6.7%
Own Delivery + Self-collection	1	3.3%
Total	30	100.0%

Table 2: Delivery fulfilment methods

Figure 1 shows the satisfaction level of online retailers with their delivery fulfilment methods. Generally, the respondents felt that they were positive with own delivery for delivery fulfilment (39% satisfied, 13% very satisfied). 50% remained neutral towards outsourcing the delivery. The majority felt dissatisfied with self-collection (37%).

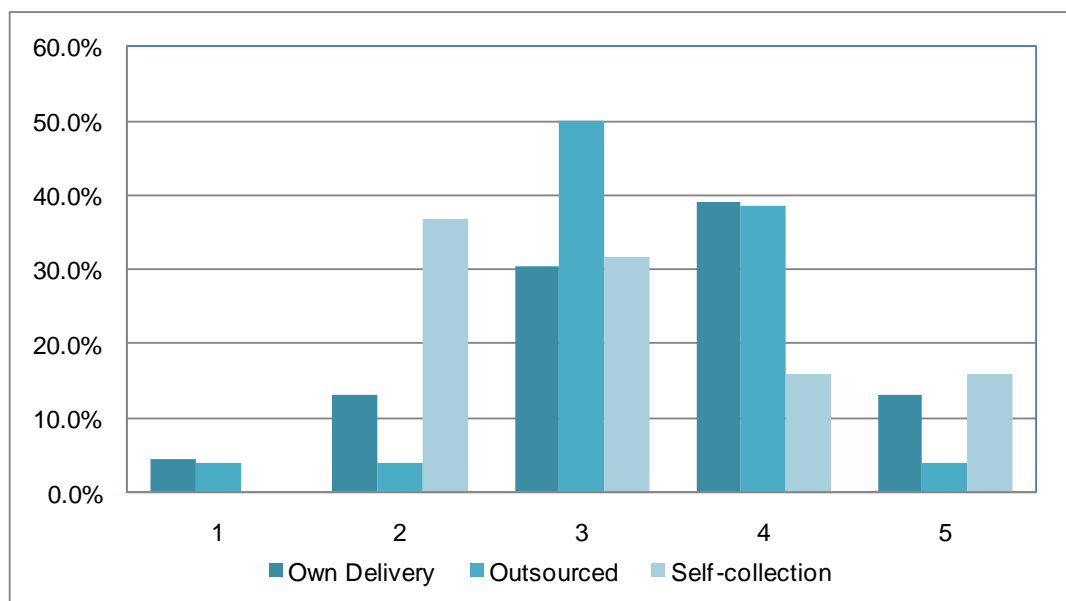


Figure 1: Satisfaction level of online retailers with delivery fulfilment methods
(Note: 1 = Very dissatisfied, 2 = Dissatisfied, 3 = Neutral, 4 = Satisfied, 5 = Very satisfied)

Delivery issues encountered

Table 3 compares the frequency of delivery issues encountered from the viewpoint of online retailers and shoppers. Online shoppers indicated a higher frequency of delivery issues encountered compared to online retailers, which is understandable as customers are more demanding and have higher expectations. Both groups of online retailers and shoppers reported that late delivery was the issue that was encountered most often compared to the other issues.

Delivery Issue	Online Retailers (N = 30)	Online Shoppers (N = 119)	Gap (Shoppers - Retailers)
Failed delivery	1.80	2.05	0.25
Late delivery	2.57	3.12	0.55
Wrong items received	2.00	2.24	0.24
Damaged items delivered	1.57	1.74	0.17
Distorted package	2.13	2.24	0.11
Inferior goods	1.77	2.32	0.55
Items different from what is shown online	2.03	2.67	0.64

Table 3: Mean frequency of delivery issues encountered
(Note: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Very Often, 5 = Always)

Importance of attributes affecting choice of delivery service providers and online retailers

The online retailer survey revealed that online retailers considered lead time (or speed of delivery) as the most important factor (mean rating = 4.53) when choosing a delivery service provider. This was followed closely by price (mean rating = 4.47). Reputation of the provider was a distant third (mean rating = 3.17).

The online shopper survey also showed that online shoppers considered delivery as the most important factor (mean rating = 4.53) when deciding whether to patronise the online retailer for future purchases. This was followed by privacy (mean rating = 4.45), and compensation and apologies (4.00). This emphasises the need for delivery to be a top priority for both online retailers and shoppers.

Hypotheses tests

The perceptions and attitudes of online retailers and shoppers as measured by the Likert scale ratings were tested further using hypothesis testing. Table 4 summarises the main results. One result that emerges from this analysis is that the effect of price, free shipping, promised delivery window and more delivery options may not entice customers to accept longer delivery times or return to the same online retailer for future purchases. However, an effective online tracking system may have the potential to attract customers to repeat their purchases from the same online retailer.

Null Hypothesis H₀	Statistical Test	Test Result
(1) There is no significant difference between the mean evaluations of different delivery service providers.	ANOVA $\alpha = 0.05$	$F > F_{crit}$ Reject H ₀
(2) There is no significant difference between the mean evaluations of likely causes of delivery issues.	ANOVA $\alpha = 0.05$	$F < F_{crit}$ Accept H ₀
(3) There is no significant difference between the mean evaluations of attributes of delivery performance factors.	ANOVA $\alpha = 0.05$	$F > F_{crit}$ Reject H ₀
(4) Having low prices for customer to accept longer delivery lead time is not important.	t-test $\alpha = 0.05$	$t < t_{crit}$ Accept H ₀
(5) Providing free shipping for customer to accept longer delivery lead time is not important.	t-test $\alpha = 0.05$	$t < t_{crit}$ Accept H ₀
(6) Having promised delivery window for customer to accept longer actual delivery lead time is not important.	t-test $\alpha = 0.05$	$t < t_{crit}$ Accept H ₀
(7) Having an accurate online tracking system for customer to repeat purchase from the same online retailer is not important.	t-test $\alpha = 0.05$	$t < t_{crit}$ Accept H ₀
	t-test $\alpha = 0.10$	$t > t_{crit}$ Reject H ₀
(8) Having more delivery options for customer to repeat purchase from the same online retailer is not important.	t-test $\alpha = 0.05$	$t < t_{crit}$ Accept H ₀

Table 4: Statistical tests on perceptions of online retailers and shoppers

Conclusions and Recommendations

This study examined the importance of delivery fulfilment for online shopping by taking into account the perspectives of online retailers and shoppers in the fashion apparel industry in Singapore. The majority of the online retailers surveyed reported that they used a combination of own delivery, outsourced delivery and self-collection for the delivery fulfilment of the goods. Both online retailers and shoppers surveyed reported that late delivery was the issue that was encountered most often compared to the other issues. Online retailers attributed the reasons for late delivery to delivery service providers, expectations of shoppers and limited delivery options.

Online retailers had different perceptions of service performance towards different service providers. They considered lead time as the most important factor when choosing a delivery service provider. Online shoppers considered delivery as the most important factor when deciding whether to patronise the online retailer for future purchases. This emphasises the need for delivery to be a top priority for both online retailers and shoppers.

The effect of price, free shipping, promised delivery window and more delivery options may not entice online shoppers to accept longer delivery times or return to the same online retailer for future purchases. However, it may be worthwhile for online retailers to consider having an online tracking system to help shoppers cope with longer delivery times and possibly retain them for future purchases.

To stay competitive, online retailers need to pay attention to delivery fulfilment where a strong foundation of the delivery process can translate into high levels of customer satisfaction and repeat business. Online retailers must continually improve and develop solutions to take the role of delivery fulfilment to next level. Further work can evaluate the factors that prevent reliable delivery and returns. The study of reverse logistics in the e-commerce environment can also be explored as the lack of good return channels may be one reason customers feel dissatisfied in order flexibility. This study is limited to the fashion apparel industry and future research should consider examining different product categories across different industries.

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CONTAINER SHIPPING TRENDS AND THEIR IMPACT ON PORT DEVELOPMENT AND COMPETITIVENESS

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ABSTRACT

Purpose: Container ports play a critical role by enabling seaborne trade to occur in a reliable, secure, cost efficient and environmentally sustainable manner. The competitive position of a container port is determined by its competitive offering to the host of shippers and shipping lines to which the port serves. This paper examines key trends and developments in the container port industry from the perspective of the market structure of a container port.

Design/methodology/approach: This paper uses market structure analysis with case studies drawn from the development experience of the port of Singapore, which is the world's largest container transshipment hub and second busiest container port.

Findings: The paper uncovers major trends that have impacted the nature of demand and supply in the container port industry. It analyses how container ports can capitalise on these developments to bring about port development and enhanced competitiveness to the benefit of their respective communities.

Practical Implications: Container ports increasingly face the challenges of limitations to physical expansion while attempting to capitalise on growing demand and needs posed by larger container shipping lines. Case studies will be drawn from how these challenges can be addressed to ensure that the container port community continues to thrive and grow.

Originality/Value: Port planners will be able to make use of the analyses on container port competitiveness and port development based on empirical evidences drawn from the industry.

Keywords: port competitiveness, container shipping, container ports, port of Singapore

Introduction

In 2012, the busiest container port in the world handled 32.6 million TEUs (World Shipping Council, 2013). In 1990, container throughput was only 5.2 million TEUs. The 2012 rankings revealed that throughput of the 11 busiest ports surpassed 10 million TEUs each. Of these, cargo traffic handled by the four busiest ports exceeded 20 million TEUs. Container ports face tremendous challenges as they strive to maintain competitiveness and accommodate the growth in traffic. Ports that are able to attain these objectives are likely to become focal points for key arteries of the containerised cargo trade. As components of value-driven logistics systems that intersect between hinterlands, efficiency gains generated by competitive ports can impact directly on the competitive advantage of their users. Ports that are supported by the provision of competitive and reliable services can increase the amount of welfare benefits that extend beyond the port community and transport users to the whole of society.

The importance of container ports as primary confluences for market forces in the container shipping industry makes it necessary to investigate the developments and challenges presented to this sector. The paper provides an overview of demand and supply forces that impact on the container port industry and examines the implications for the development and competitiveness of container ports.

Demand for Seaborne Containerised Transport Services

Seaborne trade in containerised cargoes and container throughput handled by ports grew in tandem reaching 1.4 billion tonnes and 573 million TEUs respectively in 2011 (UNCTAD, 2012). Demand by shippers set the broad overtone for container traffic movements. This demand is dependent on the performance of the global economy, types of commodities involved, average haul of cargoes, political events, and transport costs (Stopford, 2009). An environment created by a booming world economy where containerised cargoes are being shipped over longer distances and where transport costs are

declining will generate greater demand for seaborne container transport. Higher penetration achieved by containerisation will also boost demand. These factors ultimately determine the types of goods to be transported as well as seasonality, spread and direction of the containerised trade.

Besides shippers, demand faced by container ports also comes from shipping lines. Containers transported by shipping lines are used for transshipment or direct service (i.e. from port-of-origin to destination port). Shipping lines will try to optimise their logistics networks by rationalising coverage of ports, shipping routes and transit time in order to achieve economies of scale and scope (Mourão et al., 2002; Lirn et al., 2004). Notteboom (2006) noted that the determinants of demand includes the pattern and distribution of freight movement over a particular port's hinterland, cargo volume and cargo-generating potential of the port, maritime access, and quality of service. Other determinants include the ability to compete with other transport modes (Trujillo and Tovar, 2007), adequate feeder networks and efficient hinterland connections (Aversa et al., 2005). Lu et al. (2005) added that requirements by end-customers for high quality logistics services mean that demand for transporting containers by sea is linked ultimately to logistics goals. Logistics is thus seen as a strategic source of competitive advantage in a global environment which is orientated towards increased sharing of global production, shorter product life cycles, and intensification of global competition.

Supply of Seaborne Containerised Transport Services

Supply of containerised transport comes mainly from fully cellular vessels deployed in container shipping services. Carriers contend with many variables when operating such services. We examine four factors: cargo carried, trade route, cost conditions and industry dynamics. Collectively, these factors determine the kind of container shipping services to run if the decision to operate is taken.

Factors specific to cargo carried include requirements by shippers, availability of cargo, types of cargoes to be transported, freight rates and trade imbalances. The types of cargoes can be differentiated by those transported in standard containers and those that require specialised equipment such as reefers, ISO tanks and open-top containers. There are also considerations of freight rates earned and severity of trade imbalances as empty containers have to be repositioned at minimal cost to the shipping line.

Factors specific to the trade route include distance, geography and infrastructure conditions for container shipping services. For route geography, navigational hazards can impose restrictions on vessel operations whereas distance and type of route involved can influence the types of vessel to deploy. Infrastructure provided by ports-of-call can determine efficiency of port operations, cargo base and vessel turnaround time for the voyage. The importance of this factor has persuaded some of the major carriers to invest in dedicated facilities at strategic locations along key trades to enhance their competitive service offerings. Other conditions specific to the route include state of weather, risk of pirate attacks, regulatory requirements of passage (e.g. conventions enforced by coastal state and port state controls), and political conditions in littoral states.

Factors that relate to costs incurred as a result of the voyage include bunker and supplies that have to be consumed, insurance and port charges, among others. Carriers have to bear these charges upfront even though they can be covered to a certain extent by surcharges such as bunker adjustment factor and congestion surcharges.

The fourth set of factors pertains to inter-firm dynamics on the trade routes. Carriers will weigh the benefits offered from potential market entry and opportunities for cooperation with other carriers against the costs of competition with incumbents and potential entrants. The extensity of competition and cooperation can spread to embrace other routes and shipping networks.

These considerations are manifested in the network structure of liner services where shipping lines aim to optimise network design. This can be achieved by routing cargo via transshipment hubs or amalgamating with other shipment flows. Hence, carriers have to accommodate shippers' preferences and account for behavioural aspects of industry players while attempting to minimise network costs that are linked to its shipping and landside operations. They must fulfil the transport requirements of a globalised economy through organic growth, M&A or engage in various forms of horizontal and vertical cooperation to generate greater customer value vis-à-vis competing logistics networks. Successful carriers will be able to generate greater economic value and cargo volume for the ports where they

hub although the same development will increase their desire for greater control over the logistics flows and work processes at those ports (Yap, 2009).

Implications for Port Development and Competitiveness

Taking together, demand and supply factors witnessed by the liner shipping industry in the recent decade corresponded to the unprecedented increase in containerised traffic which presents many challenges to container ports. The most significant challenges relate to capacity utilisation and expansion as ports strive to:

- Cater to short-term variations in cargo volumes and vessel traffic without compromising schedule reliability of liner services and normal functioning of other port activities
- Cater to increasing size of container ships operated by mainline operators without compromising service levels for operators of smaller vessels
- Deal with demands required by the entire logistics chain
- Address increasing power wielded by large industry entities in dictating cargo routings and container-handling operations
- Compete with a wider range of ports as hinterlands expand and increasingly overlap

Short-term variations in cargo volumes and vessel traffic

Table 1 shows the container throughput and vessel capacity for the ten busiest container ports in 2012. Shanghai port experienced 3.1 times the amount of vessel capacity for every TEU handled. Shenzhen and Ningbo-Zhoushan ports saw this figure exceed four times for their corresponding amount of containers handled. Higher cargo and vessel traffic without adequate facilities to accommodate them lead to delays in berthing, departure, loading and discharge of cargoes and other forms of unexpected waiting time. Notteboom (2006) found that 86.1% of schedule unreliability on the Asia-Europe trade route was attributed to such events. This was an affront to the liner shipping industry which traditionally prides itself with high degree of schedule reliability.

Port	Container Throughput (million TEUs)	Vessel Capacity (million TEUs)	Throughput / Vessel Capacity (%)	Vessel Capacity/ Throughput
Shanghai	32.6	100.4	32.5	3.1
Singapore	31.7	81.2	39.0	2.6
Hong Kong	23.1	85.8	26.9	3.7
Shenzhen	22.9	95.9	23.9	4.2
Busan	17.0	63.2	26.9	3.7
Ningbo-Zhoushan	16.8	79.7	21.1	4.7
Guangzhou	14.7	21.6	68.1	1.5
Qingdao	14.5	36.4	39.8	2.5
Jebel Ali	13.3	32.0	41.6	2.4
Tianjin	12.3	27.6	44.6	2.2

Source: Informa UK Ltd (2012) and World Shipping Council (2013)

Table 1: Comparison of container throughput and vessel capacity for the top ten container ports

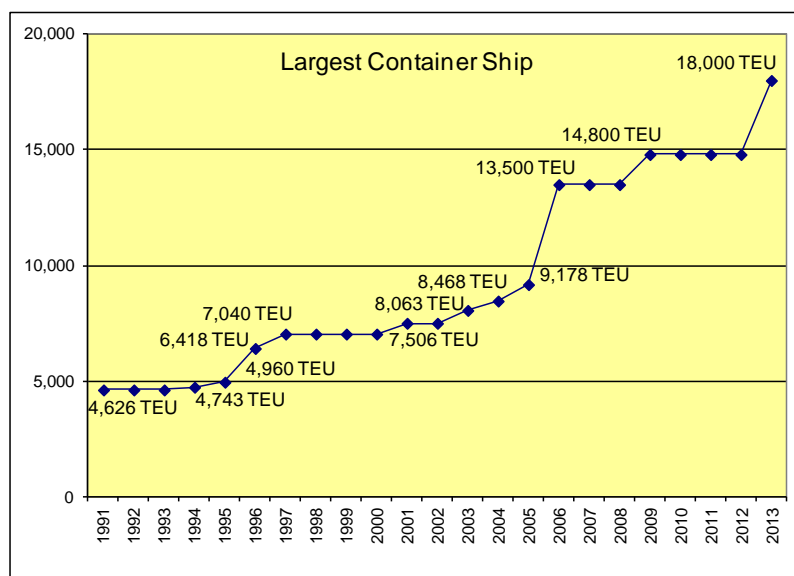
Ports typically develop new facilities ahead of demand to avoid the capacity crunch. However, the cost of development does not come cheap. In the case of Shanghai, the development cost for a 300-metre berth at Yangshan Phase 3B in 2009 amounted to US\$288 million (HKTDC, 2009). This was almost double the cost incurred for a similar berth for Phase 1 (Hong Kong Standard, 2005). On the other hand, misreading demand to be overly optimistic can result in underutilisation of very expensive infrastructure and represent a hefty opportunity cost for society.

The key challenge for container ports is to structure their facilities to achieve optimal balance between accommodating frequent short-term variations in demand and achieve gainful employment of terminal resources on a sustainable basis. Container ports need to also consider the long-term investment horizon associated with these resources. For instance, demand and supply conditions faced by a container terminal operator at the beginning of a 30-year lease period are likely to be very different compared to conditions at the end of the period. Diseconomies from increasing volume of inter-terminal haulage, hinterland traffic congestion and larger economies of scale required to generate acceptable returns to shareholders may render existing facilities obsolete. This may require an entire

system of container terminals to be redeveloped with the latest terminal design and technology aimed at achieving higher levels of productivity as well as addressing concerns of an increasingly demanding stakeholder community with regards to spatial and environmental quality of the vicinity.

Increasing size of container ships

Figure 1 shows that the largest container ships deployed in the early 1990s remained below 5,000 TEUs while maximum ship size increased to 7,040 TEUs by the end of the decade. In 2003, the 8,000-TEU record was broken. Two years later, the 9,000-TEU record was broken by the MSC Pamela. In 2006, there was a significant structural break when the 13,500-TEU Emma Maersk entered service, leading to an order-rush for ships exceeding 10,000 TEUs in size. In 2013, another break occurred when the 18,000 TEU McKinsey Moller-Maersk entered service.



Sources: various including A.P. Moller-Maersk Group (2013)

Figure 1: Increasing size of container ships (1991-2013)

To cope with increasing vessel size, container ports are boosting handling capacity by reconfiguring cargo operations through the deployment of more equipment, restructuring of terminal design for greater efficiency, or developing capacity in entirely new locations. In Singapore, container berths at Pasir Panjang Terminal Phase 1, which began operations in March 1999, were designed with 360 metres per berth. The terminal was equipped with state-of-the-art automated overhead bridge cranes and berths that could handle the largest container vessel then on the orderbook (i.e. 8,063-TEU OOCL Shenzhen with LOA of 323 metres). When Phase 2 began operations in June 2005, the longest berth had a length of 418 metres which could handle the 13,500-TEU Emma Maersk (PSA International, 2006). When Phases 3 and 4 become operational, they will be capable of handling the Triple-E megaships (A.P. Moller-Maersk Group, 2013).

Demands required by the entire logistics chain

Robinson (2002) noted that port competition had shifted to competition between value-driven logistics systems. Container ports become part of these systems that connect the entire flow of cargoes from origin to destination. As a result, the value delivered by the entire chain becomes fundamentally important to customers rather than its individual components. Lam and Van de Voorde (2011) showed that features of the logistics chain go beyond physical aspects to include considerations from the customer service, inventory setting, transport requirement and order processing angles. They suggested that while it was important to attain local optimum with respect to each individual activity, the supply chain community should focus on the overall service quality that is presented as a collective whole to the customer. As such, container ports have to position themselves to complement specific requirements of individual logistics chains that utilise their services (Lam and Yap, 2011a). In Singapore's case, container shipping can count on the efficiency of transshipment operations for hub-and-spoke, interlining and relay containers. This allows the port to serve markets across Asia to as far as Europe, Australasia, Africa and North America. In effect, the port has to deal with logistics requirements on a global scale spanning several time zones, companies, work cultures and

operational concerns. Above all, the container port industry in Singapore must be able to perceive, anticipate and act on user demands from key decision makers along the entire logistics chain.

Increasing power wielded by industry entities

The spate of M&A activities in the liner industry resulted in the top twenty carriers controlling 85% of the world's container vessel capacity in 2013 (Alphaliner, 2013). By comparison, market share of the top twenty carriers in 1992 was only 37%. Shipping lines constantly pursue strategies to establish superior positions against other players in the logistics chain. With the increase in bargaining power, ports that are less flexible in accommodating the requirements of major carriers can be bypassed. However, the costs of re-routing traffic to another port can be costly for shipping lines as well. For example, they may have to contend with the loss of key customers.

There is a growing trend of collaboration between pure stevedores and major container shipping lines for terminal investments. Table 2 shows projects involving a consortium of pure stevedores and major shipping lines. Pure stevedores desire some level of certainty and the involvement of shipping lines in the project can provide the base throughput for the terminal. Engaging prominent local partners who are major shippers or companies involved in the hinterland transport business can also enhance the viability of the project and, not to mention, improve the chances of winning the concession.

Project	Parties Involved	Nature of Business	Shareholding (%)
Shanghai Yangshan Phase 3A	PSA International	Pure stevedore	30
	China Shipping	Shipping line	30
	Shanghai International Port Group	Pure stevedore	20
	COSCO Group	Shipping line	10
	CMA-CGM	Shipping line	10
Antwerp Gateway Terminal	DP World	Pure stevedore	42.5
	COSCO Pacific	Stevedore related to a carrier	20
	Zim	Shipping line	20
	CMA-CGM	Shipping line	10
	Duisport	Logistics centre	7.5
Rotterdam World Gateway	DP World	Pure stevedore	20
	Mitsui OSK Lines	Shipping line	20
	Hyundai Merchant Marine	Shipping line	20
	APL	Shipping line	20
	CMA-CGM	Shipping line	20

Sources: various including Reuters (2013)

Table 2: Selected terminal investments involving stevedores and major carriers

Global terminal operators and shipping lines equipped with the relevant financial, technological and managerial expertise can help ports to overcome their deficiencies and sustain their competitive edge. However, access to competitive assets does not automatically translate into port competitiveness as efficiency gains generated can be monopolised in anti-competitive settings. The container handling sector in Singapore is dominated by PSA International with a market share of almost 100%. While this seems to present PSA with the advantages of a monopoly, the fact that 85% of containers handled are transshipment in nature makes this business liable to move to alternative locations if competing offers are better (PSA Singapore, 2013). Between 1999 and 2002, four of the largest container shipping lines relocated their transshipment operations to neighbouring Port Klang and Tanjung Pelepas citing more favourable terms. Ports that are able to attract internationally competitive global terminal operators and anchor major mainline operators may be in a better position to sustain their hub status and realise the stipulated economic and social benefits for their communities.

Wider range of ports

Improving transport networks and expanding markets result in hinterlands that increasingly overlap. Improvements in intermodal technology and organisation are also prompting shipping lines and shippers to frequently review service schedules, traffic routings, and assets utilised to exploit changing traffic density and achieve greater economies. As a single node in global value-driven logistics systems, container ports continuously strive to entrench and enlarge their captive hinterlands, while at the same time, erode those of competitors. A principal consideration is the total transport cost

associated with including the port in the particular logistics chain given that cargo flows are continuously seeking routes that offer the best value for comparative service levels.

Analyses of container port competition for various container-handling regions in the world show that ports do not only compete with their immediate neighbours but also with other ports located in the region. Competition was found to be more intense between major load centres located within a region (Lam and Yap, 2006). The impact of competition on the container port industry in Singapore is severe. Prior to 1999, Singapore was the uncontested container hub in Southeast Asia. However, the share of transshipment containers handled by the port fell from almost 100% in 1998 to 71% within a decade. The largest decline was registered between 1999 and 2002 where the port's transshipment market share declined by more than 20 percentage points. This was attributed to the presence of professional global terminal operators such as Hutchison Port Holdings in Port Klang (The Sun, 2001) and APM Terminals in Tanjung Pelepas (Singapore Business Times, 2000). These developments improved terminal productivity, marketing effectiveness and ability to provide better services at competitive price levels. As a result, four major mainline operators which had based their transshipment operations in Singapore decided to relocate their hubs to Port Klang and Tanjung Pelepas.

Container ports can complement and sustain each other's competitive advantage to boost performance. This is underscored by the fact that a port needs another port. First, the direction of trade can be used to determine the degree of complementarity that exists in container traffic flow between origin and destination ports. Second, complementary relationships can exist in hub-and-spoke networks where hub performance is complemented by positive developments at various spokes to which the hub is connected. However, the positive effects of this relationship can be reversed if the spoke become large enough to compete for direct calls with the hub. Analyses of relationships between container ports are usually conducted at the aggregated level. Lam and Yap (2011b) pointed out that every market served by each port involves different decision makers, geographical regions, trades routes and shipping lines. It is unlikely for a port to compete with another over the whole spectrum of market segments. Therefore, an essential element in identifying inter-container port competition and complementarity is to identify the specific markets where these relationships exist.

Engaging the port community for port development and competitiveness

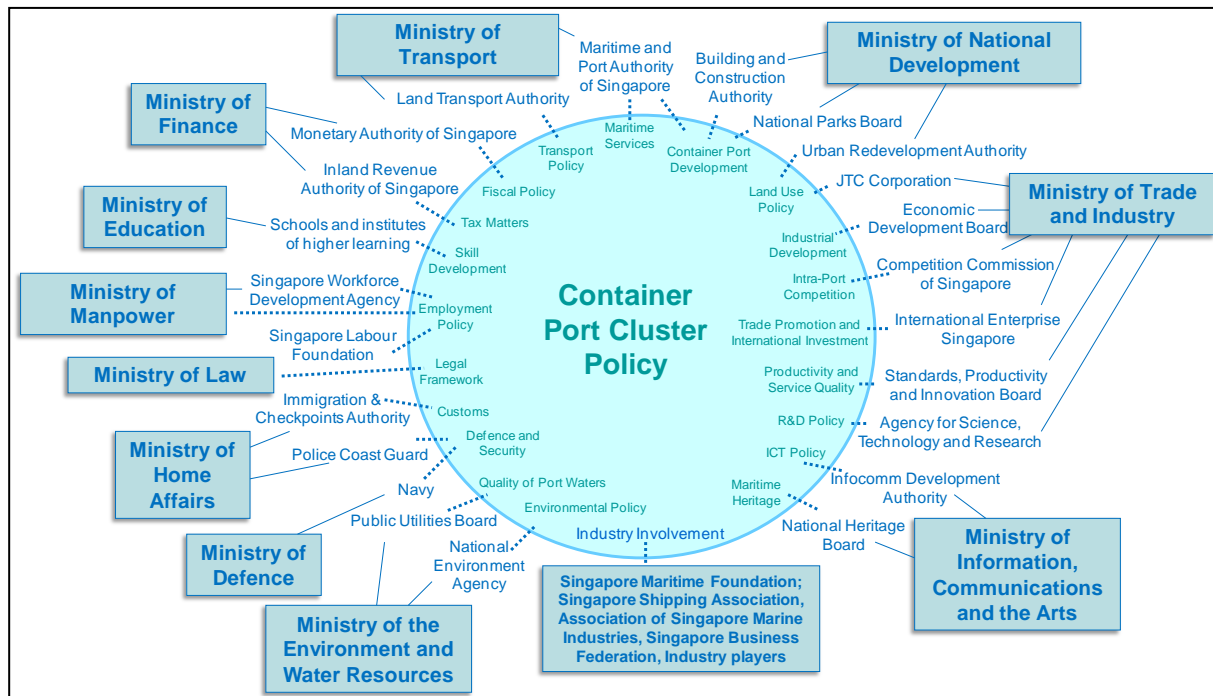
Competition can have positive effects in promoting greater efficiency and innovation, although the distribution of its benefits may be contentious. Negative effects may result as competition can lead to exploitation of resources beyond sustainable levels (Yap et al., 2011). In particular, vigorous competition in the port scene has led some to question its longer-term economic, social and environmental rationale and implications for society. Hence, container ports should be proactive in identifying and engaging relevant stakeholders to address potential flashpoints that may arise. This is most important when the situation involves issues that concern the long-term competitiveness, commercial viability and sustainability of the container-handling business on which the entire container port community is dependent. Otherwise, the interests of the container port may be misrepresented or even worse, misunderstood, and the container port community risks being marginalised.

Figure 2 shows the institutional framework governing operations and development for the container port cluster. The Ministry of Transport directly oversees the operating environment of the container port. Other organisations include those related to industrial development, employment creation, trade promotion, education policy and ICT infrastructure. The figure shows the complexity of relationships and variety of government agencies and private-sector institutions that can affect the overall competitiveness and competitive offering of the container port. The various stakeholders have different interests as well as different sources and avenues of influence. The challenge is to harness the support of these entities to advance the port's competitiveness.

Conclusions and Recommendations

The port is an important node for facilitating the efficient flow of containerised cargo. The main influence exerted by ports would be through improvements to cargo and vessel productivity, providing superior maritime and hinterland access, and ensuring that the pace of capacity expansion is sufficient to meet anticipated demand. Ports that aim to be competitive hubs must strive to become the focal point for main arteries of containerised cargo traffic by serving as collection and distribution points for hinterlands that may extend beyond their national boundaries. Ports that are able to provide an environment where trade in containerised cargo can be conducted in a safe, secure and cost-effective manner relative to competition will ensure that they will be the preferred conduits of container traffic.

The challenge is to balance long-term investment horizons with short-term variations in demand. The challenge is even greater for container ports that rely on transshipment traffic for such cargo are known to be “foot-loose”.



Source: Yap (2009)

Figure 2: Institutional framework for container port cluster development in Singapore

This paper examined the issue of container port development and competitiveness from the perspective of trends and developments brought about by changes to demand and supply forces in the container shipping industry. Given the dynamic nature of developments in these areas, future research can address the role of technology and spatial policies from the perspective of urban development. The paper also introduced the subject of container port cluster from the institutional dimension. Given the diversity of entities involved and roles held, it would be useful to investigate the subject matter from the perspectives of different parties in the cluster to obtain deeper insights for container port development and competitiveness.

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CRITICAL EVALUATION OF MANDALAY DRY PORT, MYANMAR

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Introduction

ASEAN is at the geographic centre of the emerging global centre of production and demand - the South Asia-Southeast Asia-Northeast Asia-Australia/New Zealand corridor. ASEAN has the highest share of intra-regional trade to total trade (26.3% in 2008) among the regional economic groupings in the developing world. This reflects the high level of inter-dependence between regional production networks operated by both manufacturers and producers (ASEAN Secretariat, 2011: 20). ASEAN cooperation in transport connectivity aims to establish efficient, integrated, safe and environmentally sustainable regional land transport corridors linking all ASEAN Member States and countries beyond. ASEAN has introduced a number of transport facilitation initiatives over to create a more efficient logistics and multimodal transport system for a seamless movement of goods, connecting land, maritime, and air transport. A Roadmap for the Integration of Logistics Services (RILS) was endorsed in August 2008 to strengthen ASEAN as a single market and production base, and enhance its competitiveness through trade and transport facilitation. However, as far as the missing links of the Asian Highway Network are concerned, they are located mostly in Myanmar – which is used as a case study for this paper.

We argue that major ASEAN transport corridors must be integrated with economic development corridors. First, we outline the general concepts of dry ports and special economic zones based on some of our previous research (Roso, 2009a; Black, *et al*, 2012). The critical success factors for the planning and implementation processes for successful dry ports are presented based on a search of best international practice (Table 1). In nominating the potential dry ports to be included in the UNESCAP Intergovernmental Agreement on dry ports, Myanmar has proposed potential dry ports in Mandalay, Tamu, Muse, Mawlamyine, Bago, Monywa and Pyay. Mandalay is selected as a case study of a dry port as part of ASEAN connectivity, and we critically evaluate its location (Table 3) within the context of Myanmar's import and export of commodities. Furthermore, special economic zones (especially the strategic and master planning exercises to be undertaken by governments to attract private-sector finance) can be created around ports, dry ports and airports to help create economic development along major international transport corridors, and potential policies for the Government of Myanmar are discussed in the final section.

Dry Ports and Special Economic Zones

The concept of “dry ports” was neglected for many years (Hanappe, 1986; Munford, 1980) until increased interest in environmental issues related to growing containerised maritime transport, where seaport inland access becomes a critical factor for the seaports' competitive advantage (Roso, 2009a: 3). An inland freight terminal is “any facility, other than a port or an airport, operated on a common-user basis, at which cargo in international trade is received or dispatched” (UN ECE, 1998). Inland ports supply regions with an intermodal terminal offering value added services or a merging point for different traffic modes involved in distributing merchandise that comes from ports. The term dry port is used synonymously.

The dry port concept (Cullinane, *et al*, 2012) goes beyond the conventional use of railway shuttles for connecting a seaport with its hinterland. Being strategically and consciously implemented jointly by several actors from the public and private sectors, it also goes beyond the common practice in the transport industry of “silos”. In addition to the general benefits to the ecological environment and the quality of life of people living near main roads by shifting flows from road to rail, the dry port concept mainly offers seaports a possibility to secure a market in the hinterland, increasing the throughput without physical port expansion as well as better services to shippers and transport operators.

The Republic of the Union of Myanmar (henceforth Myanmar in this paper noting that some In terms of policy, special economic zones (SEZ) are useful tools (as part of an overall economic growth strategy) to enhance industry competitiveness and attract foreign direct investment (FDI). The popularity of special economic zones (SEZ) as a national government policy instrument has taken off since the

1990s, especially in developing economies. The International Labour Organization's database of special economic zones reported 176 zones in 47 countries in 1986; by 2006 this had risen to 3,500 zones in 130 countries (Boyenge, 2007). Advanced economies also use special economic zones as policy instruments to influence the location of economic investment. For example, in the election campaign for the Australian Federal Government (September 2013) both major political parties announced policies on special economic zones in northern Australia. Furthermore, local governments apply SEZ policies: the Tokyo Metropolitan Government recently launched the Special Zone for Asian Headquarters project as a new plan to attract foreign companies to Tokyo, with the aim to make Tokyo the preferred site in the Asian region for regional headquarters and R&D centres. Foreign companies newly headquartered in five central zones (Central Tokyo Waterfront area, Shibuya, Shinjuku, Shinagawa, and vacant land near Hanada airport) will benefit from preferential tax treatment, as well as deregulation and a generous package of fiscal and financial assistance (http://www.chijihon.metro.tokyo.jp/ahq_project/index.html., accessed 29 August, 2013).

In contrast, free-trade zones are fenced, tax-free areas that provide warehousing and distribution facilities for import/export operations, sometimes with reduced customs, labour and environmental controls. To maintain control, EPZs have normally been fenced-in estates with strict customs controls at entry, and sales are typically restricted mainly to export markets. Traditional export-processing zones (EPZs) were designed to attract investment by enabling countries to better exploit low-cost labour – which was otherwise under-utilised because of low levels of domestic investment and barriers (regulatory, infrastructure, and so on) preventing foreign direct investment (FDI). EPZs allow investors to import and export free of duties and exchange controls; they facilitate licencing and other regulatory processes; and divest firms from obligations to pay corporate taxes, VAT, or other local taxes. According to a World Bank source (Farole, 2011), achieving success with zone programs in the future will require adopting a more flexible approach to using the instruments of special economic zones in the most effective way to make the most of the country's sources of comparative advantage. This will require much broader policies than the narrow scope of any special economic zone programme alone, such as: promoting skills development, training, and knowledge sharing; promoting industry clusters; supporting the integration of regional value chains; and supporting public-private institutions, both industry specific and transversal. More fundamentally, this will require a change in mindset away from the traditional reliance on fiscal incentives and wage restraint, to a focus on facilitating a more effective business environment to foster firm-level competitiveness, local economic integration, innovation, and social and environmental sustainability. It will require supporting economic and social infrastructure, and other residential and business amenities, as illustrated by the Asian Headquarters Project in Tokyo with its articulated locational advantages of the five zones.

Dry Ports – Critical Success Factors

There are a number of factors that influence the implementation process of a dry port. In the first place, there must be capacity problems in the seaport and suitable infrastructure connectivity (Roso *et al*, 2009; Roso, 2008; Rodrigue and Notteboom, 2012). There must be a suitable location for the dry port that offer environmental advantages (Roso, 2008; Hanaoka and Regmi, 2010; Cullinane and Wilmsmeier, 2011) and this will be partly dictated by geographical characteristics of the country. It is noted that the road lobby often impede railway development (Roso, 2008) and that cooperation amongst all key stakeholders in the multi-modal transport system is required (Roso, 2012) of which the regulatory environment is important. Finally, there must be the finance available to build the dry port. However, as the case studies of Falköping dry port in Sweden (Roso and Lumsden, 2009) or Nepal's dry port at Birgunj (Hanaoka and Regmi, 2010) demonstrate, it is relatively easy to develop a dry port facility but it is a considerable challenge to put it into operation. Based on a review of the international literature, Table 1 presents the factors that influence dry ports operations and, consequently, their success.

Success factor	Reference
Discuss operational agreements in advance	Hanaoka and Regmi (2010)
Emission reductions	Roso and Rosa (2012), Hanaoka and Regmi (2010)
Government logistics policies/support	Hanaoka and Regmi (2010)
Public-private ownership or government	Hanaoka and Regmi (2010)
Railway connection	Roso <i>et al</i> (2009), Roso and Lumsden (2010), Hanaoka and Regmi (2010)
Modal shift from road to rail	Roso <i>et al</i> (2009), Hanaoka and Regmi (2010), Cullinane and Wilmsmeier (2011)
Stimulating economic development	Roso (2009b), Hanaoka and Regmi (2010)
Facilitating international trade	Hanaoka and Regmi (2010)
Development of supporting infrastructure	Hanaoka and Regmi (2010)
Streamlining of institutional and regulatory frameworks	Hanaoka and Regmi (2010)
Double-stack trains	Hanaoka and Regmi (2010)
Advanced information systems	Roso (2012), Hanaoka and Regmi (2010)
Container tracking	Hanaoka and Regmi (2010), Roso (2012)
Market driven development	Hanaoka and Regmi (2010)
Cooperation between the actors of the transport system	Roso (2012), Hanaoka and Regmi (2010)
Coordination among various government agencies	Hanaoka and Regmi (2010)
Temporary warehousing facility	Rodrigue and Notteboom (2012), Cullinane and Wilmsmeier (2011)
Capacity problems in seaport reduced	Roso <i>et al</i> (2009), Roso (2008), Rodrigue and Notteboom (2012), Cullinane and Wilmsmeier (2011)
Development of value added services	Back <i>et al</i> (2013), Roso and Andersson (2010)
Lower distribution cost	Rodrigue and Notteboom (2012), Roso <i>et al</i> (2009), Cullinane and Wilmsmeier (2011)
Good intermediary location	Rodrigue and Notteboom (2012)
Better usage of regional transport infrastructure	Rodrigue and Notteboom (2012)
Expanding or reinforcing hinterland	Cullinane and Wilmsmeier (2011), Roso (2012), Roso and Rosa (2012)
Marketing support by local economic agencies and state	Cullinane and Wilmsmeier (2011)
Lower land cost and taxes	Cullinane and Wilmsmeier (2011)
Lower cost of living to attract distributions centres into area	Cullinane and Wilmsmeier (2011)

Table 1: Success Factors in the Operations of Dry Ports

Myanmar – Economic Background Data

The Republic of the Union of Myanmar (henceforth Myanmar in this paper noting that some western countries such as Australia and the USA use the former name of the country, Burma) is the largest country in mainland South-East Asia with a total land area of 676,578 square kilometres. In 2010, the total population was estimated at 60.6 million with an estimated growth rate of 1.29 percent. Myanmar is located between latitudes 09°32'N and 28°31'N and longitudes 92°10'E and 101°11'E with much of the country located between the Tropic of Cancer and the Equator. Distances range from 936 kilometres from east to west and 2,051 kilometres from north to south. Myanmar shares 5,858 kilometres of international borders with Bangladesh and India, on the northwest, The People's Republic of China, on the northeast, and Lao PDR and Thailand, on the southeast.

From 1962 to 2011, the country was ruled by a military junta – justified internally on the grounds that a military regime was necessary to prevent the regional and ethnic conflicts escalating into civil war. After a general election in 2010 a nominally civilian government installed, although the military retained a considerable influence that is now in decline with various policy reforms. Myanmar has a high socio-economic potential as a result of its abundant natural and human resources that are currently underused. In 2011, the agriculture sector contributed 32 percent of Gross Domestic Product (GDP) and generated 17.5 percent of total export earnings. Myanmar is a predominantly rural country with only 31 per cent of the population living in urban areas. Table 2 provides information from Myanmar between 1995 and 2010 but based on different data sources. Myanmar remains a predominantly rural country with only 31 per cent of the population living in urban areas.

In accordance with the market-oriented policy of the government in Myanmar, restrictions on trade and investment were removed progressively since 1988. Private-sector participation in domestic and foreign trade - previously monopolised by the state - are allowed. Border trade was regularised to facilitate cross border trade with the five neighbouring countries with the Department of Border Trade established and its 13 branch offices providing one-stop service for border trade matters in collaboration with various departments concerned. For example, the Muse Border Trade Commercial Zone has been constructed at the China-Myanmar border area to smooth border trade transiting. The

customs procedures in Myanmar are provided in the Sea Customs Act and Land Customs Act. A notification was issued to regulate the classification of imported goods and assessment of duties in accordance with the tariff law that was enacted to assist the market economic system on March 12, 1992. The Green Lane System (GLS), which has been laid out by ASEAN Customs Administrations for the rapid clearance of goods of ASEAN origins for the development of intra-ASEAN Trade, has been being implemented in Myanmar since 1st January 1999. The Harmonized Commodity Description and Coding System (HS) were introduced in April 1992 for modernisation and standardisation. In 1988, the risk management technique was initiated by Customs to avoid 100 per cent physical checking of all exports and imports following WTO recommendations. Transit duty was abolished in 2000. Customs Value Declaration Form (CUSDEC 4) was prescribed to provide the implementation of the WTO Valuation Agreement in 1999.

Indicator	1995	2000	2005	2010
GDP (kyat billion)	604.7	2552.7	12286.8	40507.9
Annual growth of GDP (%)	2.8	6.9	13.7	11.9
Per capita real GDP (kyat)	1,232.0	1,492.0	2,000.0	564,091.0
Total population (millions)	44.74	50.13	55.4	59.78
Urban population (percent of total)	26.1	29.1	30.4	30.7
Labor Force (millions)	20.5	24.3	27.4	31.0
Human Development Index*	0.481	0.552	0.406	0.483**

*Human Development Index is Composite index of longevity (measured by life expectancy at birth), knowledge (measured by expected years of schooling and mean years of schooling), and decent standard of living (measured by the adjusted per capita income in PPP US\$).

** for 2011

Table 2: Macro - Economic Indicators for Myanmar, 1995 - 2010
(Sources: Key Indicators for Asia and the Pacific, 2011 and 2012)

Southeast Asian and Asian countries dominate the pattern of trade to and from Myanmar. In 2008/9 the bulk of Myanmar's exports in value (57%) went to countries in South-east Asia, predominantly Thailand (39%) and Singapore (13%), and to other Asian countries (37%) - primarily to India (12%), Hong Kong (10%) and the People's Republic of China (9%). There is a similar geographical distribution with the value of import: in 2009/10 imports came from the People's Republic of China (30%), Singapore (29%), Thailand (9%), Japan (6%), Korea (6%) and India (5%).

Evaluation of Mandalay Dry Port Concept

A report for the United Nations ESCAP recommends a dry port of area of 8.5 hectares be established near the existing Merchandise Center in Mandalay (Ryoo *et al*, n.d.) at a total cost of \$US10.5 million. The report provides detailed costs of land acquisition, site preparation and utility services, together with the necessary dry port infrastructure, based on unit rates and typical designs on other Asian countries, especially Laos and Thailand. The criteria in Table 1 are applied to our case study of planning a dry port in Mandalay in order to assess its potential success in implementation and operations (Table 3). Internal transport is a major barrier to economic development. Myanmar is the poorest performer amongst ASEAN countries and this acts against a dry port in Mandalay. The World Bank has published the Logistics Performance Index (LPI) which is a multidimensional assessment of logistics performance that compares the trade logistics refers to trade- and transport-related infrastructure (e.g., ports, railroads, roads, information technology). Among 155 countries, Myanmar is ranked 129th (with a score of 2.37) in terms of the LPI, and 133rd (with a score of 2.10) in terms of the quality of infrastructure (ADB 2012, p. 22). According to truck drivers, the transit time between Mandalay and Yangon is about 24 hours (including 6 hours rest).

Success factor	Positive	Negative
Congestion in main port	Yangon has landside space constraints	
Government logistics policies/support		In progress
Public-private ownership or government		
Railway and waterway connections		Poor freight services and river navigation constraints
Modal shift from road to rail		Road sector developing rapidly
Stimulating economic development	Yes in Upper Myanmar	
Facilitating international trade	Between China and India	
Development of supporting infrastructure	With commitment of provisional government	
Streamlining of institutional and regulatory frameworks		Too challenging at present
Double-stack trains		No
Advanced information systems		No
Container tracking		No
Market driven development		In progress
Cooperation between the actors of the transport system		No evidence
Coordination among various government agencies		No evidence but being driven by Ministry of Economic Development
Temporary warehousing facility	Merchandise City	
Capacity problems in seaport reduced		Too far from congested Yangon unless rail is improved
Development of value added services	Potentially in Mandalay	
Good intermediary location	Between Muse (China trade) and Yangon	
Better usage of regional transport infrastructure		Requires construction of new railway to Muse
Expanding or reinforcing hinterland		Yes
Marketing support by local economic agencies and state	Requires work	
Lower land cost and taxes	Action by provincial and city governments	
Lower cost of living to attract distributions centres into area	Lower than in Yangon	

Table 3: Mandalay Dry Port – Qualitative Evaluation of its Implementation and Operation

There is a good case for a dry port to serve Yangon. The Port of Yangon is the premier port and handles approximately 90% of the country's normal exports and imports. Cargo throughput using Yangon port has been increasing markedly each year with containerised cargo at an annual growth rate of approximately 16% for the last six years. The port is located in the downtown area of Yangon with limited space for expansion and severe road traffic congestion on surrounding streets. However, whether Mandalay is an optimal location warrants careful scrutiny, and Table 3 is our critical appraisal of this dry port concept. Mandalay is the second largest city in Myanmar, situated 716 kilometres by road from Yangon and located in an arid area. It is an important point for land transport services. Most of the cargoes handled at the city are exports of beans and pulses and imports (primarily agricultural equipment and fertilizers) by land from China (via Muse) and India (via Tamu), some of which are distributed to municipalities in southern Myanmar.

It takes about a week to carry cargoes by water between Yangon and Mandalay, where freight rates are lower than trucking and railway services. The dominant provider of freight services on the inland network of waterways is the Myanmar Inland Water Transport (IWT), a state enterprise of the Ministry of Transportation. In 2011, IWT handled 5 million tons of freight – about 50 per cent more freight than carried by the railways. IWT has approximately 240 powered vessels, many of which are old, with a total capacity of about 70,000 tons. Myanmar has some 5,000 km of navigable waterways, of which about 2,400 km make up the primary inland waterway network, including the Ayeyarwaddy River on which Mandalay is located. The lack of budgetary resources for dredging activities and navigation facilities is a major constraint. Extensive and repeated dredging is required on all river systems, as well as effective navigation and communications facilities. For most locations where IWT provides services, the river ports are little more than landing beaches. Vessels are loaded and unloaded from the beach by means of a simple gangplank. At some locations, specialized cargo-handling facilities are available

for bulk commodities.

With constantly increasing cargo throughput the port of Yangon is facing severe congestion problems at the seaport terminals but also on nearby connecting roads in the city centre. Congestion does not only create delays and frustration but also financial loss for carriers. Implementation of a dry port at a convenient location in Mandalay could solve the seaport's congestion issues and increase the seaport's capacity and consequently productivity so that more container vessels could call at the port. Well functioning distant dry port could significantly improve customer service, in particular regarding lower transport cost, faster delivery and safety of cargo. Today it takes about 24 hours by road to cover a distance of about 700km between Yangon and Mandalay; with well functioning rail it should go much faster and safer. For example, before Isaka Dry Port implementation in Tanzania, it took more than a week to transport and clear containers at the 800km distant Dar es Salam seaport (Roso and Lumsden, 2010); now with the dry port in the system it takes two days. Furthermore, the Mandalay area could benefit from availability of logistics solutions in the area, which usually attracts industries in the area and creates new jobs, consequently supporting regional development. In addition, there is the current and buoyant truck cross-border truck traffic with China (Shibasaki *et al*, 2010:43). However, the role of Mandalay assumes that rail infrastructure is in place and well functioning – a considerable challenge given the current state of the national railway system (Thida Kyu, *et al*, 2013).

The busiest railway route in Myanmar is between Yangon and Mandalay, and in many cases, commodities imported from China (Yunnan) are transshipped to freight cars at Mandalay and forwarded to Yangon. On this route, 40 one-way freight train services (80 round-trip services) are operated every month. One train is made up of 15 freight cars. One freight car weights 32 tons, meaning that one train of 15 cars is as heavy as 480 tons. (JIFFA, 2012: 28). The transit time between the cities is approximately 20 hours. The following challenges facing Myanmar's railway sector; all routes are still unelectrified. As passengers enjoy priority over cargoes, freight trains are not allowed to travel in the morning. For the same reason, it is difficult to develop schedules for cargo services. As such, there is no established freight train schedule. Rails and other facilities are not well maintained. Moreover, it is not easy to buy spare parts and components. Therefore, there is a difficulty in managing and operating the railway system. - Basically, cargo loading and unloading activities at train terminals are performed manually. Furthermore, they are provided so poorly that cargoes are sometimes damaged severely.

Discussion

The Master Plan for ASEAN Connectivity (ASEAN Secretariat, 2010:30) identifies that the key issue and challenge facing the sub-regional connectivity of the Greater Mekong (including Myanmar) is in transforming the transport corridors into economic corridors and ensuring optimal use of the transport infrastructure. The report calls for the establishment of appropriate policy, regulatory, and institutional frameworks. Enhanced physical infrastructure development (physical connectivity), and effective institutions, mechanisms and processes (institutional connectivity) are two of the three-pronged strategies of the Master Plan on ASEAN Connectivity (ASEAN Secretariat, 2011). In addition to physical connectivity, a Roadmap for the Integration of Logistics Services (RILS) was endorsed in August 2008 to strengthen ASEAN as a single market and production base, and enhance its competitiveness through trade and transport facilitation. These include: (a) ASEAN Framework Agreement on the Facilitation of Goods in Transit (AFAGIT), (b) ASEAN Framework Agreement on Multimodal Transport (AFAMT), (c) ASEAN Framework Agreement on the Facilitation of Inter-State Transport (AFAFIST), (d) Roadmap for Integration of Air Travel Sector (RIATS), and (e) Roadmap Towards an Integrated and Competitive Maritime Transport in ASEAN (RICMT).

A report for the United Nations ESCAP has recommended a dry port of area of 8.5 hectares be established near the existing Merchandise Center in Mandalay at a total cost of \$US10.5 million. The report (Ryoo *et al*, n.d.) provides detailed costs of land acquisition, site preparation and utility services, together with the necessary dry port infrastructure, based on unit rates and typical designs on other Asian countries, especially Laos and Thailand. We have presented the criteria for the successful planning and operations in Table 1 are have applied these to the planning of a dry port in Mandalay (Table 3). Whilst there is a strong case for a dry port to complement the port of Yangon there are numerous adverse factors working against Mandalay as a suitable location. Therefore, to bolster Mandalay as a location we recommend that a special economic zone be promulgated around the dry port with the vision of creating a "smart city".

Smart cities – irrespective of whether they are new towns or part of the revitalization of existing cities – must address economic sustainability in addition to social and environmental sustainability. Our previous research has formulated a “triple bottom line” evaluation framework that allows urban planning policies and strategic plans to be compared quantitatively (Doust and Black, 2009). One issue in the economic sustainability of is employment creation especially in new niche industries. The challenges (Black, *et al*, 2012) are employment creation, the necessary internal and external infrastructure required to support the local economy, and effective urban management and planning to deliver an appropriate urban form that could be considered as a “smart city”. The conclusions from this previous research suggest in the case of successful special economic zones with a smart city component the need for the Government of Myanmar to set strategic directions, leading edge urban planning and development controls and a strong private-sector participation in the implementation of a dry port and a special economic zone, including job creation.

Conclusions

The *Master Plan on ASEAN Connectivity* (ASEAN Secretariat, 2011) recognises that the development of international transport corridors should be integrated with spatial economic planning. The Government of Myanmar has nominated Mandalay as a potential location to be included in the UNESCAP Intergovernmental Agreement on dry ports, where a pre-feasibility study has been recently undertaken (Ryoo, *et al*, n.d.). This paper has undertaken a critical appraisal of the Mandalay dry port concept by first examining all of the success factors in planning and operating dry ports based on a review of the international literature (Table 1) and then applying these criteria to the Mandalay case study to make a qualitative assessment of its location as a dry port (Table 3). Given the current poor state of transport and logistics in Myanmar the case for private-sector investment is far from compelling. However, we have argued that integrating a special economic zone with the planning of a dry port will enhance the likelihood of success. Previous research (Black, *et al*, 2012) suggest that successful special economic zones with a smart city component require the Government of Myanmar, when planning a dry port at Mandalay, to set strategic directions, formulate leading edge urban planning and development controls, and to encourage strong private-sector participation in the implementation of infrastructure in both the special economic zone and the dry port.

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DEVELOPMENT OF GREEN SUPPLY CHAIN PERFORMANCE INDICATORS FOR AN ARABICA COFFEE CHAIN

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Abstract

As the public has become more aware of environmental issues, so the green concept has been discussed widely by Thai industry, and in particular the agricultural sector. Green supply chain management can be defined as the integration of environmental thinking into supply-chain management disciplines. The aim of this research was then to develop green supply chain performance indicators for an Arabica coffee chain. The research followed three key steps, these being the study and screening of all relevant factors using an Analytic Hierarchy Process (AHP), the identification of all appropriate assessment indicators and the carrying out of an experiment using the designed assessment process. The first step began with a study of the relevant factors, based on theories and previous research works associated with green supply chains and Arabica coffee supply chains, covering four major groups of factors: green procurement, green manufacturing, green distribution and green logistics. Questionnaires and the AHP were used to screen for those factors actually affecting the performance of the green supply chain from the stockholders' perspectives, and such factors were then employed as indicators within the supply chain assessment process. During the second step, the screened factors were used to develop performance indicators, based on the applied balanced scorecard concept and covering four traditional key areas, these being the financial, customer, internal process, and learning and development perspectives, plus one additional area - the environmental perspective. The results of these steps were then used to design an assessment model. In the final step, the designed assessment model was utilized as part of an experiment covering two of the Arabica coffee chains, in order to compare their performance levels and establish guidelines for improvement, plus create a green supply chain performance assessment manual.

Keywords: Green Supply Chain, Performance Indicator, Balanced Scorecard, Arabica Coffee

Introduction

The Arabica coffee processing industry has been in place in northern Thailand for some time, and has made considerable progress, contributing to the rapid growth of the roasted and fresh coffee industry in the region. Nevertheless, coffee bean production in the area are still inadequate, meaning green coffee beans still have to be imported from neighboring countries in large quantities, and these are of a lower quality, and require additional roasting and distributing in order to satisfy domestic demand (Boonma and Korsamphan, 2010). Moreover, the connections between farmers, processing plant operators, shop owners and consumers are not yet clear, meaning enhanced supply chain management activities are needed in order to link information, finance, knowledge, products and services logistics operations, from the raw materials suppliers through to the consumers, plus to connect production units - whether of products or services - from the raw materials through to the end users, and so enhance the overall effectiveness and competitiveness of the industry. Recently, the government sector and concerned agencies have started to pay more attention to supply chain management issues, including the environmental impacts of the entire chain. The International Coffee Organization (ICO, 2009) has divided activities within the Arabica coffee production chain into 4 main stages, as follows: the agricultural stage, the coffee roasting stage, the additional processing stage, and the transportation and distribution, consumption and waste management stage.

Green supply chain management is a process which integrates environmental thinking into supply-chain management processes, and covers 4 key activities: green procurement, green manufacturing, green distribution and green logistics. The term "Green Procurement" refers to the purchasing of raw materials while taking into consideration the environment, while the term "Green Manufacturing" refers to the creation of a clean and environmentally friendly production process which does not create waste and pollution, and which results in energy and resource savings, plus which uses well-designed processes and appropriate technology. "Green Distribution"; meanwhile, refers to a product distribution process in which environmental impacts are minimized. Lastly, "Reverse logistics" or "Green logistics"

refers to the process of recalling products from end users in order to dispose of or recycle unused or processed materials, so as to reduce waste (Kanchanasuntorn, 2008; Choomrit, 2010).

The researchers of this paper carried out a review of previous research studies associated with supply chain management, and found a number of studies related to the assessment of organizational competency, the measurement of supply chain performance, and the assessment of the effectiveness of organizational management. However, we found little research on green supply chain management issues; most was related to the application of the green supply chain concept in large-scale industries, such as the electronics and automobile sectors. Furthermore, there was little research on the tools used to assess and measure green supply chain performance. Zhang and Zhiwei (2009) discussed the unsuitability of adapting traditional supply chain assessment systems to a green supply chain, due to the differences in factors influencing the green supply chain and also the impact of environmental issues. Also, Xue (2010) found that conventional measures focus on economic performance, such as customer satisfaction, service quality, and costs and benefits. If such factors were adopted for green supply chains, the environmental aspects might not be taken into consideration.

Therefore, the aim of this research was to develop green supply chain performance measurement indicators for an Arabica coffee chain. The study was based on the Balanced Scorecard (BSC) - a tool used to translate strategies into practice and which is known for its clear evaluation criteria, which cover both financial and non-financial areas- plus one additional area, the environmental perspective. (Kang and Juanmei, 2010; Yunning and Rong, 2010; Duarte, Cabrita, and Machad, 2011; Yao and Zhang, 2011). The results of this research may be used to assess the Arabica coffee supply chain and also provide information which may be used to develop its business strategy. The study was conducted among a number of stakeholders working at the Arabica coffee chain in Chiang Mai province, which is located in northern Thailand, and these stakeholders included roasting plant workers, distributors and coffee shop owners, but did not include farmers, processing plant workers or local collectors, as most of these stakeholders live in the highlands.

Green Supply Chain Performance Measurement

A review of previous research studies found that a variety of tools, concepts and principles have been applied to measure the performance of green supply chains. Xue (2010); for example, incorporated the green supply chain concept into the ISO14000 environmental management standards, and developed indicators for assessing green supply chain activities using Data Envelopment Analysis (DEA) - producing green supply chain management decision-making guidelines. Also, Zhang and Zhiwei (2009) proposed the use of the Fuzzy Analytic Hierarchy Process (FAHP) concept in the model development, and the model obtained from this research aimed to accurately measure performance. In addition, a research study conducted by Zongcheng and Ren (2009) took into account both financial and non-financial factors, and developed a green supply chain performance evaluation system comprised of 17 indicators covering 4 key areas, these being: financial conditions, customer service, operational processes and the degree of 'greenness', and which used Unascertained Means Cluster methodology (a combination of unascertained theory and clustering theory) to assess and improve green supply chain performance, as well as assessment reliability.

As well as the tools mentioned above, the BSC is another tool which has been applied extensively to measure green supply chain performance. For example, Duarte, Cabrita, and Machad (2011) conducted a study into the integration of the lean and green supply chain concepts. The lean concept focuses on performance improvements and waste reduction, while the green supply chain concept focuses on waste elimination and a reduction of adverse environmental impacts. Since this supply chain management performance measurement tool takes into account both financial and non-financial factors, the measurement applied can be divided into 4 categories: financials, customers, internal processes, and learning and development.

In addition to the traditional BSC approach, any evaluation of a green supply chain may also adopt the "applied BSC" model, which includes environmental aspects as a fifth category, and can be used with other tools such as the AHP and Benchmarking tools. Its use can be seen in the research conducted by Yao and Zhang (2011), who conducted an assessment of green supply chains by improving the traditional BSC to include environmental aspects, and this resulted in the use of a total of 19 indicators covering 5 categories. Similarly, Kang and Juanmei (2010) developed a green supply chain performance evaluation method, using both the BSC and Fuzzy Theory and taking into account all 5 categories (they added an environmental perspective to the traditional BSC). In this study, an indicator system and an evaluation protocol were developed using Fuzzy theory. Also, Yunning and Rong (2010) conducted a study into the assessment of green supply chain performance in the construction industry, improving the traditional BSC so as to develop an extensive indicator system that generated quantitative results. To do this, they added 2 more elements: supply chain operations

and environmental performance, to the traditional BSC, creating a total of 6 categories to be used alongside Principal Component Analysis - to minimize evaluation problems. Then, the AHP was used to weight the protocol, and the Genetic Algorithm (GA) tool employed for the final solution.

Research Methodology and Results

This research study was conducted using 3 main steps, these being: (1) study and screen those factors significant in the Arabica coffee green supply chain, using the AHP technique, (2) identify the key evaluation indicators, using the screened factors as performance indicators and developing an evaluation model, and (3) test the resulting model, in order to compare performance, and make recommendations for improvement. The details of the research activities and results are as follows:

1. Study and screening of factors significant to the Arabica coffee green supply chain using the AHP technique

This step involved a study into the Arabica coffee supply chain, including gathering key information to develop the most critical factors. A study of the primary factors was carried out covering 4 key phases: green procurement, green manufacturing, green distribution and green logistics, together with 34 secondary factors. The AHP was then used to identify those factors which actually impacted the Arabica coffee green supply chain, and this produced 28 factors of real significance. Details of the research methodology used and the results obtained can be found in Jamigranont and Chompu-inwai (2012). During the research, the key stakeholders stated that the most important activities impacting the performance of the green supply chain are those processes that produce quality products to meet consumer requirements, those which maximize effectiveness and those which minimize waste during the production process.

2. Identification of evaluation indicators for the Arabica coffee green supply chain

Those factors significant to the Arabica coffee green supply chain obtained above were then categorized based on the applied BSC tool using 5 categories, these being:

1) Financials (F) – An indication of whether the business will be able to continue, incorporating 4 sub-factors: raw materials procurement costs (F1), production costs (F2), distribution costs (F3), and waste management costs (F4).

2) Customers (C) – An important indicator for the organization in terms of recognizing customer satisfaction levels. The sub-factor stakeholders gave most importance to here was the number of returned products (C1).

3) Internal Processes (I) – Internal processes refers to the internal business processes which are importance to financial and customer aspects. In this study, the stakeholders placed importance on 13 factors: raw materials quality inspection (I1), supplier reliability (I2), proper raw material storage (I3), chemical substance control during production (I4), waste containment during production (I5), production resource control (I6), water source and water supply system control (I7), production effectiveness (I8), product quality (I9), proper product storage (I10), packaging for distribution (I11), suitability of vehicles employed for distribution (I12), and the suitability of fuel employed during distribution (I13).

4) Learning and Growth (L) -- involves employee learning and development within an organization, activities which both impact upon internal process performance. If employees acquire knowledge and enhance their competency levels through learning, it will result in better performance and eventually lead to higher product quality. In this study, the 5 factors stakeholders placed importance on within this category were employees responsible for production (L1), suitability of production areas and conditions (L2), facility maintenance planning (L3), transport route planning (L4), and transport vehicle maintenance (L5).

5) Environment (E) -- a perspective which supports environmental management within an organization. The 5 factors the stakeholders placed importance on here were: environmentally friendly processing or production carried by suppliers (E1), the selection of reliable transportation service companies – those with sound environmental policies in place (E2), wastewater treatment (E3), the appropriate management of non-conforming products (E4), and waste disposal management (E5).

After this, indicators were identified and a scoring assessment carried out. The scoring assessment was carried out based on Thai Agricultural Standards for Arabica coffee beans (National Bureau of Agriculture Commodity and Food Standards, 2009), the Thai Industrial Standard for Roasted Coffee (Thai Industrial Standards Institute, 1984), environmental management system standard ISO 14000, Good Manufacturing Practice (GMP), a review of previous research ((Udomvechayanunt, 2011; Wichaisri, 2011; Yao and Zhang, 2011; Yunning and Rong, 2010) and also interviews with business operators and coffee experts.

The scoring criteria were developed using Scoring Rubrics and based on Analytic Rubrics, both of which provided a clear definition or description for each level, as follows: 1 = Improvement required, 2 = Below average, 3 = Average, 4 = Good, and 5 = Excellent (Bunnag, 1988). Samples of indicators and descriptions, environmental objectives, assessment methods and scoring criteria used in this study, based on BSC categories are shown in Table 1.

3. Experiment using the design assessment process

The model developed to assess the green supply chain performance of the Arabica coffee chain was then used. The results show that the designed framework may be used to effectively evaluate a range of organizational types, in order to compare the performance of those with similar characteristics. From Figure 1, for instance, a comparison of Distributor B1 and Distributor B2, or of Coffee shop C1, Coffee shop C2 and Coffee shop C3 may be carried out. Nevertheless, the proposed indicators and evaluation methods may be more suitable for carrying out a comparison of coffee roasting plants than distributors and shops, as some indicators are inconsistent with the activities of such organizations.

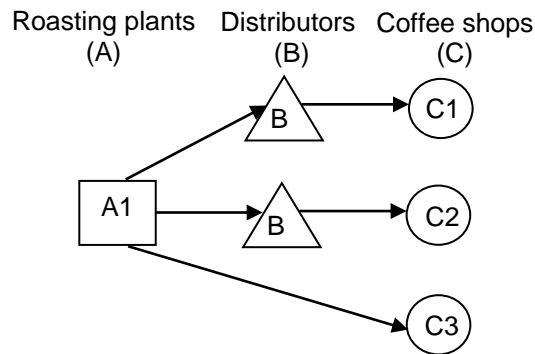


Figure 1: Example of Arabica coffee supply chains

After each indicator was used to assess the study organization’s supply chain, a spider chart was developed in order to compare performance between operators, as shown in Figure 2, which shows the results of a comparison between Distributor B1 and Distributor B2, and where Distributor B2 shows the better overall performance. However, both distributors need to improve their financial processes. As for production costs, both distributors returned “below average” evaluation scores and should seek ways to reduce costs. In terms of internal processes, Distributor B1 needs to improve its production process waste containment activities and also the suitability of the vehicles its uses for distribution, while Distributor B2 needs to improve its production process waste containment activities. For the environmental aspects, Distributor B1 needs to focus more on the selection of reliable transportation service companies; those with appropriate environmental policies in place. Carry outing an evaluation both before and after improvements are strongly recommended.

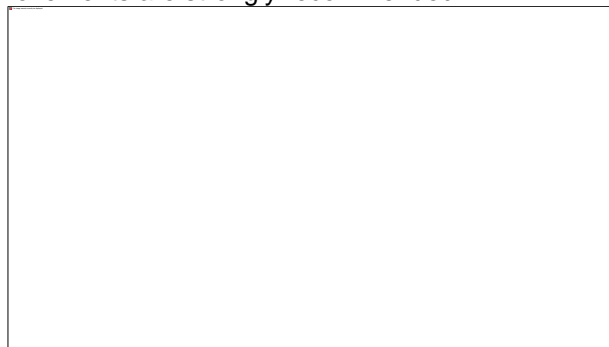


Figure 2: Performance comparison (for each indicator) between Distributor B1 and Distributor B2

Indicator and Description	Environmental Objectives	Assessment Method	Scoring Criteria
Financials			
F2 Production costs (<i>Unit: Percent</i>) refers to costs incurred when producing products, such as direct materials costs, direct labor costs and other indirect manufacturing costs such as rent, property insurance and electricity etc.	To realize lower productive resource utilization costs; the fewer resources are utilized, the less the production costs and environmental impacts will be.	$\frac{\text{Production cost}}{\text{Total operating costs}} \times 100$	1 > 90% 2 = 71 – 90% 3 = 51 – 70% 4 = 31 – 50% 5 < 31%
Customers			
C1 The number of returned products (<i>Unit: Percent</i>) refers to the number of products that do not meet customer requirements, or are damaged during transportation.	To decrease the number of non-conforming products; remove the need for product disposal processes to be in place	$\frac{\text{Number of products returned}}{\text{Total number of products delivered}} \times 100$	1 > 90% 2 = 71 – 90% 3 = 51 – 70% 4 = 31 – 50% 5 < 31%
Internal Processes			
I5 Waste containment during production (<i>Unit: Percent</i>) refers to the control of waste during production, such as dust, smoke and other waste items (shells, tissues, residues, etc.) prior to disposal within the environment.	To minimize waste prior to disposal within the environment	1 = No control of waste prior to disposal 2 = Waste quantity control in place, using a proper collection and disposal method 3 = Existence of waste management through the re-use of dust, shells, tissues and other residues - as fertilizers or planting materials 4 = Existence of waste quantity control through waste reduction, e.g. the installation of smoke/dust exhaust devices 5 = Existence of waste quantity control through innovations or new technologies to prevent wastes	Scoring 1 – 5 as specified
I9 Quality of produced coffee (<i>Unit: Percent</i>) refers to quality control during the production management process; to meet customer requirements in relation to moisture content, roasting, color, aroma and taste.	To minimize the number of non-conforming products - those not in accordance with customer specifications - and to minimize the need for an elimination process regarding such products	$\frac{\text{Total number of products} - \text{Number of non-conforming products}}{\text{Total number of products}} \times 100$	1 < 31% 2 = 31 – 50% 3 = 51 – 70% 4 = 71 – 90% 5 > 90%

Table 1: Samples of indicators and descriptions, environmental objectives, assessment methods and scoring criteria used in this study, based on BSC categories (*continued*).

Indicator and Description	Environmental Objectives	Assessment Method	Scoring Criteria
Learning and Growth			
L1 Employees responsible for production (<i>Unit: Percent</i>), refers to employee training on duties and responsibilities; enabling employees to give reasons why they need to comply with the regulations and cautions in place. The aim is to raise environmental awareness.	To decrease the number of non-conforming products made due to employees' lack of knowledge. To eliminate the production of non-conforming products by untrained employees during the production process. To raise environmental awareness	1 = Employees' lack of knowledge of production processes 2 = Existence of policies on employee training on production and the environment, but a lack of support from management 3 = Existence of employee training on production and the environment, with training carried out on a periodic basis in order to put knowledge into practice 4 = Existence of employee training on production and the environment, with regular training carried out to put knowledge into practice 5 = Existence of employee training on production and environment, with regular training carried out to put knowledge into practice, plus employees given regular knowledge tests.	Scoring 1 – 5 as specified
Environment			
E4 Proper management of non-conforming products (<i>Unit: Percent</i>) refers to the appropriate, environmentally-friendly management of non-conforming products	To be able to manage non-conforming products and prevent adverse environmental impacts	1 = No proper management of non-conforming products in place 2 = Plans for the management of non-conforming products in place, but not yet put into practice 3 = Existence of identification and sorting processes for non-conforming products 4 = Existence of identification, sorting and elimination processes for non-conforming products 5 = Existence of identification, sorting and recycling processes for non-conforming products; to create added value	Scoring 1 – 5 as specified

Table 1: Samples of indicators and descriptions, environmental objectives, assessment methods and scoring criteria used in this study, based on BSC categories (*continued*).

In addition, the designed model was also used to carry out a comparison of two Arabica coffee supply chains. Figure 1; for example, shows a comparison between two Arabica coffee supply chains, in which the first supply chain consists of a Roasting plant (A1), a Distributor (B1) and a Coffee shop (C1), and the second supply chain consists of a Roasting plant (A1) and a Coffee shop (C3) only, as there is direct product delivery from the plant to the shop. The designed evaluation framework was used by utilizing those indicators which applied to each business unit. In the second supply chain; for example, the roasting plant distributes products to the shop itself, so the indicators referring to the distributor (shown separately in the evaluation of the first chain) were used to assess the performance of the roasting plant. The results of this assessment are shown in Table 2.

Indicator	Assessment Results for the 1 st Supply Chain							Assessment Results for the 2 nd Supply Chain				
	A1		B1		C1		Score	A1		C3		Score
	%	Score	%	Score	%	Score		%	Score	%	Score	
F1	20	5					5	20	5			5
F2	90	1					1	90	1			1
F3			20	5			5	20	5			5
F4					0.1	5	5			0.17	5	5
C1	2	5					5	2	5			5
I1		4					4		4			4
I2	95	5					5	95	5			5
I3		5					5		5			5
I4		4					4		4			4
I5		2					2		2			2
I6		4					4		4			4
I7						3	3				4	4
I8	72	4					4	72	4			4
I9	95	5					5	95	5			5
I10				4			4		5			5
I11				3			3		3			3
I12				2			2		2			2
I13				4			4		4			4
L1		5					5		5			5
L2		3					3		3			3
L3		4					4		4			4
L4				3			3		4			4
L5				3			3		4			4
E1		3					3		3			3
E2			35	2			2		3			3
E3						2	2				2	2
E4		5					5		5			5
E5						2	2				2	2
Avg.							3.64					3.82

Table 2: Comparative performance of two Arabica coffee supply chains

According to the research results, the first and second supply chains had an average assessment score of 3.64 and 3.82 respectively, showing that the second supply chain has a slightly better performance in terms of the management of its green supply chain.

Conclusion and Discussion

In this study, the researchers developed indicators to assess the performance of the Arabica coffee green supply chain, using the BSC concept with its original 4 categories changed to 5 – an environment category being added, and through a use of both quantitative and qualitative evaluation techniques. The indicators developed here differ from those used in other industries, such as electronics (Wichaisri, 2011) and automobile sectors (Udomvechayanunt, 2011), due to the varying nature of each industry. Arabica coffee is an agricultural product within the food sector, and so most indicators used are associated with safety during production, such as chemical substance control, the suitability of production facilities, waste management/waste containment, the proper storage of raw

materials, and stock handling using a First in First out (FIFO) process. The quality control of raw materials and products in the Arabica coffee industry is conducted using, not only physical and chemical tests such as a moisture content analysis, but also using sensory and hygiene tests. In contrast, most indicators used for industries such as; for example, electronics and automobiles, focus on internal supply chain management processes, together with environmental management aspects such as lead times, machine readiness, downtime due to breakdowns, inventory management, product quality, and unused raw materials recycling (Udomvechayanunt, 2011; Wichaisri, 2011).

In addition, when evaluating the performance of an Arabica coffee green supply chain in the future, monitoring should be conducted regularly, including a periodic comparison of performance across business units or supply chains - such as monthly or annually, so as to provide enough information on green supply chain performance to the organization and its management team.

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DYNAMIC FACILITY LOCATION PROBLEM FOR MAE MOH MINE

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1. Introduction

Electricity Generating Authority of Thailand was significant electricity generation to meet consumer requirements and sustain Mae Moh Mine business competition. Mining operation in EGAT Mae Moh was divided by two main categories which were mine haulage system and mining logistics supporting system. The mining logistics support system was integrated system about planning, operating and control to deliver resources to many centroids of mining machines in mine haulage system to meet some requirements. The mining operation in EGAT Mae Moh was shown in figure 1.

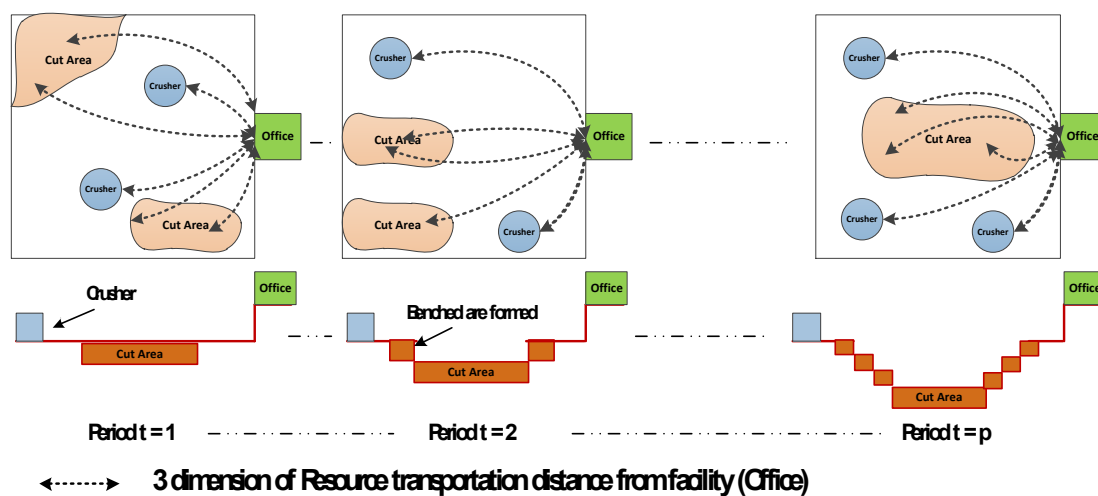


Figure 1: The traditional logistics support system efficiency was decreased because of increased line haul distance (EGAT, 2012).

Transportation activity was 1 of 7 wastes (Muda) in lean management (Rother & Shook, 1999; Bennet & Sutherland, 2007) so the logistics support system was significant this activity from facility. The facility was maintenance office that consisted sub divisions and departments were complex and multiple functions to haul resources such as maintenance, fuel delivery, electricity installation, mine surveying and others from monthly and daily planning of headquarter of EGAT. The current location of facility impacted the efficiency of logistics support system that the line haul distance was increased every mining period later because the centroid of mining machines was often moved to the deep of pit mine for productivity of mine haulage system. From the previous reason, the current logistics support system efficiency was decreased in the future that was shown figure 2. EGAT Mae Moh realized that the maintenance office should be relocated to pit mine but they had questions that “when do they start to relocate maintenance office station to pit mine and where do they install station to minimize total logistics cost since 2013-2047”. Similar ideas for minimization of total logistics cost in open pit mine context that was crusher location optimization (Chukit Luangjok, 2002; Konak, et al., 2007) so the concept of this optimization was select optimal location of crusher for minimization of truck haulage cost and removing/ installing cost of crusher with many constraints such as quantity of coal per area, geography, available site location and number of removing/ installing limitation. However, the research of direct facility location problem for maintenance was less to know. Hence this paper focused on optimization of selecting the mobile in-pit station that was one facility on the open pit mine line haul network all periods. A mathematical model was developed using multi period facility location problem (Wesolowsky, 1973; Wesolowsky & Truscott, 1975) so this problem was NP-Hard (Batta et al., 2003; Lim & Sonmez, 2012). This model dealt with the trade-offs between both transportation and facility costs at mobile in-pit station and aims to minimize the total of these two logistics costs. Within this

model, it determined location of candidate sites of maintenance mobile in-pit station all periods with many constraints such as open pit mine geography changing (distance, number of candidate sites and centroid of mining machines were changed), fleet management policy (hauling frequency and type of truck) and constant number of mining machines all periods. Therefore the model applied metaheuristic as a solution procedure to obtain an approximate optimal solution.

We scoped Mae Moh Mine’s pit mines in yearly plan since 2012-2047 and had only one mobile in-pit station for consideration. We did not use plan to trial and evaluate real problem for outcome.

2. Literature Review

2.1 Improving efficiency mining operations.

Many researches of mining operations efficiency improvement were based on the mine-haulage system which included truck-shovel dispatching system (Alarie, et al., 2002; Bissiri, 2002; Ercelebi, et al., 2009; Limsiri, 2011), crusher location optimization (Chukit Luangjok, 2002; Konak, et al., 2007), blending and mix mine (Erarslan, et al., 2001; Liu, 2008), productivity improvement of conveyor (Theerapol Poolthawee, 2006) and mine production scheduling (Newman, et al., 2006; Rafiee, et al., 2008) while mining logistics support systems efficiency improvement such as minimization of total transportation cost that was fewer people to know.

2.2 Facility location problem in open pit mine

In this paper presented the planning of mining logistics support systems efficiency improvement by using applied facility location problem (FLP) approach. However, the research of facility location problem in open pit mine was fewer people to know. We found the FLP in this environment which were research of Chukij Luangjok (2002) that applied crusher location optimization in Mae Moh Mine for improving mine haulage system efficiency so the constraints included quality and quantity of mine in each workspace, the deep workspace was increased by mine production plan, and the number of allowed crusher relocation per year. Konak, et al., (2007) studied in-pit crusher location optimization in Turkey for reducing the haulage cost of truck so they considered haulage distance with difference height of benches in pit mine environment. However, the other facility was the mining logistics supporter included maintenance department that fewer person to know.

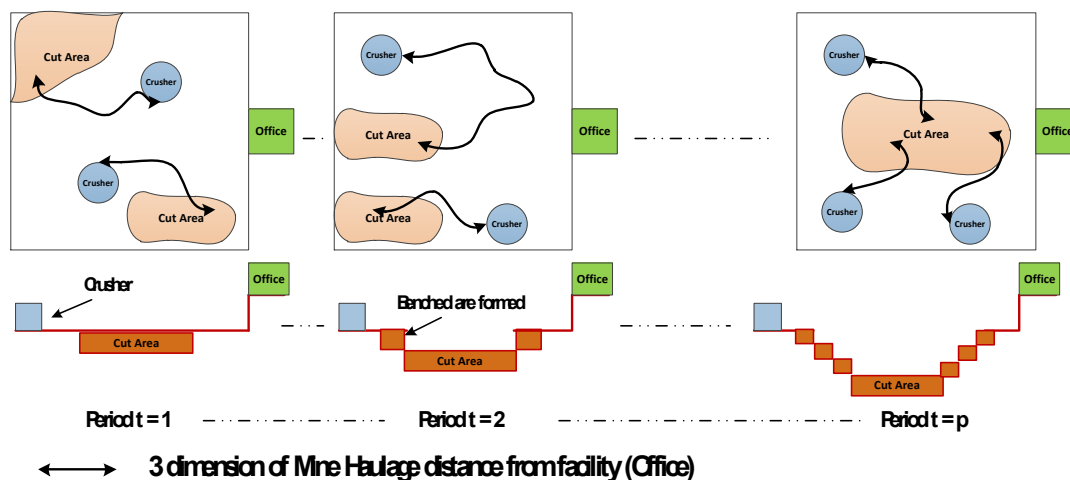


Figure 2: Model of transportation problem of r em so supporter from office was not related to improve mine operation system

2.3 Dynamic Facility Location Problems

Daskin et al. (1992) described definition of the dynamic facility location problems (DFLPs) that “the objective of dynamic facility location planning should be to find an optimal or near optimal first period decision for the location problem over an infinitely long planning horizon”. Farahani and Arabani (2012) reviewed the number of dynamic facility location problems literatures that there were two main criteria affecting the decision to identify the right location for a facility: (1) cost for which a trade-off must be set between expenditures incurred by developing a new facility or revising the current facility and profits supposed to be acquired as a result of such development. (2) time for which the opening and closing of facilities are considered over the planning horizon. Furthermore, from another point of view, dynamic models can be divided into two sub-categories: (1) explicitly dynamic models in which

facilities are opened/closed at pre-specified times and locations and (2) facilities are supposed to be opened and remained open throughout the planning horizon at the beginning of the horizon (implicitly dynamic models). Although dynamic facility might cover a wide variety of conditions, looking at different areas of FLPs, one might arrive at different notions of what dynamic means, for example, dynamic models that might have interaction with multi-period models or time dependent (Farahani and Arabani, 2012) consist of

2.3.1 Dynamic deterministic facility location problem (DDFLPs)

From primary static models, facility location models should be chosen from set of candidate points. However, there might be some circumstances in which effective parameters (e.g. population, demand patterns, distribution cost, etc.) are being changed or modified over time. In fact, the mentioned static model can be modified to dynamic deterministic model in which p time periods are considered, an optimal location is identified such as the dynamic uncapacitated fixed charge location problem or dynamic facility location (Wesolowsky, 1973; Daskin et al., 1992) and dynamic single facility location problem (Puerto & Rodriguez-Chia, 2006)

2.3.2 Facility location-relocation problem (FLRPs)

From general point view, the relocation of facility is primarily concerned with the time of relocation, the number of relocation, and the cost of relocation. A decision-maker might come up with the following concerns in the relocation problem: in order to minimize cost, when and where to relocate? How to gradually phase-out the existing facility without violating firm's activities? What is the time schedule for relocating capacity? And how cost minimization can be compensated by reducing transit times? The emergency medical services applied this concept to ensure satisfactory response time to incidents (Alanis et al., 2013) and the ambulance deployment problem (Harewood, 2002).

2.3.3 Multi period facility location problems (MPFLPs)

The decision makers should think robust FLPs to operate in terms of multi-period time horizon such a planning horizon can be obtained: (1) the appropriate timing of location decision, (2) clarifying the best location(s), and (3) allowing a firm to better anticipate any favorable/unfavorable fluctuations in market demand in the corresponding time horizon such as paper of dynamic or multi-period location-allocation model (Wesolowsky & Truscott, 1975), multi-period incremental service facility location problem (Alberada-Sambola et al., 2009), and dynamic distribution model for combat logistics was also dynamic facility location problem (Gue, 2003).

2.3.4 Time-dependent facility location problems (TDFLPs)

Such as hospitals, traffic station and fire station are supposed to be operable at any specific time (according to the availability of locations and the corresponding demand). Farahani et al.(2009) presented single facility location problem with multiple relocation opportunity for new police station.

The facility location problem was NP-Complete problem that solved problem in large environment so the feasible solution was immense. Owen & Daskin (1998), Cheung, et al., (2002) and Wong, et al., (2010) presented the feasible solution estimation of static facility location problem of integer programming problem techniques for P-Median problem below as

Which,

n = the number of available location for facility

r = the number of facility need to be assignment

$$\text{Feasible Region} = \frac{n!}{r!(n-r)!} \text{ feasible solutions for static facility location problem}$$

From Eq. (1) if the number of available location for facility was many, it was large and complex to rapidly search optimal solution when number of available location and facility was many. Hence, the dynamic facility location problems is more complex than static problems for enumeration feasible solutions that dynamic problems is NP-Hard (Batta et al., 2003; Lim & Sonmez, 2012). Metaheuristic is applied to solve NP-Hard problem for rapid and easy optimal solution searching (Mawdesley, et al., 2002; Zouein, et al., 2002; Elbeltagi, et al., 2004; Pitakaso, 2011).

2.3 Metaheuristic

Pitakaso (2011) described heuristic which was independent methodology that established any processes or procedures to apply to search solution. Blum and Roli (2003) summarized metaheuristic principles below as

- Metaheuristic are strategies that “guide” the search process.
- The goal is to efficiently explore the search space in order to find (near-) optimal solutions.
- Techniques which constitute metaheuristic algorithms range from simple local search procedures to complex learning processes.
- Metaheuristic algorithms are approximate and usually non-deterministic.

From literature were reviewed, we applied to integrate the facility location problem using by spreadsheet modeling concept and search near-optimal solution with metaheuristic optimization for improving logistics support systems efficiency in open pit mine environment. The detail was described in sector 3 model.

3. Model

The model described here aimed to identify the optimal location of single maintenance in-pit station. Figure 3 show the structure of mining logistics support system that was investigated within this paper. It was assumed that the movement of resources was resource transportation with fleet of supporter departments on open pit mine streets that went deep pit mine. Sometimes resources may be stored at facility, but no inventory and no soil stability of candidate sites were considered in this study. Points where fleet was generated by supporter department policies and was set for resource delivery within open pit mine streets all periods. These points were referred to as centroids of mining operation so they were changed position to locate at deep area by mining plan.

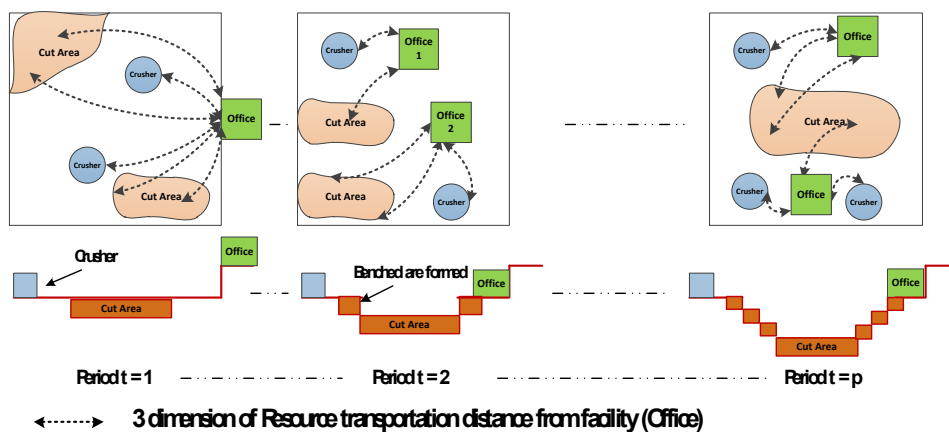


Figure 3: Facility location optimization structure of logistics support system for mine operation.

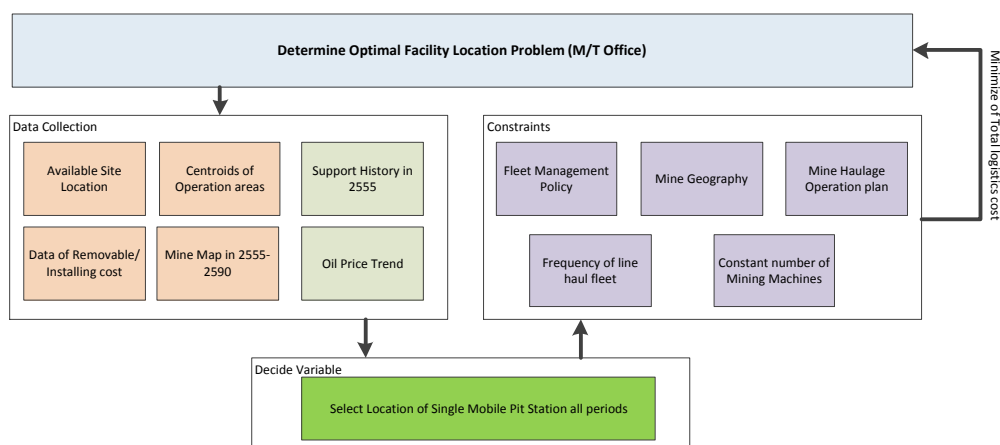


Figure 4: Structure of mathematical modeling of logistics support system in open pit mine context. Figure 4 indicated the structure of a mathematical model that described the behavior of the planner for minimizing the total logistics cost, which consisted of both resource transportation costs and facility costs. The mathematical formulation of the model (Wesolowsky & Truscott, 1975) was given below.

The following symbols are defined:

M	Set of all possible located positions of facility so $i \in m$.
N	Set of all centroids of mine operation so $j \in n$.
P	Set of yearly logistics support system plans so $t \in p$
A_{ijt}	Resource transportation cost from facility was located i to centroid j in period t
R_{it}	Removing cost of facility was located i in period t
O_{it}	Installing cost of facility was located i in period t
N_t	Number of centroids of mine operation in period t
x_{ijt}	Decision variable detailed that facility was located i service centroid j in period t
y_{jt}	Decision variable detailed that facility was removed from i in period t
z_{it}	Decision variable detailed that facility was installed at i in period t
u_{it}	Decision variable detailed that facility was exist at i in period t

Decision variable

$x_{ijt} =$	$\left\{ \begin{array}{l} 1, \text{ if facility was located } i \text{ serviced centroid } j \text{ in} \\ 1, \text{ if facility was removed from } i \text{ in period } t \\ 1, \text{ if facility was installed at } i \text{ in period } t \\ 1, \text{ if facility was existed at } i \text{ in period } t \end{array} \right.$
$y_{it} =$	
$z_{it} =$	
$u_{it} =$	

The objective function in this paper was determination the optimal location of single mobile in-pit station from candidate sites so it was trade-offs between resource transportation costs and facility cost all periods continuously.

Objective Function

$$\text{Min } Z = \sum_{i=1}^m \sum_{j=1}^n \sum_{t=1}^p A_{ijt} x_{ijt} + \sum_{i=1}^m \sum_{t=2}^p (R_{it} \cdot y_{it} + O_{it} \cdot z_{it}) \quad (1)$$

Subject to

Eq. (2) was constraint that identified each centroid of mine operation j must be serviced by facility was located i in period t only 1 site of facility.

$$\sum_{i=1}^m x_{ijt} = 1, \quad \{\forall j, t\} \quad (2)$$

Eq. (3) was constraint that identified facility was located at i must service all N centroids of mine operation with this single facility was existed at i in period t .

$$\sum_{j=1}^n x_{ijt} = N_t u_{it}, \quad \{\forall i, t\} \quad (3)$$

Eq. (4) was constraint that identified facility was existed at i in period t (no removing) so it was only one site of facility in period t .

$$\sum_{i=1}^m u_{it} = 1, \quad \{\forall t\} \quad (4)$$

Eq. (5) was constraint that identified facility was the maximum number of facility location changes allowed no more than 1 facility in period $t = 2, 3, \dots, p$

$$\sum_{i=1}^m y_{it} \leq 1, \quad \{t = 2, 3, \dots, p\} \quad (5)$$

Eq. (6) was constraint that identified facility was existed i in the period $t-1$ but not period t , the removing status at point i was investigated. In the other hand, facility was existed i in the period t but not period $t-1$, the installing status at point i was investigated.

$$u_{it} - u_{i,t-1} + y_{it} - z_{it} = 0, \quad \{\forall i; t = 2, 3, \dots, p\} \quad (6)$$

Eq. (7)-(10) was constraint that identified decision variables were binary variable.

$$x_{ij}^t \in \{0,1\} \quad \{\forall i, j, t\} \quad (7)$$

$$y_j^t \in \{0,1\} \quad \{\forall j, t\} \quad (8)$$

$$z_j^t \in \{0,1\} \quad \{\forall j, t\} \quad (9)$$

$$u_j^t \in \{0,1\} \quad \{\forall j, t\} \quad (10)$$

4. Application to an actual logistics support system

The model in Figure 3 and 4 were applied to an actual logistics support system in Mae Moh Mine. For maintenance mobile in-pit station were specified along with several logistics support plans. The current location of facility for maintenance department was analyzed anby fuel consumption and support activities history that they were multiplied to logistics cost per years. The current system was evaluated logistics cost approximately 29,983,644 Baht for the serie years since 2012-2047. From the previous reason, the initial cost should be improved by strategic planning tools for reducing transportation activities so it was one of waste in lean management principle that was applied dynamic facility location problems.

The number of space solutions was very large to search the best solutions within short time because of $\left(\frac{22!}{2!(22-2)!}\right)^7 \times 22^9$ solutions that was exploding growth rate of time complexity function exact algorithm when problem size was increased. Hence, the metaheuristic was applied to search nearly optimal solution for time complexity function algorithm reduction so we applied genetic algorithm approach with finished software which added on spreadsheet modeling in Microsoft Excel. We set genetic operator for search optimal solution included;

- Crossover rate = 0.7,
- Mutation rate = 0.005,
- Population size = 184 (2 times of number real available site in series 16 yearly plans)
- Number of trials = 200,000

From the current value was 29,983,644 Baht to finised at 28,820,984 Baht or 3.87% reducing total logistics cost for solution 1 and 29,101,147 Baht or 2.94% reducing total logistics cost for solution 2. Figure 5 indicated the optimal solution of selected stations that compared the costs current solution and other solution. The comparison denoted that cost incurred that relocation of maintenance office had a relatively resonable difference in each solution, the resource transportation cost had a great differences. This implied that facility relocation greatly affected the optimal solution although this approach must trade-offs facility costs.

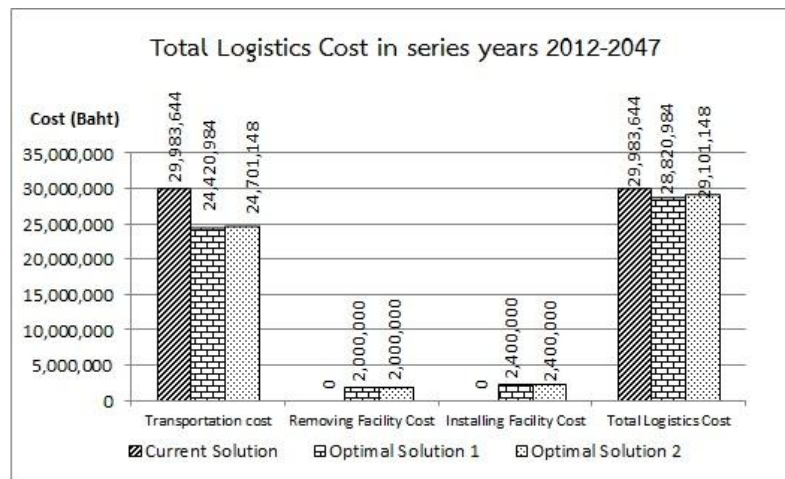


Figure 5 Comparison of costs for optimal and other solutions.

6. Conclusion

The logistics support system in open pit mine with maintenance mobile in-pit station optimization was special problem that less person knew about this context. From we reviewed improving efficiency mining operations and FLP approaches, we found less researches about direct logistics support systems efficiency because only crusher location optimization was FLPs in open pit mine context. Wesolowsky (1973) concluded that dynamic facility location was NP-Hard whereas static facility location was linear programming model. Hence, we applied multi periods facility location problems (MPFLPs) of Wesolowsky and Truscott (1975) which one of categories of dynamic facility location problem to develop mathematical modeling to adopt actual logistics support systems which selected location of maintenance mobile in-pit station in open pit mine for minimization of total logistics cost. The spreadsheet modeling was applied by mathematical modeling and search optimal solution by metaheuristic because $\left(\frac{22!}{2!(22-2)!}\right)^7 \times 22^9$ solutions that was exploding growth rate of time complexity function exact algorithm when input problem size was increased so it was NP-Hard problem. This research methodology could save planner time and work plans.

The result of current mining logistics support system evaluation since year 2012-2047 was 29,983,644 Baht of total cost. The improving result searched optimal solution from 880,510,464,000 feasible solutions that optimal solution's total operation cost was 14,682,9343 Baht so it can save cost 51.03%. We established strategic planning model to improve logistics support system efficiency with dynamic facility location problem for innovation and knowledge of logistics support system.

7. Future Research

In this study scoped only dynamic facility location-allocation problems to make decision planning with metaheuristic. In the future, we will compare efficiency between exact algorithms and metaheuristic. Finally we will use optimal plan to evaluate real situation for improving efficiency of logistics support systems in Mae Moh Mine.

8. Acknowledgement

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FACTORS EFFECTING DECISION MAKING ON ELECTRONICS INDUSTRY SUPPLY CHAIN REDESIGN WITHIN ASEAN ECONOMIC COMMUNITY

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Abstract

Upon the ASEAN Economic Community where labor, material, investment can freely flow within ASEAN countries, supply chain will be redesigned. Of interest is the electronic industry which is one of the key production industries of ASEAN countries. The research, developing model and questionnaire, focusing on identifying key factors that affect the decision making should the supply chain redesign. Further investigation is also conducted to reflect the industry supply chain redesign in terms of low-end and high-end perspectives. For both high-end and low-end electronic industries, labor, material and government are among the most significant factors. In low-end case, infrastructure is also of interest.

1. Introduction

ASEAN or Association of South East Asia Nations is the collaboration of Brunei Darussalam, the Kingdom of Cambodia, the Republic of Indonesia, the Lao People's Democratic Republic, Malaysia, the Union of Myanmar, the Republic of the Philippines, the Republic of Singapore, the Kingdom of Thailand and the Socialist Republic of Viet Nam (see Figure 1). With the goals of stable, prosperous, and highly competitive region with equitable economic development, and reduced poverty and socio-economic disparities, ASEAN countries agreed to establish ASEAN Economic Community (AEC) to jointly realise the end goal of economic integration by deepening and broadening economic integration through existing and new initiatives. [1]



Figure 1: ASEAN Countries

The AEC envisages the key characteristics as a single market and production base which comprise of 5 core elements as (i) free flow of goods; (ii) free flow of services; (iii) free flow of investment; (iv) free flow of capital; and (v) free flow of skilled labour. [1]

This collaboration is based on the plentiful resource, to potentially support any economic development per AEC goals. Table 1 summarise some key economic data of 10 ASEAN countries. It can be seen that the total of the population is nearly 600 million, accounting of 8.6% of global population. However, the GDP per capita of ASEAN is very low in comparison to global average (approximately 1/3 of the average). Yet, the GDP is growing very quickly at 5.8%, whilst global GDP growth is only at 3-4%.

Moreover, ASEAN countries mostly rely export, where more than 56% of ASEAN GDP is based on export.

Country	Population (in million)	GDP (billion USD)	GDP Growth (%)	GDP per capita (USD)	Export (billion USD)
Indonesia	242.3	846.7	6.5	3,511	203.6
Thailand	69.5	346.1	4	5,117	226.4
Malaysia	28.9	288.1	5.1	9,949	227.1
Singapore	5.2	260	4.9	46,241	409.5
Philippines	94.9	224.8	3.9	2,346	48.3
Viet Nam	88.8	123.6	5.9	1,375	96.9
Myanmar	48.3	51.9	10.4	857	0.1
Brunei	0.4	16.4	2.2	38,715	12.4
Cambodia	14.3	12.9	6.9	909	5.3
Lao	6.3	8.1	8	1,281	1.9
Total/ Average*	599	2,179	5.8*	3,638	1,231

Table 1: Key Economic Data of ASEAN Countries

Source: [2]

2. Electronic Industry in Thailand and ASEAN

2.1 Electronic Industry in Thailand

Electronic industry is one of Thailand key industries. Thailand has exported electronic components and parts, including electric appliances more than 2,507.32 billion THB (approx. 83 billion USD), by which 17% is exported to China, 17% to EU, 16% to USA, 15% to ASEAN and 12% to Japan. This figures accounted for more than 30% of Thailand's export revenues in each year. [3] Main exports are hard disk drives (HDD) and integrated circuits (IC), accounting for more than 75% of total electronic exports

In the past 10 years, world-class/ multinational manufacturers are the main players in this sector, including Fujitsu from Japan, Seagate from the USA, Philips Electronics from the Netherlands, and LG Electronics from Korea and many more. The industry involves hiring of more than 370,000 skilled people in several hundred factories across Thailand. [4]

2.2 Electronic Industry in ASEAN

Apart from Thailand, Malaysia and Singapore are playing an important role in global electronic economics (see Table 2). Moreover, Viet Nam', Indonesia' and the Philippines' electronic industry are also growing very quick for the past few years. [4]

Country	Electronic Export (million USD)
Malaysia	273,598,875
Singapore	91,526,468
Viet Nam	8,798,457
Indonesia	5,813,936
Philippines	14,444,865
Myanmar	271,398
Lao	645,941
Cambodia	44,092
Brunei	3,852

Table 2: Export Figures of Electronic Industry of ASEAN

Source: [4]

Therefore, in this study, the data collection will conduct on Thailand, Malaysia, Singapore, Indonesia, the Philippines and Viet Nam as the main player of electronic industry of ASEAN. Table 3 summarise key impact to economy and main products of these countries.

<i>Country</i>	<i>Impact to Economy</i>	<i>Main Products</i>
The Philippines	2/3 of total export and increasing 40,000 engineers 3/4 of companies are foreign owned 1/3 exports to US and EU and 2/3 to Japan, China and other parts of Asia	semiconductor manufacturing services, electronics manufacturing services
Malaysia	57% of total export	semiconductor, room air- conditioners, telecommunications equipment, computers, computer peripherals
Singapore	40 semiconductor companies and 160 supporting organizations operating at all levels of the value chain	wafer fabrication, semiconductor, production equipment and material
Thailand	24% of total export and increasing	data processing
Indonesia	N/A	N/A
Viet Nam	N/A	transformers, printers, computer and mobile telephone parts, circuit boards

Table 3: Key Characteristics of Electronic Industry in ASEAN Countries

Source: [5]

2.3 Industry Classification

The study classify electronic industry into 2 class, i.e., high-end and low-end. Where high-end electronic industry are mostly the finished product or main components for assembly, low-end are generally parts, components or basic/principle material. It is understood that low-end products involve with labor intensive activity and mostly low technology machine and process. Oppositely, high-end products are mostly machine-based or high-technology. Within the data collection 36% of industry surveyed are high-end, the rest are low-end. Whilst the nature of both class are different, the decision making shall be so.

3. Model Development on Key Factors Affecting Decision Making in Electronic Industry

3.1 Model Development

Of interest are the key factors affecting decision making in electronic industry. Such decision making is whatif the industry shall expand their business, relocate, resize, recruit and reorganize. Here, the term "Supply Chain Redesign" is used in the research question. Therefore, the model is developed to address those factors. Per literature, this case of supply chain redesign can be established based on the problem of site relocation or selection and related topics. [6][7][8][9]

Here, the factors related to the redesign are grouped and constructed of 8 main factors, i.e., (1) labor, (2) supply, (3) logistics, (4) economics, (5) government, (6) infrastructure, (7) risk, and (8) location. Moreover, each main factor are described and constructed by sub-factors, in total of 58 sub-factors. Figure 4 summarise the model.

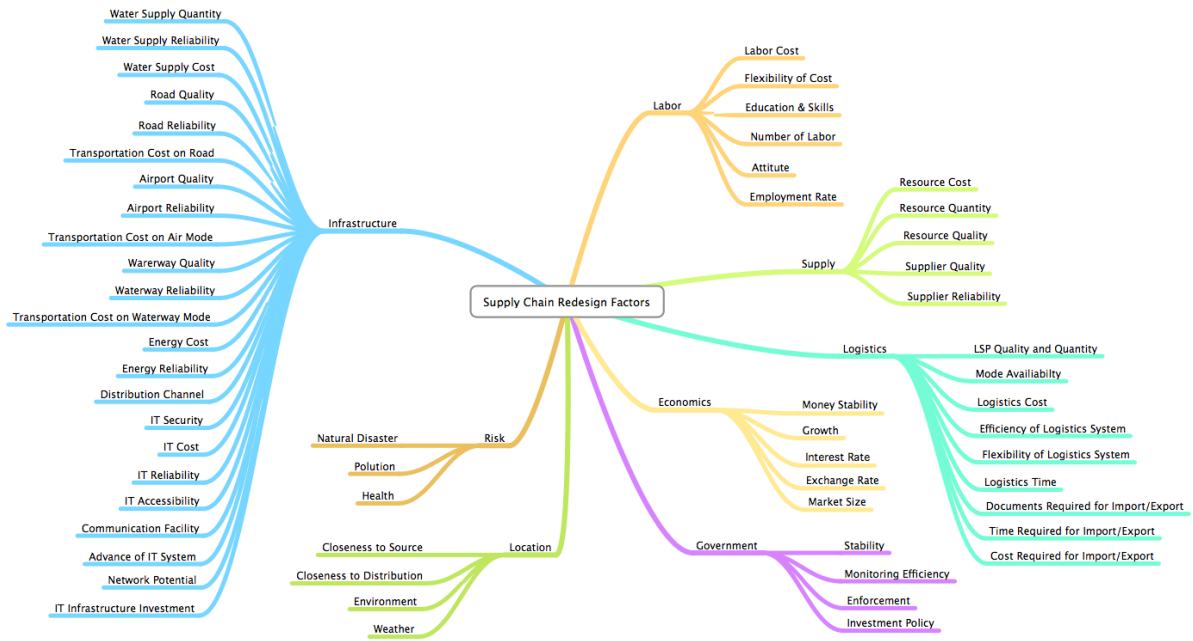


Figure 4: Supply Chain Redesign Model

3.2 Questionnaire Development and Distribution

The questionnaire is developed on top of the model described earlier. Here, to simplify the understanding of the questionnaire answerer, 8 main factors are asked to be ranked by their importance and 58 sub-factors are to be scaled, 1-5. Then to calculate the significance of each factor and sub-factor, weight-form rank is used. Therefore, only few sub-factors will be identify as the key sub-factors.

It shall be noted that there is a limited resource of the research. Therefore, only 88 questionnaires were returned and the distribution is mostly concentrate to Thailand (which is the main interest of the research). The return rate and acceptance rate are less than 10%. Figure 5 summarise the distribution of returned survey.

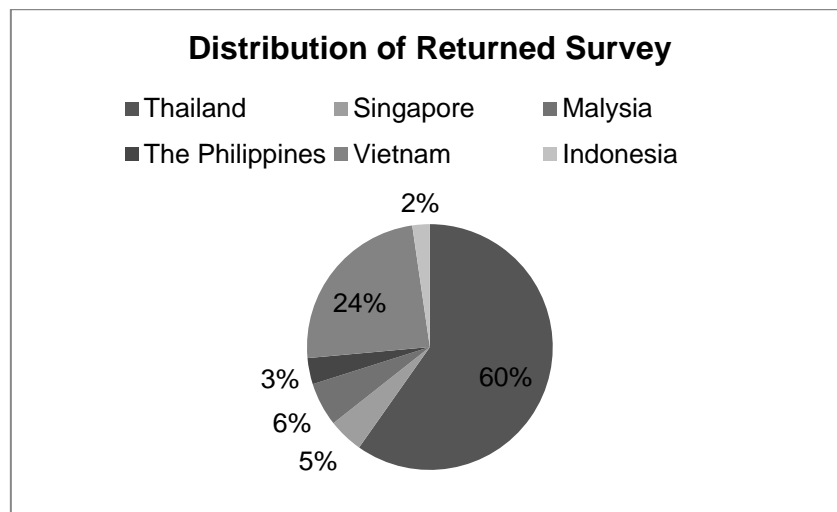


Figure 5: Distribution of Returned Survey

4. Results

After calculation, Figure 6 and Table 4 summarise key sub-factors and their weight of interest.

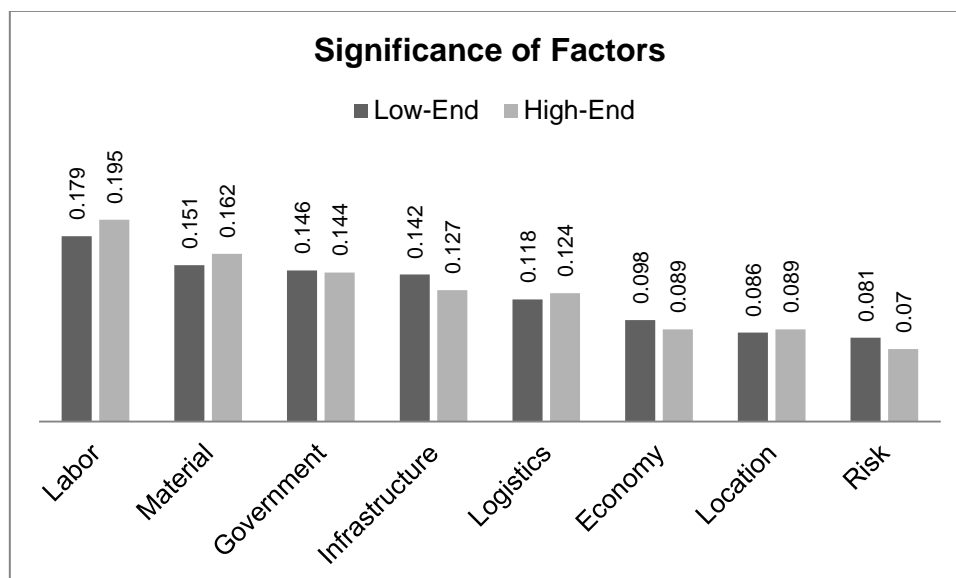


Figure 6: Significance of Factors – Low-End vs High-End

Here, it can be seen that for the high-end, labor, material and government are among the most significant factors. For the low-end, again, labor, material and government are among the most significant factors, like-wise the high-end. However, infrastructure are appears to be more-or-less significant.

Factor	Low-End Key Sub-Factor	High-End Key Sub-Factor
Labor	Employment attitude	Employment attitude
	Labor skill	Labor skill
	Labor availability	Labor availability
	Labor cost	Labor cost
Material	Material quality	Material cost
	Supplier quality	Material availability
Government	Government security	Government security
	Funding for infrastructure project	Law enforcement
Infrastructure	Connectivity	Connectivity
	Availability of air transport	Cost of air transport
	Reliability of air transport	Availability of latest technology
	Quality and reliability of information technology	Reliability of air transport
	Reliability of energy resource	Distributional infrastructure
	Availability of energy resource	Availability of water resource
	Cost of energy resource	Availability of air transport
Distributional infrastructure	Quality and reliability of information technology	
Logistics	Transport performance	Transport performance
	Transportation cost	Availability of 3PLs
Economy	Exchange rate	Inflation rate
	Inflation rate	Exchange rate
Location	Accessibility to supplier	Accessibility to supplier
	Working environment	Working environment
Risk	Risk of natural disaster	Pollution problem
	Disease problem	Disease problem

Table 4: Key Sub-Factors – Low-End vs High-End

Focusing on the sub-factors, for material factor, the main difference between high-end and low-end appears that the high-end is interested in material cost and availability, where the low-end is interested in material and supplier quality. This may be because the high-end is levelled up to the cost reduction level where material cost and availability are the main interest. On the other hand, the low-end is focusing on the quality to address the high need of the customer.

On government factor, the difference is where the high-end is interested in law enforcement, the low-end is, on the other hand, interested in the funding for infrastructure project. The infrastructure's sub-factors are also the main difference between this two classes. Where the low-end shows concern on this factors, the high-end is not so.

5. Conclusion

The study identifies the factors of interest of high-end and low-end electronic industry. Where labor, material and government are among the most significant factors for both high-end and low-end, for the low-end, infrastructure is also of interest. The difference between this two classes are also identifies on the key sub-factors. Where the nature of the industry is difference, the key sub-factors are so. The study is based on real needs and requirement. Therefore, if any country should aim to induce investment, benefit from supply chain redesign, in the electronic industry, these sub-factors are area of the focus.

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HALALAN TOYYIBAN SUPPLY CHAIN THE NEW INSIGHTS IN SUSTAINABLE SUPPLY CHAIN MANAGEMENT

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Introduction

In today's business environment companies are seeking to find the key successful strength in the organization to remain competitive. Therefore, logistics is an activity which can be considered by the industry players. As a result of the expansion of logistics and purchasing activities which have grown universally since the 1980s, it formed the supply chain management. In the supply chain management, it involves integration between channel members. Indeed, this supply chain integration is also essential in gaining more investment to the company which returns better quality and higher profits. Recently, numerous companies have started realizing that supply chain integration creates value added to the company. Therefore, the key objective and policy of the company has been changed to deliberating final customer's requirements. (Wisner, 2005). Lately, customers' do not only require the food safety but also further transparency of the food chain in ensuring the food is good to consume. As a result, activities in the supply chain management which involve food product are also essential to the customers.

Supply Chain Management

To begin this discussion about halal food supply chain it will help to define supply chain at as an introducing part of this paper. A widely accepted definition would be the following:

Authors	Definition
Bowersox (1969)	In describing several benefits of integrating various functions surrounding physical distribution.
Jones and Riley (1985)	An integrative approach to dealing with the planning and control of the material flow from suppliers to end-users.
Ellram (1991)	A network of firms interacting to deliver product or service to

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Authors	Definition
	the end customer, linking flows from raw material supply to final delivery.
Christopher (1992)	A network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer.
Lee and Billington (1992)	Networks of manufacturing and distribution sites that procure raw materials, transform them into intermediate and finished products, and distribute the finished products to customers
Berry et al. (1994)	Supply chain management aims at building trust , exchanging information on market needs, developing new products, and reducing the supplier base to a particular OEM (original equipment manufacturer) so as to release management resources for developing meaningful, long term relationship
Saunders (1995)	External Chain is the total chain of exchange from the original source of raw material, through the various firms involved in extracting and processing raw materials, manufacturing, assembling, distributing and retailing to ultimate end customers.
Kopczak (1997)	The set of entities , including suppliers, logistics service providers, manufacturers, distributors and resellers, through which materials, products and information flow.
Lee and Ng (1997)	A network of entities that starts with the suppliers' supplier and ends with the customers' custom the production and delivery of goods and services.
Tan et al. (1998)	Supply chain management encompasses materials/supply management of the supply of basic raw materials to final product (and possible recycling and re-use). Supply chain management focuses on how firms utilize their suppliers' processes, technology and capability to enhance competitive advantage. It is a management philosophy that extends traditional intra-enterprise activities by bringing trading partners together with the common goal of optimization and efficiency.
Mentz (1998)	Is the logical progression of developments in logistics management.
CSCMP	Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all Logistics Management activities. It also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers.

Table 5. Definition of Supply Chain Management

Adopted from Croom, Romano, & Giannakis (2000) and Larson, Poist, & Halldórsson (2007)

These are remarkable definitions. First, the focus is on integration within the process rather than “benefits to customer”. This has been indicated since the year 1969 to 1992 by several authors Bowersox (1969); Jones and Riley (1985); Ellram (1991); Christopher (1992) and Lee and Billington (1992).

On the other hand, in the Table 1, the supply chain management definition from the year 1994 until the year 1998, still focus on the network entities with value added during the development of logistics management in relation to the total chain. So we need to realize that the concept of the supply chain is also concerning the consumer benefits (that is, user good to consume), rather than about buyer benefits (which may include non-users).

Second, the supply chain is considering both upstream and downstream users' benefits. It involves a relationship among the channel members which in short term or long term relationship. It resides in the user's mind that the relationship will contribute to the mutual agreement which result 'win-win' situation.

Third, supply chain commonly refers to the organizational performance has threshold at both upstream and downstream supply chains. This means that consumers' benefits may be neglected as both stream focuses on organization. In addition, the concept of integration and total flow has been defined for supply chain management as in Table 6.

Authors	Definition
Monczka, Trent and Handfield (1998)	SCM requires traditionally separate material functions to report an executive responsible for coordinating the entire materials process, and also requires a joint relationship with suppliers across multiple tiers. SCM is a concept, "whose primary objective is to integrate and manage the sourcing, flow, and control of materials using total system perspective across multiple functions and multiple tiers of suppliers."
La Londe and Masters (1994)	Supply chain strategy includes: "... two or more firms in supply chain entering into a long term agreement;... the development of trust and commitment to the relationship; ... the integration of logistics activities involving the sharing of demand and sales data; ... the potential for a shift in the locus of control of logistics processes."
Steven (1989)	"The objective of managing the supply chain is to synchronize the requirement of the customers with the flow of materials in order to effect a balance between what are often seen as conflicting goals of high customer service, low inventory management, and low unit cost."
Houlihan (1988)	Differences between supply chain management and classical materials and manufacturing control: "1) The supply chain is viewed as a single process. Responsibility for the various segments in the chain is not fragmented and relegated to functional areas such as manufacturing, purchasing, distribution and sales. 2) Supply chain management calls for, and in the ends depends on strategic decision making. "Supply" is a shared objective practically every function in the chain and is of particular strategic significance because of its impact on overall costs and market share. 3) Supply chain management calls for a different perspective on inventories which are used as a balancing mechanism of last, not first, resort. 4) A new approach to system is required - integration rather than interfacing."
Jones and Riley (1985)	Supply chain management deals with the total flow of materials from supplier to end users..."
Cooper et al (1997)	Supply chain management is "... an integrative philosophy to manage the total flow of a distribution channel from the supplier to the ultimate user."

Table 6. Definition of Supply Chain Management

Adopted by (Mentzer et al., 2001)

Although there were various definitions from the authors (Table 1 and Table 2), it can be classified into three groups: a management philosophy, implementation of a management philosophy, and a set of management processes. Hence, numerous activities which are essential to implement SCM philosophy successfully have been recommended in the previous research. The supply chain management activities involve integrated behavior; mutual sharing information; mutual sharing risk and rewards; cooperation, the same goal and the same focus on serving customers; integration of processes, partners to build and maintain long-term relationships (Mentzer et al., 2001). As a result, supply chain management activities

HALAL AND TOYYIBAN

Halal is an Arabic word which means lawful or permissible by Islamic laws. In Malaysia, the use of the Halal expression is referred to in the Trade Descriptions 1975, 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 the Haram (Jabatan Kemajuan Islam, n.d.).

Consequently, the specific motives of Haram in Islam are to preserve the purity of religion, to safeguard the Islamic which can be applied to food. The term 'Ditanggung halal' or 'Makanan halal' indicates that a Muslim is allowed to consume the products as permitted by Islam. On the one hand, halalan toyyiban means any consumption of products, mentality, to preserve life, safeguard future generations and integrity (Yahya, 2006), to safeguard property, to and to maintain self-respect which are not harmful and are safe to be consumed as Anything that is halal to eat or consume is considered to underline in the Syariah law, and thus is allowable and permissible.

Halal concept is not only for Muslims but also non-Muslims due to the fact that the term 'halalan-toyyiban' means it must be halal and good to be consumed which has been mentioned in the Qur'an . Indeed, the concept of halal is not only introduced to the food sectors, but also to the non-food sectors such as pharmaceuticals, cosmetics, financial services and also other services which include supply chain. Accordingly, in realizing the supply chain and halalan-toyyiban concept in the daily food consumption is interrelated, thus the application of the halalan-toyyiban concept of the supply chain is deemed important. Hence, it is vital to focus on the supply chain of the food in ensuring only halalan toyyiban food will be consume by consumer.

Halal Supply Chain

To date, the new approach in supply chain namely halal, has create attention to the worldwide market which include food and non-food industry players. Thus, trully understand of halal supply chain has been defined as in Table 3.

Authors	Definition
Omar, Jaafar, & Osman (2012)	Halal supply chain is the concept starting from farm to the consumers which means everything must be halal and also toyyib along the chain.
Bahrudin, Illyas, & Desa (2011)	Proses of managing the procurement, movement, storage and handling of materials, parts livestock and semi- finished inventory food and non-food and related information and related documentation flows through the organization and supply chain in compliance with the general principles of Shariah Law . Halal Supply Chain also has the same definition with conventional supply chain but with the additional of Syariah law, whereby the Islamic law is the guideline for a proper halal process.
Tieman (2011)	Halal supply chains can be characterized as robust supply

Authors	Definition
Omar & Jaafar (2011)	<p><i>chains</i> that strive for a lower vulnerability for Halal contamination.</p> <p>Halal is <i>applied in the supply chain</i>; thus become a halal supply chain starting from the <i>point of origin to the point of consumption</i>. These activities include warehousing, sourcing, transportation, handling of products, inventory management, procurement and order management which must follow the <i>Syariah Islamic perspectives</i>.</p>

Table 7 : Halal Supply Chain Definition

Omar, Jaafar, & Osman (2012b) have been highlighted that in the halal supply chain, the total chain must be halal and tayyib. Indeed, Bahrudin et al., (2011) emphasis that the halal supply chain also has a similar definition like conventional supply chain; it involves the managing process in the supply chain activities with relevant information and necessary documents and only dissimilar in the aspect of following the principles of Shariah law. This definition is also similar to studies by Omar & Jaafar, (2011) which discover applying the halal concept in the activities of the supply chain which begins from the point of origin to the point of consumption with regard to Syariah Islamic perspectives. Unlike, Tieman (2011b) expresses the halal supply chain is a robust supply chain which attempts to reduce the halal contamination. Consequently, the halal supply chain is more suitable for the food industry as it has immediate response after consumption to the consumers. Therefore, halal food supply chain was well-defined in the next section.

Halal Food Supply Chain

Of late, consumers are more concerned towards food safety, quality, origin and authenticity for the reason of global food safety crises and incidents. Hence, this generated needs for more transparency in the food chain and also guarantees the healthiness of food from the various features of quality information (Verbeke, Rutsaert, Bonne, & Vermeir, 2013). Indeed, a quality assurance system within the halal meat chain may change the civic and domestic coordination of quality towards an industry or market coordination of the halal meat market in non-Muslim societies (Bonne & Verbeke, 2008). Therefore, halal food supply chain is becoming well known as demand for halal product is increasing. This is due to the fact that Muslim population increasing yearly for instance in the year 2011, the World Muslim population is about 1977.24 million and it increased to 2013.62 million in the year 2012 (Muslim Population, n.d.). Therefore, demand for halal food is also increasing as well as customers' acquire for the halal food supply chain.

In describing the halal food supply chain as in TABLE 8, many researchers focus on the process of supply chain from the point of origin to the point of consumption (Che Man et al, 2007; Tieman, 2009a,

2009b; Lodhi, 2010 and Zulfakar, Jie & Chan, 2012). However, Tieman (2009a, 2009b) and Lodhi (2010b) emphasize the supply chain must comply to the Shariah law general principles and Islamic dietary. Indeed, the products must also be halal certified (Che Man et al, 2007). Unlike other researchers, only Zulfakar, Jie & Chan (2012) highlights towards exceptional to the types of products which have been handled.

Authors	Definition
Che Man et al, 2007	'Process of planning, implementing and controlling the efficient flow and storage of Halal certified product from the source to the demand point'
Tieman, 2009a, 2009b	' Process of managing the procurement, movement, storage and handling food products through the organization and the supply chain in compliance with the general principles of Sharia law '
Zulfakar, Jie & Chan, 2012	'Halal food supply chain applies the same principles as conventional or generic supply chain with special exception on the type of products that have been handled'
Lodhi, 2010	The halal food supply chain requires conforming to the Islamic dietary laws at all stages from production to consumption . Hence, the intentional addition of any amount of prohibited food or material is not allowed into the food chain at any stage and strict control of all stages is essential to ensure the integrity of the halal product.

TABLE 8 : Halal Food Supply Chain

Adopted from (Zulfakar, Mohamed, & Ab Talib, 2012) and author

Similarities and Differences

1. Definition

The process of supply chain remains the same as the conventional supply chain activities nevertheless it must comply with the general principles in the Shariah law. However, this definition did not include the underlying reason for the consumers which will benefit them. As in halalan toyyiban supply chain, the main aim is to provide halalan toyyiban food to consumers which mean good to consume. This is due to the fact that *halal* and *toyyiban* concept are comprehensive as stipulated in Islam as the concept covers nutritiousness, quality, cleanliness, and safety for everyone i.e., not for Muslim society only. For instance, halal poultry will be good to consume by the consumer if the halal poultry is in good quality.

2. Objectives

Accordingly, the aim of halal supply chain is to ensure halal integrity of halal products for final consumers (Bahrudin et al., 2011). Additionally, the halal supply chain also ensures halal process performance through advance technology and coordination between the channel members. As a result, it will reduce the lead time of the certification process and supply chain as well as quality monitoring of the products (Belkhatir & Bala, 2004).

Although the objective of halal supply chain is the same with halalan toyyiban supply chain, but in the context of poultry, the aspects of animal welfare and halal animal feed must not be neglected. Apart from the animal welfare, the halalan toyyiban concept which is comprehensive covers nutritiousness, quality, cleanliness, and safety will result good to consume by consumers.

3. Cross Contamination Occurrence

Possibility of cross contamination would exist in the conventional supply chain, nevertheless in the halal supply chain cross contamination definitely must be guaranteed would not occur. As the halal product will be contaminated with non-halal products, the product will result or become non-halal.

Even the product is halal; it may not be suitable or good to consume by consumers and vice versa, the product is *toyyib* but it is not halal also cannot be consumed by Muslim consumers. Consequently, in the *halalan toyyiban* supply chain segregation is important to ensure the halal authenticity of the poultry.

4. Segregation

In the conventional supply chain concept, there will be possibilities of no segregation among various products compare to a halal supply chain, which segregate between halal and non- halal product is needed. Thus, in the *halalan toyyiban* supply chain, proper segregation is also needed and the concept of dedicated is recommended as it ensures the halalness of the product.

Elements	Comparison	
	Conventional Supply Chain	Halal Supply Chain
Definition	Functions that plans, implements and control the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customer requirements	<i>Proses of managing</i> the procurement, movement, storage and handling of materials, parts livestock and semi-finished inventory food and non-food and related information and related documentation flows through the organization and supply chain in compliance with the general principles of Shariah Law. Halal Supply Chain also has the same definition with conventional supply chain but with the additional of Syariah law, whereby the Islamic law is the guideline for a proper halal process.
Objective	Minimize cost, maximize profit	Ensure Halal integrity of Halal products for end consumers
Cross contamination occurrence	Possibilities for cross contamination exist	To ensure no cross contamination happens
Segregation needs	Possibilities for no segregation among various products	Separation of halal products and non-halal products

Table 9. Comparison between conventional supply chain and halal supply chain
Adopted by (Bahrudin et al., 2011)

Conclusion

To conclude, *halalan toyyiban* supply chain is the concept of applying syariah principles in the supply chain management. The concept of *halalan toyyiban* along the supply chain will begin from the sourcing aspect to the point of consumption. In the *halalan toyyiban* supply chain activities, all aspect of halal and *toyyib* must be deliberated (everything must be halal and *toyyib*) in order to ensure final consumers will be getting *halalan toyyiban* food. With regard to poultry industry, *halalan toyyiban* supply chain safeguards the halal animal feed, proper slaughtering, proper segregation (Omar & Jaafar, 2011) and animal welfare (Omar et al., 2012a). Apparently, in identifying the possibility of *halalan toyyiban* will break the chain, it can identify through the *halalan toyyiban* critical control points (HTCCPs) at all stages in the supply chain which result *halalan toyyiban* poultry. However, this study

limit to the supply chain, halal and halalan toyyiban definitions only, other area such as financial aspect of halalan toyyiban supply chain for can be discussed further in the future research.

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IMPLEMENTATION OF GOVERNMENTAL LOGISTICS POLICIES TO ENHANCE COMPETITIVENESS IN THAILAND'S INDUSTRIAL SECTOR

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Abstract

Thailand industrial sector is now facing intense logistics cost disadvantages, amounted to about 14.3% GDP. Cost control from supply chain and logistics management is the main priority for every companies. The Bureau of Logistics, Department of Primary Industrial and Mines, one of the major governmental offices who are responsible for National logistics cost reduction has introduced a number of policies to cut down industrial logistics cost. With significant and regular funding to focused industries, tangible results and achievements have been realized and demonstrated.

Purpose: This research paper aims to highlight the outcomes from the “Northern Thailand Logistics Improvement Project”, which was supported by the Bureau of Logistics in 2012. This paper provides insight into the improvement of the logistics performance obtained from applying various logistics techniques to the six highest exporter industries, consisting of (i) food, (ii) petroleum and plastic, (iii) electrical and electronics, (iv) auto parts, (v) garment and textiles, and (vi) natural rubber industries.

Design/methodology/approach: Twenty-five selected companies from Northern Thailand have been evaluated using the industrial standard, Logistics Scorecard. Then, two improvement sub-projects are introduced to each company considering from the revealed weaknesses. Appropriate logistics and supply chain management tools are subsequently proposed to the company s' improvement team to resolve identified problems.

Findings: It has been shown that the average score from the Logistics Scorecard was increased from 2.57 to 3.15, where the highest increasing score belonged to the electrical and electronics industry (42.5% improvement). This resulted in a decline of the logistics cost in selected companies (Northern Thailand area) by more than 15% or in total about 2 million USD. Potentially, these players can expect to reduce the logistically related costs by more than 14 million USD within five years.

Research limitations/ implications: The findings here are based from only 25 companies in the Northern Thailand. The Bureau of Logistics involved with more than 350 companies countrywide in 2012. A great number of companies are expected to benefit from similar kind of projects in the near future to come.

Originality/ value: Similar approach can be extended to potential companies in different area or industrial sector in order to reduce companies' logistics cost or enhance their competitiveness.

Keywords: Logistics Policy Implementation, Productivity improvement, Logistics Scorecard

Paper type: Logistics Development Policy

Introduction

Thailand has been ranked highly worldwide as a major exporter in many industries, such as electronics, automobile or agricultural products. With potentially bright outlook, Thailand has been blessed with great opportunities to obtain increasing foreign direct investments from all over the World. However, Thailand's industry is currently facing intense cost competition, such as high labour and high transportation costs, which will affect the competitiveness of each industry. According to the statistics reported by the Siam Commercial Bank's Economic Intelligence Center (EIC), Singapore was ranked

first in having the lowest logistics costs per GDP, followed by Malaysia and Thailand. The Thai logistics costs per GDP was 14.3%, consisting of 1.3% of GDP on management, 5.9% of GDP on inventory, and 7.1% of GDP on transportation costs. For these reasons, the supply chain and logistics management is clearly the main issue for every companies.

The Department of Primary Industries and Mines (DPIM) is one of the Royal Thai governmental arms, responsible for improving supply chain and logistics of the country's industry. DPIM is well aware of the logistics cost situation in Thailand. The logistics policies have been established and put in place to increase the performance and decrease the cost, leading to continually improved competitiveness of Thailand. The logistics policy consist mainly of three strategies; to support human resources of the logistics management for each industry, to establish the logistics integration between each company, and to support and provide necessary facilities to increase the efficiency of the supply chain and logistics for the targeted industry. In order to decrease the logistics cost, DPIM took a serious action on making an improvement plan which can be applied to the industry. This action plan supported the strategy of logistics cost reduction plan which intended to decrease the logistics cost per GDP from 14.3% to 12.0% by 2016.

In this work, a showcase in Northern Thailand is highlighted. The logistics policy implementation and improvement are reviewed. From the detail of logistics policy in Thailand, the research methodology is put forward. The main results are analyzed, Finally, the main conclusions and recommendation are given.

Literature Review

Supply chain and logistics management policy in Thailand offers crucial solutions to increase the performance and efficiency of each company. There are several literatures describing in detail how to improve and implement those supply chain and logistics techniques to a company. For this research, two topics of literature review have been studied. They are logistics policy implementation on other countries and logistics efficiency improvement.

Logistics policy implementation in other countries

Over the last 30 years, many countries rapidly constructed and improved transport system and logistics infrastructure, which has successfully contributed to the economic growth and development. Singapore was ranked top on supply chain and logistics management worldwide. She has built her own strength as a transportation and distribution hub, becoming one of the leading logistics center. (Bhatnager et al., 1999). The long term policy on logistics improvement of Singapore consists of developing technical know-how, developing manpower, development infrastructure and enhancing the business process. Singapore also focuses on tracking and monitoring the trends and changes in the logistics industry, not only in Singapore but also in the emerging markets and economies in the Pacific rim (Sum and Teo, 2001). China is also a major player on logistics management. China logistics performance is among of the highest improved countries. China has reached the point of the most attractive destination for the foreign entrepreneurs. One reason is the low cost of manufacturing and vast domestic market potential (Einhorn, 2001). The key success of China is supply chain and logistics improvement such as, the improvement of transportation network, high-tech warehouse structure and knowledgeable skill labor force. For further improvement, China has been applying several logistics strategies and policies for both government and private organizations (Goh and Ling, 2003). It has been clearly demonstrated that logistics improvement would be the best way to increase the potential for each industry and gain more competitiveness.

Logistics performance improvement

There are several techniques and tools which can be applied to improve the logistics performance.

(i) Lean management is defined as principle of loss elimination which focuses on the input, process and output to increase the efficiency of each activity. The most important tool supporting the concept of lean management is value stream mapping (VSM). It can be used as a process diagnosis to define the value of activities in the process. Furthermore, VSM is accepted by every companies to be the best practice for analyzing and improving the process (Tapping, 2002). Based on VSM, each process can be grouped into 3 categories which consist of non-value added (NVA), necessary but non-value added (NNVA), and value added (VA). The NVA is the activity which does not increase the value to process and also can be eliminated from the VSM to increase the efficiency of the process

(ii) Inventory and warehouse management is one of the most important activity of the supply chain and logistics management because this activity supports the production process and the customer relation for rapidly response to the customer demand. The inventory management has the highest cost, compared with other activities. It could directly affect the profit of the company and the customer satisfaction (Baker and Canessa, 2009). The inventory management focuses on 4 main activities, consisting of receive, storage, pick up and deliver. To manage the inventory, several activities are taken into account, e.g. location selection, inventory sizing, inventory plant and layout design, warehouse management system, location control, delivery and record and data (Gu et.al., 2011). There have been many research works about inventory management. Chan and Chan (2002) applied inventory management and Pareto chart to prioritize the value of the material. Plant and layout technique was also applied to rearrange material storage by considering the inventory constraint such as type of material, inventory turnover or the space requirement for each material. Petersen et al. (2002) applied inventory management to improve order-picking performance through the implementation of class-base storage. Materials were classified by considering the effect of the number of storage classes, the partition of storage classes and the storage implementation strategy applied in the warehouse. They were grouped into 3 different types, consisting of class base storage, random storage and volume bas storage. It was shown that the class base storage can provide the significantly reduced time of order-picking. The inventory management is the most important and widely used technique to increase the supply chain and logistics performance.

Logistics policy in Thailand

Supply chain and logistics management is a serious issue, not only for Thai companies but also the Thai government. Strategies and policies have been established to increase the efficiency of the Thai supply chain and logistics management. This six perspective strategies consist of logistics and

<p>Objective</p> <ol style="list-style-type: none"> 1. Decrease Logistics cost per GDP to 12% in 2016 2. Increase Logistics performance to 4 out of 5 by using Logistics performance Index: LPI to evaluate the score. 3. Increase the economy value of logistics industry by 10% per year. 4. Increase the value of target industry by 10% per year
<p>Vision</p> <p>Thailand as the ASEAN Logistics Connecting Gateway to Global Markets</p>
<p>Goals</p> <ol style="list-style-type: none"> 1. To increase the efficiency and standard of logistics service in term of cost efficiency to increase the responsiveness reliability and security for customer 2. To gain more competition advantages on each industry and increase the country's economy value

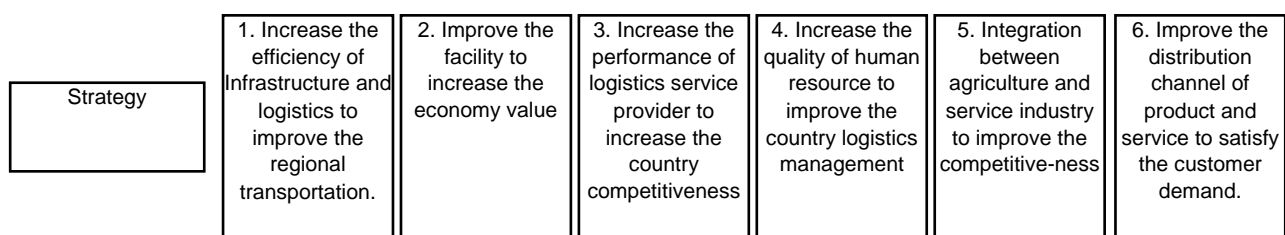


Figure 1: Thai logistics policy improvement 2012-2016

Regarding the research of Office of the National Economic and Social Development Board, transport cost still is the highest proportion of logistics cost structure corresponding to 49.8%, following by inventory cost and logistics management cost at 41.1% and 9.1%, respectively. Around 200 companies in Thailand were involved in data collection for evaluation of the logistics performance index (LPI). Result of the cost indicator showed that the electric and electronics industry has the highest inventory cost, while the automotive industry and plastic industry was ranked highest on transport cost. The result of time indicator showed that the automotive industry was the best in order management, while the food industry was the best in inventory management. For the reliability

indicator, the electric and electronics industry and the food industry gained the highest score of punctual shipment, while the plastic industry was the best in forecasting accuracy, shown in Figure 2.

From the data, each industry should improve their logistics performance to increase the competitiveness. DPIM is one of the governmental organizations who concerns with and focuses on logistics improvement, especially the inbound logistics. Along with the policy of Ministry of Industry (to decrease the inventory cost per sale by 15%) and the policy of Thai logistics improvement, the Northern Thailand project focuses on the logistics improvement in targeted industry to decrease the logistics cost per GDP.

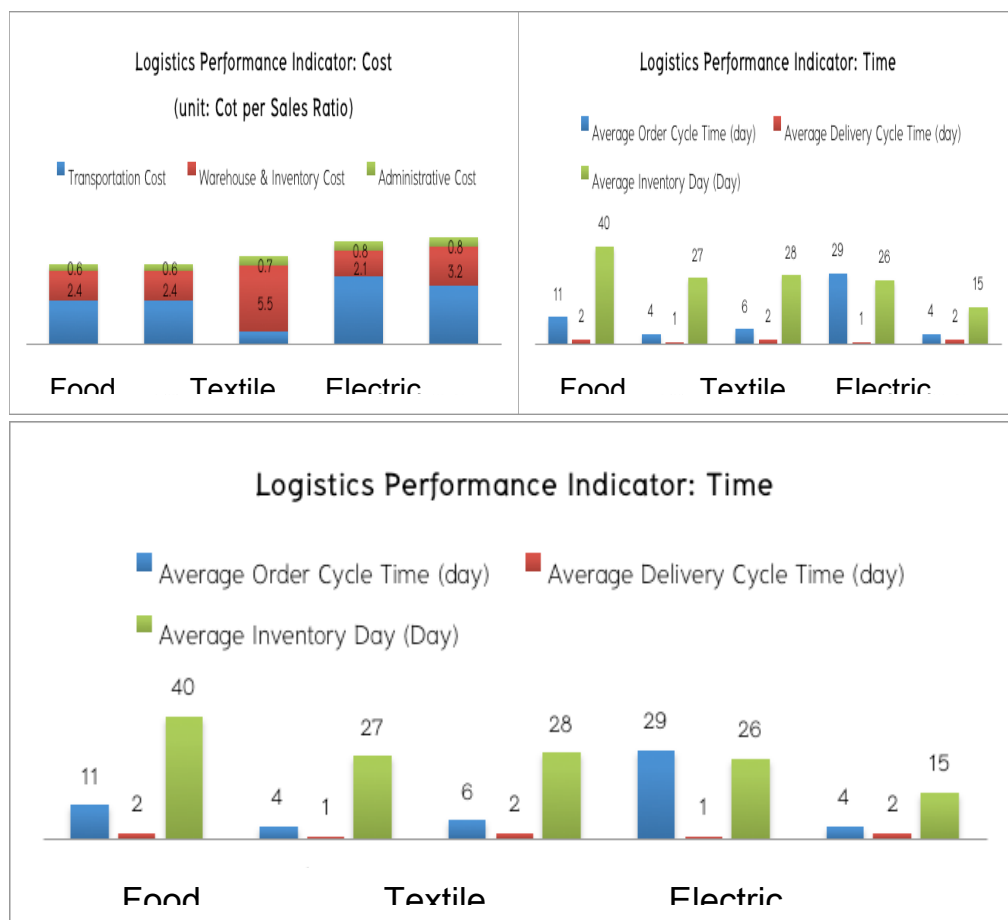


Figure 2: Thailand Logistics Performance Index (LPI)

Research Methodology

This research is about improving the supply chain and logistics management on the target industries. The target industries consist of five members namely, food industry, electric and electronics industry, automotive and automotive part industry, textile industry and petroleum and plastic industry. The methodology has four phases. The first one is preliminary investigation and company selection, following by the diagnosis, consultation, and dissemination, respectively, shown in Figure 3.

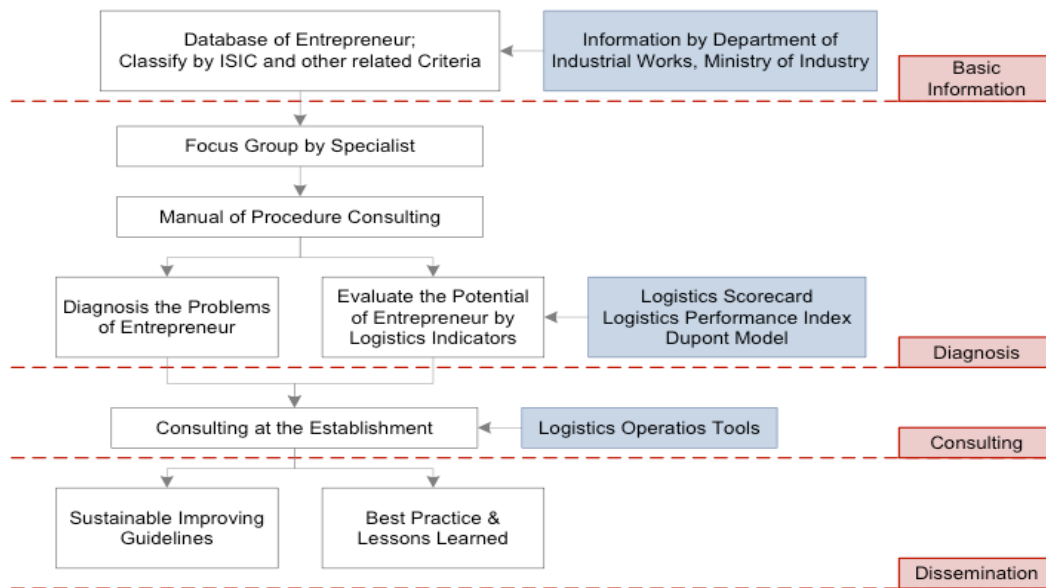


Figure 3. The research methodology

Preliminary investigation and company selection

The first phase of this research is to investigate and select the entrepreneur or target companies. The information about the revenue of each industry, the amount of investment and other primary data have been searched. This data was used to create the database of company, classified using the ISIC code and other related criteria to select the target industry. 25 companies were chosen, 15 from food companies, 2 from petroleum and plastic companies, 3 from electric and electronics companies, 2 from automotive and automotive part companies and 3 from textile companies.

Diagnosis

After the company selection, each company was evaluated for the current logistics performance. The Logistics Scorecard technique was used. After company diagnosis, the result showed that the average score was 2.84 out of 5. The highest average score belongs to the efficiency of lead time management indicator which has a score 3.44, followed by the customer satisfaction management indicator which has a score 3.14. Additionally, the industrial engineering techniques were also conducted, such as Fish Bone Diagram, Value Stream Mapping (VSM), Logistics Performance Index, and Dupont Models, to identify main causes of the problem. According to the result, the expert and company owner will discuss and decide which project would be the main focus. Two different projects were selected and both of them focus on the supply chain and logistics improvement.

Consultation

In this phase, the project will be implemented to the company. The consultation provided by the expert was separated into several times during the year, and covered all necessary topics such as the business plan, supply chain and logistics management, and industrial engineering tools. The outcome will be reported to the owner to show the detail about the company strengths and weaknesses. Appropriate techniques and tools were proposed and implemented to the company to develop existing

process. Several types of project were extended specially for each company such as the plant and layout design improvement, the inventory improvement or process improvement by optimization technique. After the implementation, the data will be collected to compare between the current and the improved processes.

Dissemination

After implementation, the data was collected and analyzed for the comparison. According to the result, the average score measured by Logistics Scorecard has increased by 22.6%. The best two improved companies were selected to be the role model for other companies. Conclusion of each company has been made and reported as the best practice improvement.

Results and Discussion

The supply chain and logistics improvement project was implemented in 25 companies. The result of this research consists of the logistics performance improvement and the logistics cost reduction.

Logistics performance improvement

The logistics performance improvement was evaluated by Logistics Scorecard in five criteria and 23 sub criteria. The category of five criteria includes Corporate strategy & inter-organizational alignment, Planning and execution capability, Logistics Performance, IT implementation and management and, Collaboration with external business partners. The result after improvement showed that the average score of every criteria was 3.15 (22.6% increase compared with the previous score 2.57). The highest score was 3.7, belonged to sub-criteria of "System for measurement and improvement of customer satisfaction". Furthermore, the score can be categorized by type of industry.

(i) Food Industry: The evaluation result of logistics performance in the food industry is shown in Figure 4a. The average score after improvement was 3.16 (20.6% increase compared with the previous score 2.62). The highest score was achieved in the sub-criteria "system for measurement and improvement of customer satisfaction", scoring 3.83 out of 5. The lowest score was achieved in the sub-criteria "Development of logistics activity department" (score of 2.47).

(ii) Petroleum and Plastic Industry: The evaluation result of logistics performance in petroleum and Plastic industry is shown in Figure 4b. The average score after improvement was 2.62 (19.1% increase, compared with the previous score 2.02). The highest score was achieved in the sub-criteria "Collaboration on logistics development with research and development institution, such as, research institution, university, etc", which scored 4.00 out of 5.

(iii) Electric and Electronics Industry: The evaluation result of logistics performance in the Electric and Electronics industry is shown in Figure 4c. The average score after improvement was 3.82 (47.5% increase compared with the previous score 2.59). There were two sub-criteria which scored the highest, the first one was achieved in the sub-criteria "Control and tracking of inventory (product/parts/WIP): accuracy and visibility" and the another one is the sub-criteria "Delivery performance and quality" which were scored 4.50, while the lowest score was achieved in 2 sub-criteria, "The Strategies for optimizing logistics system resources based on design for logistics" and "The Accuracy and adaptability of SCM planning" (scored 3.17)

(iv) Automotive and Autopart Industry: The evaluation result of logistics performance in automotive and auto part industry is shown in Figure 4d. The average score after improvement was 3.26 (6.2% increase compared with the previous score 3.07). There were three sub-criteria which scored the highest consist of the "System for measurement and improvement of customer satisfaction", "The Accuracy and adaptability of SCM planning" and "The Process standardization and visibility", which were scored 4.50 while the lowest score was achieved in the sub-criteria "Corporate strategy regarding logistics and its importance" (scored 1.75).

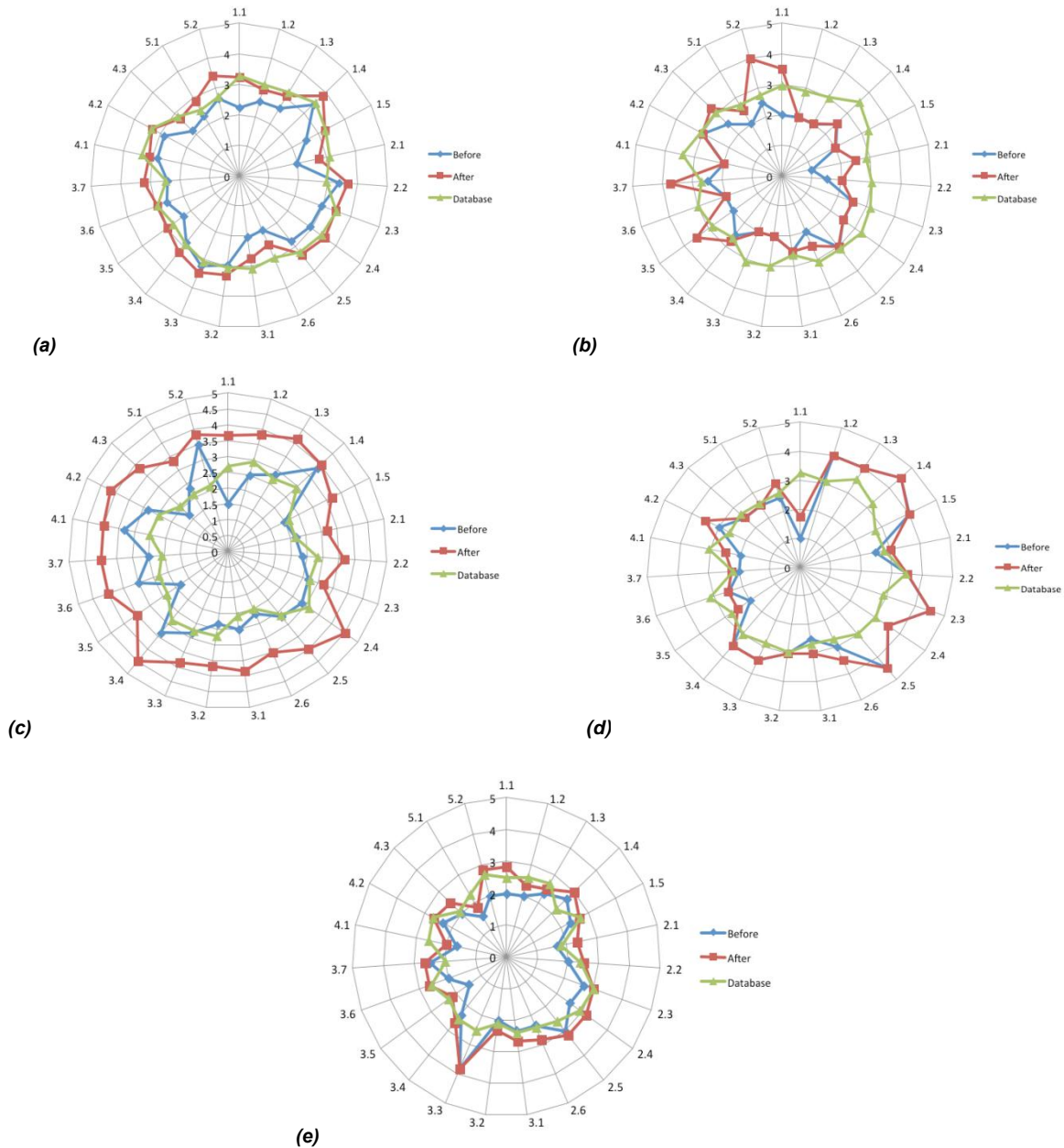


Figure 4. Evaluation results of logistics performance in the (a) food, (b) petroleum and plastic, (c) electric and electronics, (d) automotive and autopart, and (e) textile and garment industries

(v) Textile and Garment Industry: The evaluation result of textile and garment industry's logistics performance is shown in Figure 4e. The average score after improvement was 2.66 (18.8% increase

compared with the previous score, 2.24). The highest score was achieved in the sub-criteria "Customer lead time (from order placement to receipt) and load efficiency", which scored 3.83 while the lowest score was achieved in the sub-criteria "Collaboration on logistics development with business partners and with the same business cluster" (scored 1.83).

Company Code	Revenue, 2011 (Million USD)	ISIC Code	Industry VGO of each ISIC (Million USD)	VGO / sale	Cost reduction (Million USD)	Extended factor	An expected cost reduction (Million USD)	National extended factor	An expected overall cost reduction (Million USD)
F-01	10.67	1513	1946.83	182.52	0.043	10.0	0.432	15%	11.800
F-02	1.20	1513	1946.83	1,638.29	0.002	7.2	0.012	15%	3.033
F-03	1.67	1513	1946.83	1,163.45	0.005	10.0	0.054	15%	9.400
F-04	1.13	1513	1946.83	1,705.75	0.005	7.2	0.033	15%	8.467
F-05	491.30	1513	1946.83	3.96	0.061	7.2	0.441	15%	0.267
F-06	10.87	1541	1048.80	96.40	0.039	5.4	0.213	15%	3.067
F-07	38.20	1513	1946.83	50.95	0.041	4.2	0.171	15%	1.300
F-08	14.40	1513	1946.83	135.25	0.014	3.6	0.049	15%	1.000
F-09	4.97	1513	1946.83	393.03	0.037	7.2	0.268	15%	15.800
F-10	0.60	1544	866.33	1,443.89	0.123	5.4	0.666	15%	144.300
F-11	3.67	1531	3703.37	1,008.82	0.015	4.2	0.061	15%	9.267
F-12	0.73	1549	3073.60	4,231.67	0.075	7.2	0.540	15%	342.767
F-13	24.90	1513	1946.83	78.20	0.181	6.0	1.083	15%	12.700
F-14	43.03	1513	1946.83	45.24	0.018	4.8	0.087	15%	0.600
F-15	0.77	1513	1946.83	2,500.21	0.008	4.8	0.037	15%	14.033
P-01	0.40	2520	7996.60	20,142.57	0.002	8.0	0.013	15%	37.867
P-02	3.80	2520	7996.60	2,096.09	0.075	5.6	0.419	15%	131.600
E-01	0.33	2692	1223.43	3,819.20	0.007	9.0	0.062	15%	35.733
E-02	27.17	3210	16641.67	612.73	0.680	9.0	6.120	15%	562.500
E-03	31.97	3691	2381.90	74.55	0.115	4.8	0.552	15%	6.167
A-01	10.90	2899	4589.03	421.61	0.126	9.0	1.131	15%	71.533
A-02	1.03	3430	12465.47	11,966.85	0.145	4.2	0.609	15%	1092.967
T-01	2.73	1810	6607.60	2,403.64	0.066	4.2	0.279	15%	100.533
T-02	0.50	1810	6607.60	13,215.20	0.002	3.0	0.005	15%	9.033
T-03	6.43	1810	6607.60	1,028.05	0.024	4.2	0.101	15%	15.600
Total	733.37				1.908		13.439		2641.467

Table 1. Overall expected cost reduction

Cost reduction and performance improvement

The result of this project can be calculated as the percentage of cost reduction or increase in efficiency. By applying the logistics improvement project, logistics cost was reduced by 1.9 million USD (0.26%). By continuing this project, the total logistics costs can be decreased by 13.43 million USD (1.83%). If this project is to be applied all over Thailand, the logistics costs can potentially be decreased by more than 2600 million USD within 5 years, as seen in Table 1. According to the results shown in the research, we can clearly see that after executing the projects within the company, the logistics performances can be increased greatly.

Conclusion

Successful implementation of governmental logistics policy has been demonstrated. Case study of Northern Thailand is highlighted. This research work aims to improve the efficiency of the supply chain and logistics management of target industry. The outcomes are evaluated based on two criteria; improvement of logistics performance, and reduction of logistics cost. After the project implementation, increase in the logistics performance from 2.57 to 3.15 or 22.6% overall improvement for the industry was realized. This will directly translate into a reduction in the logistics cost of almost 2650 million USD within 5 years if these projects are to continue. With such a huge achievement, continual support and expansion of similar projects should be carried out in order to improve the overall logistics performance. This way, the industries and Thailand will become and remain winners in the current global market and the future to come.

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IMPROVING THE VALUE OF THE INFORMATION SERVICE FLOW IN LOGISTICS PROCESS INTEGRATION

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1. Introduction

Companies have started to integrate internal business processes in global organizations by establishing enterprise applications integration (EAI). The main motivations have been the need to have better real-time information to manage business and build better competitiveness. In many cases, multinational organizations have had various applications in different locations without a real possibility to establish cost effective interoperability between services. Huge enterprise resource planning (ERP) system implementations have been carried out over the last decade.

Electronic payment has been the biggest success story to start external integration over the internet by using a common information model. The financing sector really understood the value of using a standardized information model for process integration of payments. This business process model changed the entire financial sector's business model with private customers, business and the public sector. The benefits of this integration of payment have been obvious to the entire business ecosystem.

The financing sector is now offering an interoperable eInvoicing service and a bank network to all customers. These are the key processes used in any business-to-business (B2B) or business-to-consumer (B2C) and business-to-government (B2G). It has been estimated that the volume of invoices in the world in 2012 was at minimum about 350 billion, whereof 150 billion was between (B2B) and (B2G). The penetration level (the estimated electronic invoicing proportion of the total volume of invoices) in the world is about 5%, and in Europe the volume is about 18% (Koch, Billites 2012). In our case study, we have estimated the volumes of orders and shipping's compared to invoicing volumes in percentages. This explains why there are 246% more orders and 138% more shipping's than invoices.

Table 1 will summarize the volumes of invoicing in the whole world and in Europe and also the penetration level (the estimated electronic invoicing proportion of the total volume of invoices in 2012, Koch, Billites (2012)). In this same table we present the invoicing volumes in our case study and we also show the volumes of orders and shipping's compared to invoicing volumes in percentages.

Table 1: Process transaction volumes and penetrations

	Orders	Shipping's	Invoices	e-invoices *
World				
Consumer (B2C)			200 billion	5 %
Business (B2B) & Government (G2B)			<u>150 billion</u>	5 %
Total			350 billion	
Europe				
Consumer (B2C)			17 billion	12 %
Business (B2B) & Government (G2B)			<u>16 billion</u>	18 %
Total			33 billion	
Case study business (B2B)				
Tier 0 (18 companies)			861 632	70 %
Tier -1 (22 companies)			<u>1 632 750</u>	40 %
Total (40 companies)			2 494 382	
Volume of transactions compared to invoices	246 %	138 %	100 %	

* Estimation of electronic invoicing penetration

All those users, business networks, ecosystems and even countries which have implemented ePayment and invoicing have realized the benefits and they are seeking the next step to expand business process integration by expanding the integration to ordering, shipping processes. Companies have understood the importance of B2B integration as a whole, but there exists quite little understanding of how much savings could be done in different processes. In this paper, we show how better integration and automation of information flows enhance the speed of processes and thus provide cost savings and other benefits for the organization.

This paper will contribute special knowledge to this academic field by establishing a well conducted case study and methods to collect data, analyze and simulate the results. For business partners, this paper will establish an organizational and business network level understanding of potential savings. Competitive advantages will be established by joint efforts. At the end of the day, the actions taken will also have an impact on environmental aspects of sustainability.

The empirical part of the paper is structured as follows. In the first part of the empirical section, we will structure the information model needed for logistics integration. Then we will design the structure of organizations and stakeholders for the study in order to collect data. Finally we will analyze the value of information flows by using the Monte Carlo simulation method.

2. Theoretical background: Related literature

An accurate and real-time information flow in logistics processes is essential for functions to proceed smoothly, e.g. transportation and related activities, such as ordering, shipping, forwarding and invoicing.

Even though effective information exchange is widely identified and acknowledged as a significant element of process integration which has shown to improve cost-effectiveness and overall supply chain performance (Croom, 2005; Closs et al., 1997), there are still obstacles for deeply automated activities between stakeholders in supply chains. High investment costs, incompatibility of software/hardware and lack of awareness about automation benefits are the main obstacles to deploying advanced technologies (Evangelista and Kilpala, 2007; Murphy and Daley, 1999; Ferguson et al., 1990).

2.1 Logistics

Logistics as a common notion relates to the movement of physical goods. The evolution of the concept derives from big historical actions, such as the construction of the great pyramids, the emigration from Europe to the Americas, and both World War I and II, which have all been enormous logistical challenges. The exact term of logistics has its roots in the military, and later in the 1980s it expanded to the terminology of business. In business practice, the concept of logistics is often used interchangeably, e.g., with material management and physical distribution (Lummus et al., 2001, Daugherty et al., 1996).

Commonly logistics is seen as a function of one company even though it manages material, service and information flows between its suppliers and customers. In other words, as the logistics function is carried out at multiple locations in a given supply chain, it is an integrative factor across a supply chain. Logistics activities cover a company's inbound and outbound, internal and external raw material and products' movements as well as return streams back to the company. The information flow is an essential part of the function as it is a basis for decision making in the logistics chain (Lummus et al., 2001).

Council of Supply Chain Management Professionals have defined logistics as "the process of planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including services, and related information from the point of origin to the point of

consumption for the purpose of conforming to customer requirements. This definition includes inbound, outbound, internal, and external movements". CSCMP (2010). The survey study by Lummus et al. (2001) showed that logistics is seen more as a tactical and operational action, like an executive function of more strategic supply chain management.

2.2 Information logistics

Information within the supply chain has become a vital element for B2B integration, performance and successful management implementation. To enable dynamic actions and decision-making, the information exchange and information quality are very important issues for coordination operations within the supply chain (Li and Lin, 2006; Fiala, 2004). Most approaches to network information focus on certain user groups or processes without discussing the integrated, network-wide information logistics (Dinter et al., 2010).

According to Dinter et al. (2010), information logistics can be defined as “the planning, implementation, and control of the entirety of cross unit data flows as well as the storage and provisioning of such data”. Information logistics should provide value to the whole supply chain not only by benefits but by cost reduction and eliminating risks as well (Dinter et al., 2010; DeLone., 2004). ICT is typically considered an enabler to (re)design, manage, execute, improve and control business processes both within and between organizations (Melao, 2009). B2B integration can be understood as collaborations between supply chain partners using ICT in business interactions, which are exchanges of business documents over the internet in a business process as part of information logistics (Dinter et al., 2010).

Visibility in supply chains and an accurate and real-time information flow among partners are essential for smoothly proceeding functions and logistics activities. In integrated processes, information gathering, sharing and exchanging among the participants is essential (Gunasekaran and Ngai, 2003; La Londe and Masters, 1994). Even though B2B integration is widely identified and acknowledged to build efficiency to the supply chain (Croom, 2005; Wu et al., 2005; Closs et al., 1997) the interoperability of systems still remains on a low level and the real benefits have not been realised (Evangelista and Kilpala, 2007; Murphy and Daley, 1999).

Collaboration and information exchange within logistic chain operations and processes has to be organized in an effective and reliable manner that requires changing from managing individual functions to integrating activities into key logistic chain processes. E-logistics and the outsourcing of logistics business processes can be seen as subsets of a wider external logistics market. E-logistics can be defined by Wiengarten (2012) as the transfer of goods and services using internet-based information exchange.

In our empirical study, we are interested in benefits that are potentially achievable through efficient information exchange primarily in logistics processes. Based on the literature review, more effective information exchange would have a significant effect, not only on logistics processes but on the broader, systematically functioning supply chain as a whole.

3. Empirical Study

In order to make an in-depth investigation into the nature and information value of logistics processes, we have built a research framework that covers both the information model design elements of the logistics processes and the measurement and analysis of the monetary value of the B2B integration. The logistics processes were selected as the focal area of the empirical study since we made an initial hypothesis that information plays a key role in the process improvements and since there is still lot of potential for further process integration.

3.1 Research approach

The empirical part is based on an empirical study on 40 companies operating in the biorefinery business. We firstly selected focal companies (tier 0), which represented the focal supply chain actors. Then we asked the focal companies to select the most suitable suppliers (tiers 1 and 2) to be included in the study. It can be said that the selected group of companies corresponds with the company structure in the industry sector. The biorefinery industry is an interesting area for the empirical study because the economic value of the business is high and the business covers various types of business-to-business service and product transactions in a global scale.

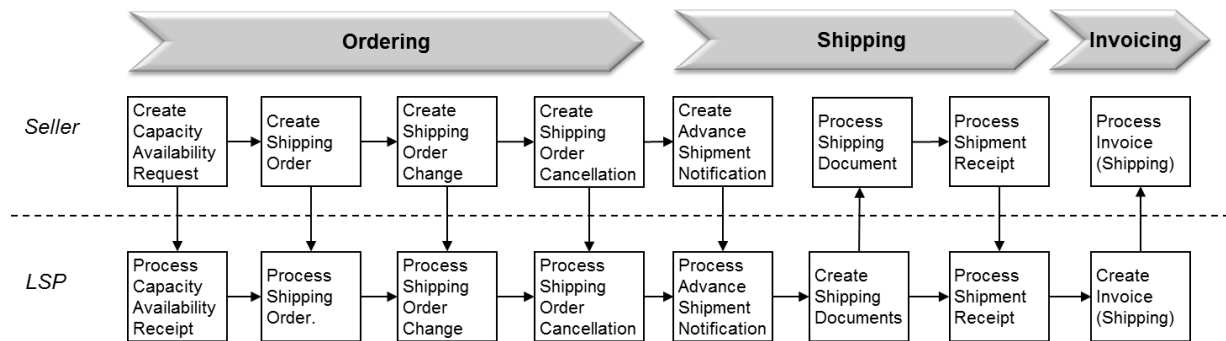


Figure 1. Information logistic process model in the Seller-Logistic Service Provider case study

The process activity mapping framework for logistics information flows illustrated in Figure 1 provides a useful method for identifying the sequence of activities under study. Lead time was used as a primary measure for the quantification of process flow efficiency in the simulation. The assigned expert measures were used as input values for the simulation.

The selected research design covers the expert data collection methods related to the logistics processes and a simulation-based application for investigating process value by using the process lead times as a measure. Simulation analysis was selected as the method for the data analysis because of its suitability for creating a sophisticated analysis based on the expert judgments in a case where no historical data was available about process scenarios.

Table 2. Data collection

Step	Method	Purpose	Number of sources
1	Survey instrument	- To collect the data about the transaction volumes and frequencies	40
2	Expert group interviews	- To identify and validate the structure of the business process activities for the information model for the industry	5 interviews, key experts from standardization organizations
3	Focus group interviews	- To assess the lead time distributions and automation rate of business processes	2 workshops, 14 experts from the seller and LSP side

The research process covers different data collection methods. We developed a survey instrument for collecting the data about the transaction frequencies and volumes of logistics activities. For the purpose of the process selection and mapping of the business process activities, several expert group interviews were organized. We also used the manuals and expert knowledge from the leading standardization organizations (GS1/RosettaNet, Oasis/UBL, UN/CEFACT) in this process mapping and information model development stage. Measures of process lead time variations and automation were also collected during the expert group interviews.

3.2 Simulation model of logistics processes

We used Monte Carlo -based simulation software for calculating the lead time flows with variation. In the analysis, the activity lead-times are modelled as triangular distributions, which are commonly used when the expert is able to evaluate the minimum, maximum and most likely value for a variable. We restricted the usage of extreme cases by applying the general rule of taking away 10 per cent of the upper and lower bounds cases. In the analysis, the Monte Carlo simulation method was applied, which randomly selects values from the distribution and uses several iteration rounds to complete an analysis. The number of iterations in the model was selected as 1000. Table 3 summarizes the main data variables used in the study. Median values of lead times were used as the most likely values on the simulation input worksheet.

Table 3. Simplified example of the data sheet for the simulation model

Actor	Process	Median lead-time [min]	Automation rate %	Frequency	Cost [EUR/min]	Cost Potentia [EUR]
Seller	Create Capacity Availability Request	25	0,3	3444250	10,5	36164625
Logistic	Process Capacity Availability Reseipt	20	0,3	3444250	6,5625	22602890,63
Seller	Create Shipping Order	15	0,3	3444250	4,375	15068593,75
Logistic	Process Shipping Order	20	0,3	3444250	6,5625	22602890,63
Seller	Create Shipping Order Change	15	0,05	344425	7,71875	2658530,469
Logistic	Process Shipping Order Change	20	0,3	344425	6,125	2109603,125
Seller	Create Shipping Order Cancellation	10	0,05	344425	5,34375	1840521,094
Logistic	Process Shipping Order Cancellation	15	0,3	344425	4,375	1506859,375
Logistic	Greate Shipping Documents	15	0,3	3444250	4,375	15068593,75
Seller	Process Shipment Delivery Report	6	0,01	3444250	3,34125	11508100,31
Logistic	Process Shipment Delivery Report	6	0,01	3444250	3,34125	11508100,31
Logistic	Create Invoice (Shipment)	10	0,3	3444250	3,9375	13561734,38
Seller	Process Invoice (Shipment)	30	0,003	3444250	18,070625	62239750,16

The outcome of the simulation analysis when the lead time was used as a measure is illustrated in Figure 2. The analysis shows the logistics process improvement potential in the monetary values. It is based on the calculation of lead time improvement potential when transferring from manual to automated information flows by taking into account the assessed automation rate %. Time saving potential is transferred into monetary values (EUR) by multiplying the working time with the average salary. The simulation analysis shows that the lead time impact in EUR could vary between 136 533 250 EUR and 287 989 190 EUR with the mean value of 216 776 312 EUR.

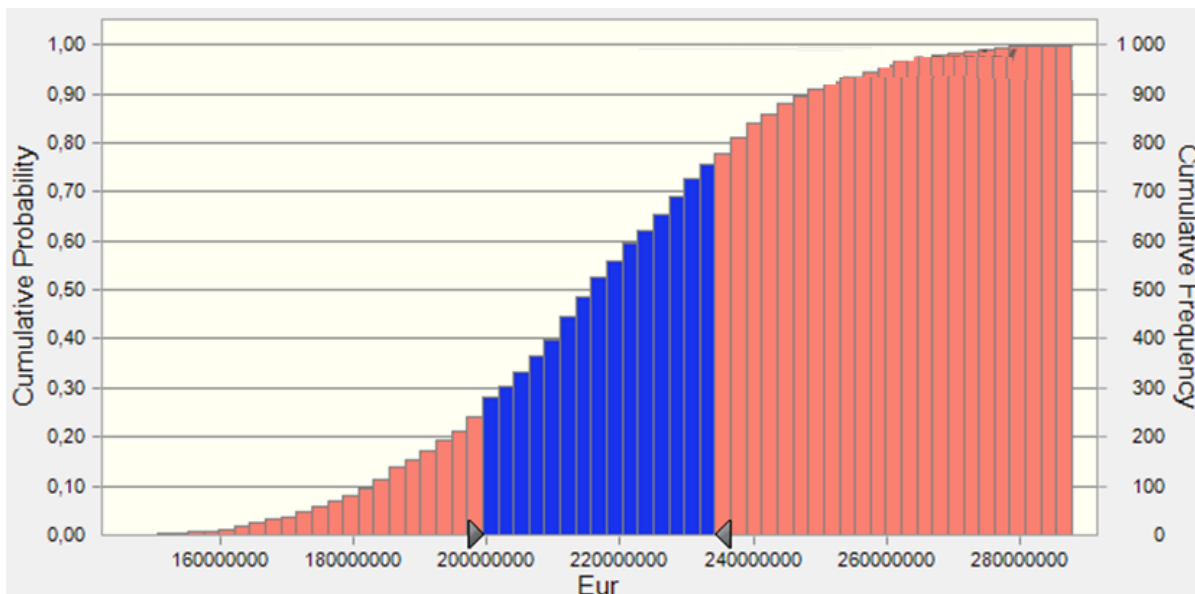


Figure 2. Simulated distribution of value provided by the logistics process (n=40 firms)

The sensitivity chart in Figure 4 illustrates the potential of most essential process activities for creating cost savings in the logistics. Based on the simulation analysis, Process Invoice - Shipment (59.5%), Process Shipping Order (9.3%), Fire (10.5%), Process Capacity Availability Receipt (6.7%) and Create Shipping Order (6.2%) are the most potential process activities in the case logistics supply chain. The sensitivity chart provides a valuable analysis of the importance of the process activities and allows organizations to put priority on process steps that have the highest impact on the results. The advantage compared to traditional methods is that it takes into account both actual lead times and the lead time variation of the processes.

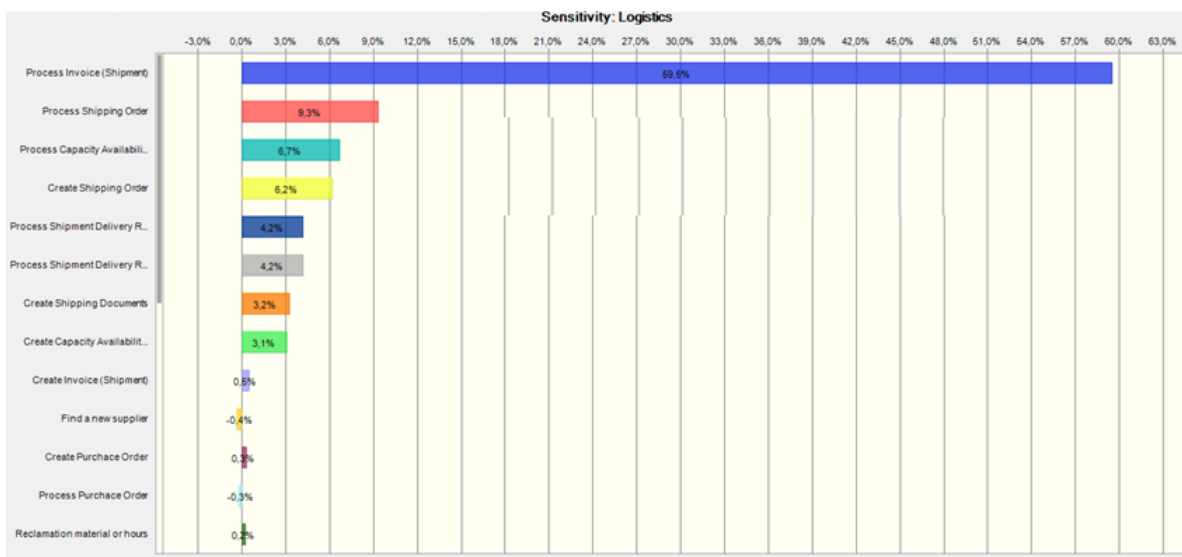


Figure 3. Sensitivity chart of the value of different processes

The simulation approach seems to provide many advantages for the analysis value potential of B2B integration and information flows in logistics. From the decision-making perspective, it allows to connect the variability of process lead times to the measuring of the flow efficiency.

The potential is shown as a probability distribution, which provides opportunities to take risk and uncertainty into account in the decision making. An outcome of the simulation method is the sensitivity analysis, which shows the contribution of the process activities for the resulting value potential outcome. For investment calculations, it illustrates the value potential of process improvements.

4. Discussion and conclusions

The aim of this study was to define a general logistics process used in manual and electronic business transactions between a buyer, supplier and logistic partner. The mutual understanding was built by an expert group, consisting of key global experts in different major standardization organizations. The common business processes formed an information model for logistics. The data collection and valuation was done by a focus group, formed from executives and managers involved in global B2B integration as a buyer, seller or logistic partner. The analysis was done by using the Monte Carlo method.

This study was able to define the economic value in the form of cost savings in logistic B2B integration. The results give a broad understanding of B2B integration as discussed in the following. B2B integration has a great impact on independent firms, strategic business partners and value adding services. The results explain the importance of logistic and information interoperability. The current literature expresses the importance of business process integration in logistics (see e.g. Hazen and Byrd, 2012 and Jeffers et al., 2008) and businesses have started to design and implement the common standards, but there exists little evidence in the literature of its economic impact. This study was able to report the cost savings in one supply network case. This method can be used in other industries and even further developed for other business sectors and processes. These results can be scaled to other networks and explain the overall understanding of cost savings in logistics process integration. This information is needed in decision making when outsourcing logistic and information services.

The key findings and recommendations for academic and business networks are to seek for a common interoperable information model for B2B integrations. This will help to design data collection in a heterogeneous business environment. The result will offer a better business-level understanding of economic value of logistics process integration. The establishment of a common information model will support the design of interoperable solutions and systems. The common information model was designed by using literature and interviews of standardization experts. The data collection was executed by high-level business partners and managers responsible for global logistic integration. The volume of the data represents a rather good sample size. However, the research was dominated by one industry domain and rather large firms, and therefore future studies should be extended to cover a large population of business sectors. Small and medium size companies and other industries should be covered in further research.

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INFLUENCE OF CULTURE AND CULTURAL DIFFERENCES ON SUPPLY CHAIN RISKS

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Abstract

Culture is an important element which affects human behavior. Cultural differences can either benefit or ravage every human related activity. Almost all supply chain activities are inevitably involved with human resources. This paper focuses on risk management in supply chain based on influence from culture and cultural differences. It analyzes possibilities and impacts of risks which can be revised in global supply chain scenarios. Hofstede's theory of cultural dimensions is used for analyzing relationships between culture and top supply chain risks.

Keyword

Risk management, supply chain risks, supply chain management, culture

Introduction

Supply chain is an essential system which link between manufacturers and consumers. It is one of the most important factors which determine competitiveness in modern industry. As technology develops, supply chain management has become increasingly essential to all kinds of business. Indeed, a risk in supply chain could lead to major loss if not mitigated properly and timely. However, managing risks in supply chain can be complicated since there are many factors involved.

Human resources are key element in a supply chain. Indeed, although several supply chain activities can be automated, human are still largely needed for an assurance of smooth operations. On the other hand, human can undeniably become a major risk factor. This challenge tends to further intensify in scenarios which involve international stakeholders due to the fact that people from different cultural background are likely to perceive and act diversely on the same environment or stimuli (Weisinger & Trauth, 2002). As a result, special attentions and appropriate mitigations would be needed for certain situations.

There is a great number of risks throughout an entire supply chain (Wieczorek, 2012). Few of these risks include major unpredictable and uncontrollable phenomenon such as natural disasters and terrorisms. Some of them, such as fluctuated exchange rates and uncertainty in demand, are very difficult to predict. Yet, other risks, such as labor dispute and contracting, are presumably easier to accurately forecast and hence efficiently mitigate. Many of the latter risks are human related and can be influenced by culture.

Cultural dimension is a theory which describes human behaviors based on five characteristics i.e. societal inequity, individualism, gender inequity, risk perception and time perception (Hofstede, 1997). The main benefit of this theory is that it represents a set of relative cultural scores for a number of countries. As a result, it is possible to determine whether if a country is more likely to be more susceptible to certain challenges if compared to another country.

This paper attempts to utilize the theory of cultural dimensions to explain and determine its connection and potential effects to top supply chain risks. Cultural dimensions are described in the second section. Then, the third section of this paper discusses top risks in supply chain management. The fourth section analyzes relationships and potential impact of cultural dimensions on top supply chain risks. Finally, the fifth section concludes this paper.

Cultural Dimension

Cultural dimension is a theory which suggests that normal human behaviors can be explained from five different perspectives as follows (Hofstede, 1997):

- Power distance index (PDI). This cultural index signifies the degree of perceived societal inequity. A high PDI value indicates a culture which people with high seniority, wealth, social ranks and educational level are more respected than other. In contrast, a low PDI index indicates more equality in the community.

- Individualism (IDV). Individualism index illustrate preferences towards objectives. People from high IDV communities tend to prioritize their goals over their group agenda. On the other hand, a low IDV indicates a collectivist community which regards group objectives as their top priority.
- Masculinity (MAS). This cultural value identifies competitiveness and gender equality. A high MAS indicates a society which are more masculine, i.e. highly competitive and male dominated. In contrast, a low MAS implies a feminine culture which people live more peacefully.
- Uncertainty avoidance (UAI). UAI denotes the perception towards challenges. In a high UAI community, people tend to avoid risky and unfamiliar scenarios. On the other hand, people from a low UAI society are more likely take risks.
- Long term orientation (LTO). LTO suggests community's perspectives on time. People with high LTO are able to sacrifice short term objectives in order to achieve their long term goal. On the contrary, low LTO people are more focused on short term results.

Table 1 illustrates cultural dimension score from various key supply chain countries based on a landmark survey in 1994 (Hofstede, 1997). Each cultural dimension score from 0 to 100, with a few exceptional cases which have scores of more than the expected maximum value. These cultural score are relative and are generally used for comparison.

Country	PDI	IDV	MAS	UAI	LTO
<i>Africa</i>					
West Africa	77	20	46	54	16
South Africa	49	65	63	49	-
<i>America (Central)</i>					
Costa Rica	35	15	21	86	-
Mexico	81	30	69	82	-
<i>America (North)</i>					
Canada	39	80	52	48	23
United States	40	91	62	46	29
<i>America (South)</i>					
Argentina	49	46	56	86	-
Brazil	69	38	49	76	65
<i>Asia (East)</i>					
China	80	20	55	30	118
Japan	54	46	95	92	80
South Korea	60	18	39	85	75
<i>Asia (Southeast)</i>					
Malaysia	104	26	50	36	-
Singapore	74	20	48	8	48
Thailand	64	20	35	64	56
Vietnam	70	20	40	30	80
<i>Asia (South)</i>					
India	77	48	56	40	61
Pakistan	55	14	50	70	0
<i>Australia</i>					
Australia	36	90	61	51	31
New Zealand	22	79	58	49	30
<i>Europe (East)</i>					
Czech Republic	57	58	57	74	13
Russia	93	39	36	95	-
<i>Europe (North)</i>					
Finland	33	63	26	59	-
Ireland	28	70	68	35	-
United Kingdom	35	89	66	35	25
<i>Europe (West)</i>					
France	68	71	43	86	-
Germany	35	67	66	65	31
Spain	57	51	42	86	-

Table 1: Cultural scores of major countries (Hofstede, 1997)

The relative score in Table 1 suggests expectable cultural differences between countries. Considering PDI scores for example, if a Chinese (PDI=80) firm plans to establish a supply chain with an American (PDI=40) company, a large cultural gap should be expected. In this case, the Chinese could feel that the American do not respect on seniority or educational background as much as they experienced in their home country. Yet, if this Chinese firm expand their business to Singapore (PDI=74), they should feel that Singaporean have similar perspective towards these societal powers.

It can be seen from Table 1 that countries from the same region usually have similar cultural scores. On the other hand, major gaps can be generally found in countries from different regions. For example, relative PDI and IDV scores of most Asian countries and North American nations are completely opposite. This reveals significant cultural differences which can potentially affect risks in supply chain management.

Top Risks in Supply Chain Management

There are a number of risks involved in the cycle of supply chain management. The possibility and impact of each risk can be varied based on particular stakeholders, scenarios and environments. Among them, there are a number of challenges which are frequently addressed.

Chopra and Sodhi (2004) defined nine categories of risks. Firstly, disruption risks involve risks which can extensively interrupt the entire chain of supply. Disruption risks include natural disasters, labor dispute and supplier bankruptcy. The second category, delays risks, signifies risks which can setback the process such as problems on the supply source and change in transportation modes. System risks, as the third category, include challenges from platform and infrastructure such as difficulties of system integration and infrastructure breakdown. Fourthly, forecast risks comprise potential errors from forecasting. The fifth risk category is intellectual property risks. This includes various forms of poor intellectual property protection in global supply chain scenarios. Procurement related risks such as fluctuated currency exchange rate and difficult contract management are classified as the sixth category. Seventhly, receivable risks incorporate customer related challenges such as unpredictable number of customers as well as their financial strength. Then, inventory risks such as increasing holding costs and depreciation are considered as the eighth category of risks. Lastly, capacity-oriented matters such as increasing costs and flexibility of capacity are categorized as capacity risks. It can be seen from this list that the majority of supply chain challenges are related to business environments. Human related risks, on the other hand, are comparatively smaller in numbers.

The McKinsey Quarterly published a global survey on supply chain risks in 2006 (Muthukrishnan & Shulman, 2006). Based on more than three thousand respondents, labor challenge is found to be the most concerned issue. This includes availability, cost, and quality of the labors. The other highly disturbing risks comprise regulatory concern, reliability of suppliers, shortage of commodities, fluctuation of prices and intellectual property theft. War, terrorism, natural disasters, political instability and infrastructure breakdown are also raised as major risks by the participants. This paper highlights the importance and difficulties of human resource management in supply chain.

Global Risk 2013 report published by World Economic Forum divides modern global risks into four categories (World Economic Forum, 2013). Firstly, economic risks involve variety of imbalance economic elements such as income disparity, failure of financial systems, inflation and deflation, liquidity crises and increasing prices of energy and agriculture products. Secondly, environmental risks include growing level of greenhouse gases, rapid change of climate, extreme weather, pollution, mismanaged utilities and mismanaged urbanization. The third category, geopolitical risks, comprises risks from international issues such as failed governance, corruption, organized crime and terrorism. Fourthly, societal risks delineates rising threats on communities such as shortage of food and water supply, religious fanaticism, unsustainable population growth and rising rates of chronic diseases. The last category of risks is outlined as technological risks. This includes cyber attacks, failure of critical systems, fraud, technology theft and failure in intellectual property protection. Although this paper discusses on risks in general, a number of risks are largely related to supply chain.

This paper simplifies the categorization of risks by adopting the concept from World Economic Forum (2013). Another risk category, management, is added in order to expand the list to cover managerial issues such as skills and costs of workforce. As a result, risks are divided into six categories, i.e.

economic, environmental, geopolitical, societal, technological and management. Table 2 demonstrates the collection of supply chain risks derived from ten selected literature and business reports.

Type	Risks	Citation	Count
Economic	Fluctuated product price and value	(Chopra & Sodhi, 2004; Enslow, 2012; Muthukrishnan & Shulman, 2006; Rao & Goldsby, 2009; Tang, 2006; Wagner & Bode, 2006; World Economic Forum, 2013)	7
	Fluctuate demand and supply	(Chopra & Sodhi, 2004; Christopher & Peck, 2004; Enslow, 2012; Rao & Goldsby, 2009; Tang, 2006; Wagner & Bode, 2006)	6
	Instability of production	(Christopher & Peck, 2004; Muthukrishnan & Shulman, 2006; Rao & Goldsby, 2009; Tomlin, 2006; Wagner & Bode, 2006)	5
	Fluctuated currency exchange rate	(Chopra & Sodhi, 2004; World Economic Forum, 2013)	3
	Bullwhip effect	(Chopra & Sodhi, 2004; Wagner & Bode, 2006)	2
	Income disparity	(World Economic Forum, 2013)	1
	Failure in financial system	(World Economic Forum, 2013)	1
	Inflation and deflation	(World Economic Forum, 2013)	1
	Financial strength of customer	(Chopra & Sodhi, 2004)	1
	Inventory holding cost	(Chopra & Sodhi, 2004)	1
	Utility and capacity costs	(Chopra & Sodhi, 2004)	1
	Environmental	Natural disasters	(Chopra & Sodhi, 2004; Christopher & Peck, 2004; Enslow, 2012; Muthukrishnan & Shulman, 2006; Rao & Goldsby, 2009; Wagner & Bode, 2006)
Extreme weather		(Christopher & Peck, 2004; World Economic Forum, 2013)	2
Mismanaged use of utilities and capacity		(Chopra & Sodhi, 2004; World Economic Forum, 2013)	2
Industrial waste		(Blanchard, 2009)	1
Rising of greenhouse gases emission		(World Economic Forum, 2013)	1
Mismanaged urbanization		(World Economic Forum, 2013)	1
Failure of climate change adaptation		(World Economic Forum, 2013)	1
Pollution		(World Economic Forum, 2013)	1
Geopolitical	Terrorism	(Chopra & Sodhi, 2004; Muthukrishnan & Shulman, 2006; Rao & Goldsby, 2009; Wagner & Bode, 2006; World Economic Forum, 2013)	5
	Regulatory concern	(Christopher & Peck, 2004; Muthukrishnan & Shulman, 2006; Rao & Goldsby, 2009; World Economic Forum, 2013)	4
	War	(Chopra & Sodhi, 2004; Muthukrishnan & Shulman, 2006; World Economic Forum, 2013)	3

Type	Risks	Citation	Count
Table 2: Top cited risks in supply chain management			
Societal	Poor governance	(World Economic Forum, 2013)	1
	Failure of diplomatic conflict resolution	(World Economic Forum, 2013)	1
	Organized crime	(World Economic Forum, 2013)	1
	Corruption	(World Economic Forum, 2013)	1
	Political instability	(Rao & Goldsby, 2009)	1
	Water supply shortage	(World Economic Forum, 2013)	1
	Food shortage	(World Economic Forum, 2013)	1
	Religious fanaticism	(World Economic Forum, 2013)	1
Technological	Ageing population	(World Economic Forum, 2013)	1
	Unsustainable population growth	(World Economic Forum, 2013)	1
	Diseases and pandemics	(World Economic Forum, 2013)	1
	Unmanaged migration	(World Economic Forum, 2013)	1
	Breakdown of infrastructure or machines	(Christopher & Peck, 2004; Enslow, 2012; Muthukrishnan & Shulman, 2006; Rao & Goldsby, 2009)	4
	Intellectual property theft	(Chopra & Sodhi, 2004) (Enslow, 2012; Muthukrishnan & Shulman, 2006; World Economic Forum, 2013)	4
	Accident	(Christopher & Peck, 2004; Wagner & Bode, 2006)	2
	Inadequate infrastructure	(Blanchard, 2009; Muthukrishnan & Shulman, 2006)	2
	Failure of critical systems	(Chopra & Sodhi, 2004; World Economic Forum, 2013)	2
	Obsolescence technology	(Muthukrishnan & Shulman, 2006)	1
	Cyber attacks	(World Economic Forum, 2013)	1
	Unforeseen sequences of new technology	(World Economic Forum, 2013)	1
	Ineffective system integration	(Chopra & Sodhi, 2004)	1
	Unforeseen sequences from E-Commerce	(Chopra & Sodhi, 2004)	1
Physical security	(Blanchard, 2009)	1	
Management	Poor reliability of supplier	(Blanchard, 2009; Chopra & Sodhi, 2004; Christopher & Peck, 2004; Enslow, 2012; Muthukrishnan & Shulman, 2006; Rao & Goldsby, 2009; Tomlin, 2006; Wagner & Bode, 2006)	8
	Delay on shipment and uncertain lead time	(Blanchard, 2009; Chopra & Sodhi, 2004; Christopher & Peck, 2004; Enslow, 2012; Tang, 2006; Tomlin, 2006)	6
	Labor dispute	(Chopra & Sodhi, 2004; Rao & Goldsby, 2009; Wagner & Bode, 2006)	3
	Over dependency to supplier	(Chopra & Sodhi, 2004; Christopher & Peck, 2004; Wagner & Bode, 2006)	3
	Poor quality or yield from supplier	(Chopra & Sodhi, 2004; Tang, 2006; Tomlin, 2006; Wagner & Bode, 2006)	3

Type	Risks	Citation	Count
Table 2: Top cited risks in supply chain management (Continued)			
	Difficulty in contract management	(Chopra & Sodhi, 2004; Rao & Goldsby, 2009; Tang, 2006)	3
	Inappropriate mode of transportation	(Blanchard, 2009; Chopra & Sodhi, 2004)	2
	Reliability of transportation	(Christopher & Peck, 2004; Wagner & Bode, 2006)	2
	Inappropriate manufacturing process	(Blanchard, 2009; Christopher & Peck, 2004)	2
	Low availability of labor	The McKinsey Quarterly (2006); Rao & Goldsby (2009);	2
	Inaccurate forecast	(Chopra & Sodhi, 2004; Tang, 2006)	2
	Distorted information	(Tang, 2006; Wagner & Bode, 2006)	2
	Different labor policy	(Blanchard, 2009)	1
	High cost of labor	(Muthukrishnan & Shulman, 2006)	1
	Low quality of labor	(Muthukrishnan & Shulman, 2006)	1
	Poor brand reputation	(Enslow, 2012)	1

Table 2: Top cited risks in supply chain management (Continued)

As can be seen from Table 2, supply chain management involves in a number of risks. Yet, only a set of certain risks are commonly raised in recent scholarly literatures. From more than sixty risk items, only seven of them are addressed by at least half of the selected papers. Management and economic risks unsurprisingly dominate the majority of the concerns. The challenges which are addressed by more than half of these scholarly literatures are listed as follows:

- Poor reliability of supplier
- Fluctuate product price and value
- Fluctuate demand and supply
- Delay on shipment and uncertain lead time
- Natural disasters
- Instability of production
- Terrorism

Potential Impact of Cultural Differences on Supply Chain Risks

Based on the aforementioned findings, top supply chain risks includes poor reliability of supplier, fluctuate product price and value, fluctuate demand and supply, delay on shipment and uncertain lead time, natural disasters, instability of production, and terrorism. This section analyzes and suggests potential impacts of cultural dimensions of supply chain stakeholders on each of these risks.

Poor reliability of supplier

This risk mostly involves capacity and reliability of the suppliers on successful delivery of the products. Societal inequity and masculinity do not seem to have any connections to this challenge. In contrast, individualism and long term orientation may have certain affects. Since low individualism communities usually prioritize mutual objective, the supply chain stakeholders should strive to meet each other's demands. This is likely to happen more often in countries with higher long term orientation scores and high uncertainty avoidance because the people tend to prefer long term cooperation with familiar counterparts.

Fluctuate product price and value

Product price and value can be changed by an infinite issue. However, culture is not likely to be one of these drivers.

Fluctuate demand and supply

Demand and supply can be very fluctuating in extreme scenarios. Despite the fact that this risk can be human driven, culture does not seem to be a major drive of this risk. It is possible that in a community with low masculinity, the low competitive nature could influence the demand and supply to be more stable. Yet, this relationship is not likely to be significant.

Delay on shipment and uncertain lead time

Delay on shipment and uncertain lead time are mostly caused by disruption of logistic activities. Culture is not likely to be the source of this risk. On the contrary, certain cultural dimensions can exacerbate its outcome. For example, in a high societal inequity culture, people can feel more awkward to directly express problems or reveal negative information which can damage their reputation to their superiors or partners. This can cause false expectation and result in major inaccuracy in supply chain forecasting.

Natural disasters

Natural disasters are major risks which are uncontrollable yet extremely destructive. Yet, cultural differences are obviously not related to them.

Instability of production

Production stability involves problems in the manufacturing lines which cause disruption to the chain of supply. Since production generally involves human resources, cultural differences can play an important role on this risk. Individualism, uncertainty avoidance and long term orientation seem to be the most relevant cultural dimensions which influence production stability in the same way as one of the previous risk, supplier reliability. This challenge could be relatively less likely to happen in a society with low individualism, high uncertainty avoidance and high long term orientation.

Terrorism

Terrorism is a very damaging risk and it is never easy to be predicted. It is illogical to claim that culture and terrorism are related.

Table 3 summarizes potential associations between cultural dimensions and frequently cited supply chain risks. It can be seen that most of these risks are not clearly related to culture. Yet, all of the five cultural dimensions seem to have connections to at least one risk. Indeed, the degree of impact is related to the degree of cultural difference between the supply chain stakeholders. The uprising arrows in Table 3 indicate positive relationships while the downward arrows suggest otherwise. For example, the fluctuate demand and supply could be lower in a lower masculinity culture.

Risks	PDI	IDV	MAS	UAI	LTO
Poor reliability of supplier		↑		↓	↓
Fluctuate product price and value					
Fluctuate demand and supply			↓		
Delay on shipment and uncertain lead time	↑				
Natural disasters					
Instability of production		↑		↓	↓
Terrorism					

Table 3: Expected relationship between cultural dimensions and top supply chain risks

Conclusions

This paper divides risks in supply chain management into six categories, i.e. economic, environmental, geopolitical, societal, technological and management. Based on a review of selected literature seven risks are found to be most frequently cited. These risks includes poor reliability of supplier, fluctuate product price and value, fluctuate demand and supply, delay on shipment and uncertain lead time, natural disasters, instability of production, and terrorism.

Culture is an important foundation of communities. A study on culture suggests that this essential element can be divided into five dimensions. These comprise power distance index, individualism, masculinity, uncertainty avoidance, and long term orientation. A collection of relative cultural scores from various countries are reported. Interestingly, countries within the same region are likely to share similar culture. However, such culture might be completely different in other regions. This can result in cultural clash in cooperative activities, including supply chain management.

Based on assumptions, this paper suggests that culture can have effects on top supply chain risks. Yet, these effects may not be significant as most frequently cited risks are not directly human related. In fact, not only the top referred but also the majority of other less frequently cited supply chain challenges are not significantly related to culture. This fortunate finding suggests that cultural differences might not significantly affect supply chain management.

Nonetheless, managing culture can definitely the overall efficiency of the supply chain. Although not significantly related to the top risks, cultural differences often exacerbate trivial issues into major problems. Building a strong organizational culture can considerably lessen the influence of national culture. This could also apply to building a sustainable culture of the entire supply chain.

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ISSUES AND CHALLENGES IN IMPLEMENTING HALAL LOGISTICS

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Background of the study

Logistics is the [management](#) of the flow of [resources](#) between the point of origin and the point of consumption in order to meet some requirements, for example, of customers or corporations. The resources managed in logistics can include physical items, such as food, materials, equipment, liquids, and staff, as well as abstract items, such as time, information, particles, and energy. The logistics of physical items usually involves the integration of information flow, [material handling](#), [production](#), [packaging](#), [inventory](#), [transportation](#), [warehousing](#), and often [security](#). The complexity of logistics can be modeled, analyzed, visualized, and optimized by dedicated simulation software. The minimization of the use of resources is a common motivation.

Halal vs Haram

Based on Al-Quran, Halal means lawful or permitted. In reference to the food, it is the dietary standard, as prescribed in the Quran the Muslim scripture. General Quranic guidance dictates that all foods are Halal except those that are specifically mentioned as Haram (unlawful or Prohibited). While Haram means not permitted, not allowed or unlawful and illegal. The Al- Quran mentioned;

“O ye who believe! Eat of the good things wherewith We have provided you and render thanks to Allah, if it is He whom we worship¹”

The unlawful foods which are mentioned in the Al-Quran, are in the following verses;

“Forbidden unto you (for food) are: carrion, and blood, and swine flesh, and that which hath been dedicated unto any other than Allah, and the strangled, and the dead through beating, and the dead through falling from a height, and that hath been killed by the gorging of horns, and the devoured of wild beasts saving that which ye make lawful and that which hath been immolated to idols, and that ye swear by the divining arrows”.

"Forbidden to you is anything that dies by itself, and blood and pork, as well as whatever has been consecrated to something besides Allah, and whatever has been strangled, beaten to death, trapped in a pit, gored, and what some beast of prey has begun to eat, unless you give it the final blow; and what has been slaughtered before some idol, or what you divide up in a raffle; (all) that is immoral!...²”

In determining the Halal and Haram status of foodstuffs and other material, Islam has laid general guidelines on this matter, which are:

- 1) All raw materials and ingredients used must be Halal.
- 2) All of the Halal animals must be slaughtered according Islamic way.
- 3) All of the Halal ingredients and materials must not be mixed or come in contact with Haram materials.

Definition of Halal Logistics

Halal logistics is basically the process of managing the procurement, movement, storage, and handling of materials, part of livestock and (semi) finished inventory both food and non-food (and related information, and documentation flows) through the organization and the supply chain in compliance with the general principles of Shariah law.

While Halal Development Corporation (HDC,2010) defined halal logistics as “The basic principal of halal logistics is to ensure segregation of halal cargo from non-halal cargo. This is to avoid cross contamination and ensure that the logistics system is aligned to the expectations of Muslim consumers and so halal integrity is thus protected along the whole supply chain.” The objective of implement halal logistics is to ensure the halal integrity of halal products from the manufacturer to the consumer. The scope of halal logistics covers the halal logistic hub, transportation, route and also the management. The halal status will only be gain when the concept is fully implemented.

Research objective

In order to implementing halal logistics, any issues and challenges must be overcome. So in this research, we are going to determine any issues and challenges in implementing halal logistics. The issues and challenges in implementing halal logistics may become a problem for the service provider in providing the halal logistics services to their customer. With the issues and challenges, the halal logistic services might be hard to achieve. In findings the issues and challenges apparently halal logistics service operators can try to overcome all of the issues in implementing halal logistics.

Problem Statement

According to Darhim D. Hashim (2010) the Muslim population in 2009 is estimated at 1,657.7 million whereby 24% of the world population are Muslims. As Islam is the second largest religion, the demands for halal product are very high. The increasing number of Muslims is very high thus the demand for halal products must also high. It is because the demand for halal products do not come from Muslims only but the demand also comes from non-Muslims. So from that we can see that the demands for halal products are increasing.

It is because Muslims is obliged to consume halal products and avoid any haram products. As Islam obligate their people to consume halal product, the availability of halal product in the market is important to Muslim customers. For Muslims, they will rely on the halal logo in making the product choices. Due to the high cost of halal market, there are some manufacturers and retailers that are misuse in using or gaining the halal certification, halal logo and also halal services. As there are many institutions and agencies that are issuing the halal certificates that is why it might be hard to standardize the standard of halal around the world. And because of that there are some customers become more cautious in making a product choice.

The conventional logistics activities in general comprise of inbound and outbound of transportation management, fleet management, warehousing, materials handling, order fulfilment, logistics network design, inventory management, supply or demand planning and management of third party logistics services providers. Each of this activity was managed separately. Unlike the conventional logistics, halal logistics is a process like conventional but in compliance with generals' principals of Sharia law. As the demand for halal products is high, the needs for halal logistics also must be high. However in providing the halal logistics, there are a few issues and challenges which must be faced by operators in implementing the services. So the issues and challenges might be the reasons why there are only a few operators providing the halal logistics services.

Literature Review

Halal logistics is about embedding excellence in the supply chain during the sourcing, production and distribution processes. When a manufacturer puts a halal logo on products, it is a promise that everything is halal-compliant. The consumer assumes that the manufacturer takes care to ensure halal compliance throughout the supply chain. This means there is a need for halal storage facilities worldwide (Tieman, 2008).

Tieman (2013) defined Halal logistics as the process of managing the procurement, movement, storage and handling of material parts, livestock, semi-finished or finished inventory both food and non-food, and related information and documentation flows through the organization and the supply chain in compliance with the general principles of Shariah (Islamic Law).

Although halal market is booming and on an upward trend, there are very limited studies published on halal logistics (Lodhi, 2009; Zulfakar et al. 2012) and academic research in this area is highly needed (Tieman, 2013). However, there are several studies performed on halal logistics. In Malaysia, halal is under the authority and jurisdiction of Department of Islamic Development Malaysia (JAKIM), a government agency under the Religious Division, Prime Minister's Department Malaysia, and Halal Industry Development Corporation (HDC) under the purview of Ministry of International Trade and Industry (MITI).

There is no standard which is used across the world. The first attempt is made by the IHI Alliance in Malaysia and is official published standards as in; the MS 1500:2004 and the halal food production standard according to (Chaudry and Riaz 2004).

The consumer's consumption trends not only towards halal products but also halal logistics (Kamaruddin and Shabudin 2012). The issues of halal in general are the inconsistent definition of halal, the introduction of halal logo by individual firms, rampant use of Arabic or Islamic signalled brand names, widespread use of Quran verses on products and the lack of enforcement by authorities (Shafie and Othman 2006). If these issues are not rectified it can affect the halal industry, including halal logistics. The issues encountered in halal logistics from the context of the logistics company, the halal products, halal supply chain and halal value chain (Tieman 2011). Other than that the issues related with halal logistics are lack of halal certification authority, halal integrity, issues relating to certification process, transparency issues, and lack of certified halal logistics service provider.

However, halal logistics is still a growing industry worldwide and Malaysia is among the pioneer but there are still not many service providers applying the correct method. The best scenario to describe is the transportation and warehousing process. Segregation of halal and non-halal food products must be practiced to avoid contamination (Riaz and Chaudry, 2004).

In handling the halal food product, the tools must not be shared with non-halal food product by workers as it will cause contamination (Talib 2010). But these systems are not really being practised by operators in the industry hence the halal and non-halal products are still being transported in the same truck or stored in the same warehouse.

Transportation activities for halal logistics can be very challenging because there are lacks of collaborative efforts among the logistics service providers. In other words there can be lack of networking because when one party practicing halal logistics, they can rest assured that the activities are handled according to Shariah law but when the responsibility is passed to other party which are not practicing halal logistics there will be a problem regarding the halal integrity.

Theoretical framework

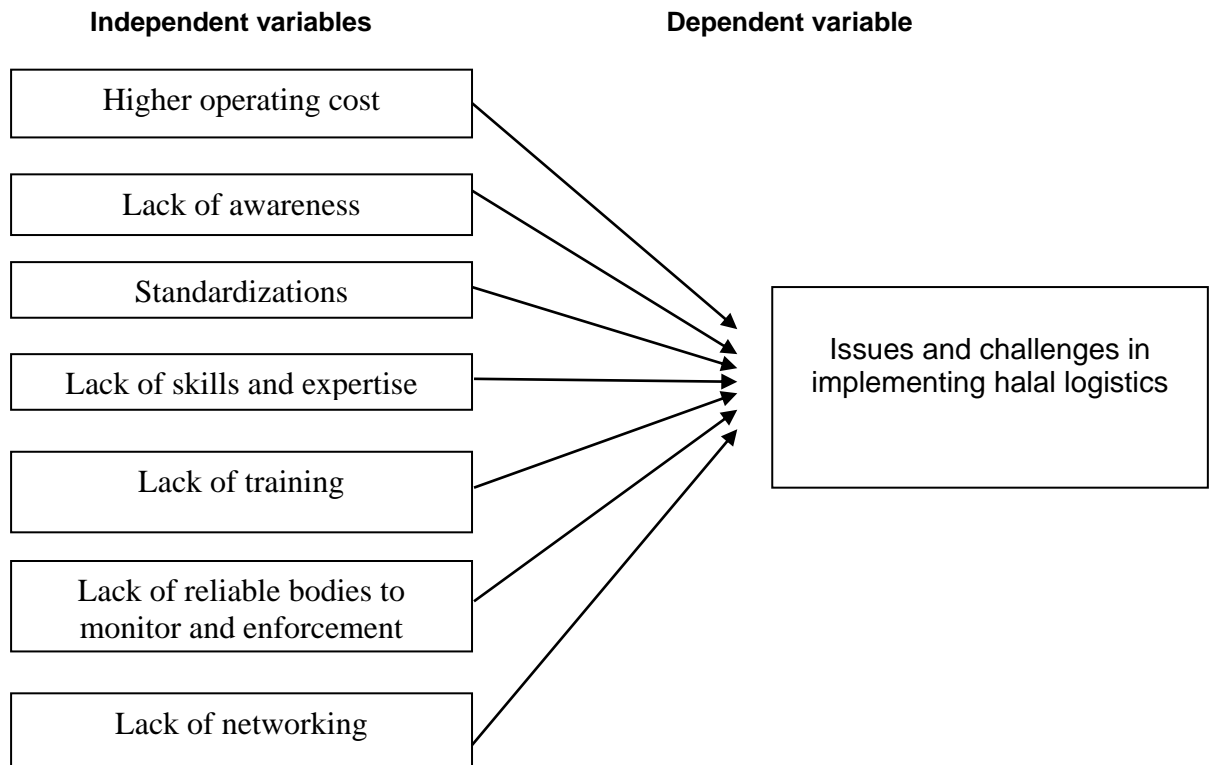


Figure 1: Theoretical framework by Authors

Research Methodology

The method for this research is by using the quantitative and qualitative research. This is due to the previous researchers have used quantitative and also quantitative survey method to collect data. The methodology that will be applied by the study has been chosen in order to acquire information and deduce conclusions about the issues and challenges in implementing halal logistics. For the purpose of this research, and in order to achieve the objectives, data will be collected and will be used both primary and secondary data.

- Primary data - Quantitative and qualitative approach using questionnaires survey will be used in primary data collection. The respondents will be the people whom are working in the logistics industry.
- Secondary data - Literature review from published journal, conference proceedings, books, articles and news releases.

This research paper is using exploratory research design because this type of research design will help researcher to find true problem or something that is unclear in which not much is known about the situation at hand, or no information is available on how similar problems or research issues have been solved in the past. This study is also necessary when some facts are known, but more information is needed for developing a viable theoretical framework. It also can demonstrate the relationship between the dependent variable and also independent variables in the theoretical framework.

As the topic of this study is about the issues and challenges in implementing halal logistics. Hence, this study is a correlational study. When the researcher is interested in delineating the important variables associated with the problem, the study is called correlational study (Uma Sekaran, 2009).

Organizational research can be done in the natural environment where work proceeds normally are called as non-contrived setting (Uma Sekaran, 2009). Therefore, study setting for this research is non-contrived setting this research is appropriate to use non-contrived setting because it involves natural environment and the type of investigation is the correlational studies. In fact, field experiment and field studies are examples of non-contrived setting. This study setting also is done in natural environment with addition of moderate interference by the researcher.

Unit of analysis can be referred as the level of aggregation of the data collected during the subsequent data analysis stage (Uma Sekaran and Bougie, 2009). This is where the researcher will be looking at the data gathered and interview from each of the logistics companies' response as data source. As for this research, the respondents only consist of logistic companies that are providing the halal logistics and also companies which are not providing halal logistics to get accurate data and information regarding the issues and challenges in implementing halal logistics.

The population for this research is the logistic companies' that are providing the halal logistics and also companies that are not providing halal logistics. There are a lot of logistic companies in Malaysia. However the population has been narrowed down to only several big logistic companies in Klang Valley.

Conclusion

From the topic of the research, we can see that the purpose of this study is to find the issues and challenges in implementing halal logistics. As the demand for halal products is high the demand for halal logistics also must be high. So the aim is to find the issues and challenges towards logistics operators in providing and implementing halal logistics services. Following the literature review, researcher found that there are seven issues and challenges which faced by logistics operators. It was hoped that this study would help logistics operators in determined the issues faced by them and help them to overcome the issues and challenges so that they can implement and provide halal logistics services.

Besides this study also will identified operators whom provide the halal logistics services and also operators whom did not provide the halal logistics services. Furthermore this research also can identify the level of awareness towards the halal logistics services in Klang Valley.

The issues and challenges need to be overcome by operators as the halal logistics industry need to keeps pace with the global demand for halal products and services. In logistics, products and services must be handled appropriately to avoid the halal to become haram. So in overcome these issues and challenges, operators and government must play an active role so that all of the issues and challenges could be overcome so that more operators could implement and provide the halal logistics services.

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Author's Biography

Azlina Hj Muhammad graduated in BBA (Transport) from UiTM in 1996 and pursued a degree in MSc International Transport from Cardiff University of Wales, United Kingdom and graduated in 1998. She has gained a tremendous industry experience when she joined Kontena Nasional Berhad (KN) in 1999. Early in her career, she was trained as a strategic and corporate planning professional and moved on to a new and higher level later on within the industry. Her industrial background consists of more than 10 years of successful experience and skills in strategic and corporate planning field. She was also responsible for the setting-up of the Halal Business Unit at KNB and managed to obtain the recognition for KNB as the first Halal logistics provider in the Country. Whilst in the industry, she was heavily involved in the development of various projects via her feasibility studies skills and expertise. Some of the projects that she involved directly were the feasibility study on Cross-border logistics between Malaysia and Thailand, establishment of dry port at Hiep Phuoc Vietnam and development of temperature-controlled distribution centre facilities in Japan. She was also involved with various Government agencies representing Kontena Nasional for her inputs in the initial establishment of ASEAN Multimodal Framework and other works related to ASEAN initiatives. Azlina set herself up as a strategic and corporate planning professional and progress her passion in the same field for getting a job well done. She is also a member of the Chartered Institute of Transport and Logistics (CILT) since 2002.

MANAGING EFFECTIVE LOGISTICS AND SUPPLY CHAIN MANAGEMENT FOR THAILAND'S ONE TAMBON, ONE PRODUCT (OTOP) - A WAY TO CREATING SUSTAINABLE BUSINESS

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Abstract

Under intense competition among small and medium enterprises (SMEs), "One Tambon, One Product" (OTOP product) need to adapt and respond to dynamic changes. Thai government has promoted the OTOP project to continuously boost Thailand's economic growth, and seek competitive advantages. However, there are evidences that OTOP firms lack knowledge and understand how to apply logistics concepts and strategy to their business operations.

The literature in OTOP businesses led to the conclusion that OTOP's logistics adoption has been overlooked. Further, studies on logistics in OTOP products are very few. The objective of the research is to examine issues how to apply logistics in functions for example purchase, production, warehouse and distribution. It also extends a knowledge body related to the status for adopting logistics strategies to OTOP entrepreneurs in Thailand.

A total of 240 questionnaires were distributed and 225 completed questionnaires were returned, generating a response rate of 94 percent. The hypothesis is statistically tested using SPSS version 11.0.5. The results indicated that there are strong relationships between OTOP adoption in functions and enhancing their competitive advantage in term of cost reduction and service level improvement. The implications reflect that encouraging and motivation adopting an effective logistics strategy in functions would offer opportunities, including creating sustainable competitive advantage.

Keywords: Logistics, OTOP, strategy, purchasing, operations, Thailand.

Introduction

Under intense competition among small and medium enterprises (SMEs), "One Tambon, One Product" (OTOP product) need to adapt and respond to dynamic changes. Thai government has promoted the OTOP project to continuously boost Thailand's economic growth, and seek competitive advantages. The programme was designed to upgrade the standard of living of the poor, mainly rural farmers which were a majority of Thai population. In 2004, sales volumes were estimated up to US\$1.63 billion. In 2005, the government set a growth target for OTOP exports of 25-30%. However, there are evidences that OTOP firms lack knowledge and understand how to apply logistics concepts and strategy to their business operations.

After launching the project, there are problems and barriers associated with the OTOP growth, especially, in the area of marketing, production, and logistics. Even though Thai government put full efforts to use marketing and production strategies for developing and promoting OTOP products in international market. However, the role of logistics has been still ignored or at least seen as cost-generated activities. Therefore, the objective of this paper is to survey the current status of logistics adoption in Thailand's OTOP entrepreneurs. It also examines factors affecting the implementation, including using logistics strategies for building competitive advantage. Finally, the effectiveness and efficiency of OTOP firms' logistics implementation will be examined.

Literature Review

The literature from four leading logistics journals between 2005 and 2012 (International Journal of Logistics Management, International Journal of Physical Distribution & Logistics Management, Journal of Business Logistics, Logistics, and Transports and Transportation Review) were reviewed to address issues related to implementation of logistics strategies in SMEs. The relationship between logistics implementation and its organizational effectiveness, especially focusing on the SMEs was also examined.

Logistics management refers to the art of managing the flow of physical material and information from source to user (1). It encompasses all of the information and material flows throughout an organization

and interorganisations (2). It includes everything from movement of a product or from a service that needs to be rendered, through to management of incoming raw materials, production, storing of finished goods, its delivery to the customer and after sales service (3). The role of logistics function is a key determinant of business performance to ensure that there is smooth flow of material and information throughout a company's supply chains (4). Logistics has also become more prominent as a critical success factor in competitive advantage (5, 6) through reducing costs and improving service level or responsiveness to customers.

Problems arising in SME firms include delayed and inaccurate information, incomplete services, slow and inefficient operation, and a high product damage rate (5). While the western small firms are developing and implementing quick response systems, efficient consumer response, cross docking and other areas of logistics management (3, 4, 5), these concept are not yet well recognized by Thailand's SME and OTOP entrepreneurs in making a strategic difference in competitiveness. The SMEs effectively lack strategic logistics formulation and implementation. The consequences are an inability to provide interlinked services, high operating costs and lack of flexibility in responding to changing demand.

Authors (4, 5, 6) identified the critical success factors in effective logistics management including not only good planning, close relationship with partners, effective purchasing, warehouse and distribution management, and effective order processing, but logistics concept and mindset would be pervasive to all levels of an organisation.

The literature review led to conclusion that SMEs are increasingly recognizing the role and importance of logistics management in purchasing and operations as a strategic tool for enhancing competitive advantage. It revealed that effective logistics adoption would be carefully considered associated with factors affecting physical and information flows. It also needs to consider internal and external environmental factors. Further, it found that studies on Thailand's OTOP products were few and very limited, especially in logistics management. The research reveals that OTOP entrepreneurs have not given importance or priority to logistics management. Logistics activities (e.g. warehouse transport and purchasing) are overlooked as potential areas for building competitive advantage.

Research Methodology

First, the study initially conducted exploratory interviews to generate broad views of OTOP operations. It collected data in *two* major sources. Second, secondary sources were conducted through *literature review* and *data analysis*. Thirdly, primary data were collected by using *survey method*, *in-depth interviews* and *observation methods* for examining a relationship between variables and answering research questions.

The questionnaire was used for eliciting attitudes and perceptions of OTOP entrepreneurs in Chonburi province, Thailand. First, pre-testing was carried out to thirty five respondents, which found Cronbach's Alpha equaled 0.92. There were some minor changes in items of questionnaires. Three weeks later, the second pre-testing was conducted on the same group of respondents, with Cronbach's Alpha equaling 0.94. The result showed that the research instrument had a highly acceptable degree of reliability.

The key measures were based on assessing their perceptions related to roles and the importance of logistics, including implementation of logistics functions. Further, they also examined factors affecting implementation and effectiveness and efficiency after implementing logistics strategies in their operations. The questionnaires were randomly distributed to sampling targets by applying a five-point Likert-type scale. The 240 questionnaires were distributed in three major channels: postal mail, face-to-face and electronic mail (e-mail). The total response rate generated was very good with 225 respondents or 94 percent. The span of time took two months. The data was processed with SPSS 11.0.5. Verifying dimensionality and reliability of each construct that included factor analysis, and item-to-total correlation and regression analysis were conducted.

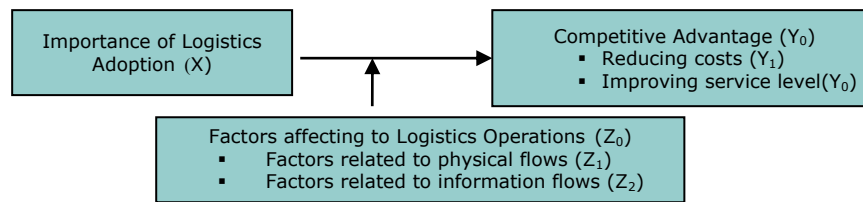


Figure 1 Theoretical framework of the study

Based on the theoretical framework, variable **X** represents OTOP firms' adoption and implementation of logistics activities. Variable **Y₀** represents effectiveness and efficiency in term of cost reduction and service level improvement after adopting logistics management in business operations. After having conducted factor analysis, the variable was grouped in 2 parts: **Y₁** and **Y₂** which were building competitive advantage through cost reduction and improving service level to customers respectively. Variable **Z₀** included factors affecting logistics implementation and using logistics to build competitive advantage. The variable (**Z₀**) was divided in 2 parts: **Z₁** and **Z₂** were factors related to physical flows and information flows respectively

The model was based on two hypotheses of small enterprise behavior to logistics implementation and using logistics strategies for building competitive advantage:

1. OTOP entrepreneurs' perception of logistics need and implementation were positively associated with building the firms' competitive advantage.
2. There was a relationship between factors affecting logistics operations and effective logistics implementation. Identifying the factors would facilitate OTOP firms to develop carefully more integrated logistics strategies.

Finding Results

The results show that samplings are normal distribution. It is significantly used as representative of the population. The variable **Y₀**, which means adoption of logistics in OTOP firms to build competitive advantage can be divided in two groups: **Y₁** and **Y₂** which are building competitive advantage through cost reduction (e.g. operating costs, logistics costs), and improving service level to customers (e.g. responsiveness, flexibility) respectively. Variable **Z₀** includes factors affecting logistics implementation for creating value added in OTOP products. The variable is also divided in two groups: **Z₁** and **Z₂**, which are factors related to physical flows (e.g. effective warehouse, transport), and information flows (order processing, IT for logistics) respectively.

Table 1 Summary relationship between variables

Variable		Sig.	P-Value
Independent	Dependent		
X	Y ₁	0.000	0.784
	Y ₂	0.001	0.842
Z ₁	X	0.001	0.702
Z ₂	X	0.001	0.760

The factors affect to OTOP firms' operations and business. The results show that most firms identify the following factors: lack of raw materials (85%), lack of skilled labors (75%), problems related to product quality (74%), intense competition (67%), economic conditions (64%), fuel prices (64%), customer demand (61%), funds for investment (53%), and support from government sectors (47%).

It also identifies factors influencing logistics implementation, as the result reveals as follows: warehouse management system (91%), after sale services (86%), fuel prices (83%), information technology (IT) for logistics (83%), order processing (80%), material management (78%), transport system (75%), logistics knowledge and management (75%), physical distribution management (64%).

Variable		R Square	Adjusted R Square	Regression Result		Regression Equation
Independent	Dependent			Sig.	Beta	
X1	Y1	0.068	0.054	0.032	0.166	Y = 2.866+0.17X1+0.136X2
	Y2					
X2	Y1	0.068	0.054	0.007	0.136	Y = 3.345+0.225X1+0.11X2
	Y2					
Z1	Y1	0.16	0.06	0.002	0.085	Y = 4.18+0.17X1 - 0.198X2 - 0.198X3
	Y2					
Z2	Y1	0.02	-0.02	0.002	0.047	Y = 4.12-0.047X1 - 0.025X2 - 0.02X3
	Y2					

Table 2 Summary of Regression Results

After testing the hypotheses, the results show a significant relationship between tested variables in some degrees. It found that there is a moderate relationship between the adoption of logistics management (**X**) and building competitive advantage through reducing costs (**Y₁**) and improving service level (**Y₂**). Further, it also found that there is strong relationships between these factors and effective logistics implementation. Importantly, the factors have influence in a higher degree on logistics operations and management, especially factors related to information flow. Physical flow (**Z₁**) has a relationship to a lesser degree with improving service levels to their customers.

Discussion and Research Implications

The results indicate significantly strong relationships between variables. The first hypothesis reflects that entrepreneurs recognize the importance and need of logistics implementation for building and enhancing their competitive advantage. Although adoption of their logistics tends to reduce operating costs more than improve service levels, it also reflects that entrepreneurs have an expectation of outcomes from logistics implementation to a high degree. Further, it found that resources have not been fully utilized. Many Losses of raw materials, for example, occurred in production and movement processes. Transporting finished goods to markets took several weeks, instead of a few days. The symptoms reflect that entrepreneurs sufficiently lack essential skills and knowledge how to effectively implement the logistics strategies to utilize efficiently their resources to minimize costs and improve service levels to customers.

It also found that some factors using IT for logistics for example have a strong contribution and influence on logistics functions and operations. The question is why entrepreneurs provide the factors related to information flow a priority. Mainly, the reason is that entrepreneurs use the internet as importance channel for transaction and receiving orders from customers. However, the internet has been narrowly limited of using only the four and five star products'. Further, some factors related to physical flows influence logistics implementation. Poor warehouse and distribution management, for example, would influence to logistics implementation, in a negative way including their competitive advantage.

While the study covered a wide range of OTOP products, it only surveyed in a specific province. It uses an inductive method or inferential statistics. It studied a small group, but the results should tend to represent the whole population. Therefore, in a broad view, OTOP entrepreneurs would recognize logistics' role and importance as a value-added tool for their operations, including considering as key driving for enhancing their competitive advantage. They would increasingly put more focus on adoption of logistics techniques and strategies with their operations, especially in weak logistics functions (e.g. inventory, distribution and transport management).

Further, entrepreneurs would seek an optimized way for managing logistics functions to reduce costs, in particular non-value added costs. Also, to improve the service level, they would understand importance of customer service, including how to effectively and efficiently manage physical and information flow with higher service quality to enhance customer satisfaction. Controlling is one of the major activities which has been ignored. They would adopt a performance measurement system to monitor and control logistics functions effectively and efficiently. The research implications reflect that building and adopting effective logistics and supply chain strategy offers opportunities to create sustainable competitive advantage. The role of support and assistance from government sectors is still needed, including seeking a way to build sustainable networks among OTOP stakeholders.

Conclusion and Recommendations

The paper examined issues related to logistics in the case of Thailand's OTOP products. The literature was reviewed in area of small and medium enterprises (SME), OTOP products, logistics and supply chain. The review provided a foundation for clearly developing a conceptual framework and research objectives. The rigorous methodology was conducted to generate a reliable and valid measurement instrument. Questionnaires and in-depth interviews were a major tool for collecting data. The sampling was randomly chosen to ensure that it represented characteristics and attributes of the population. The obtained data was analyzed using SPSS.

In conclusion, OTOP entrepreneurs have been limited in understanding the role and importance of logistics affecting their operations. However, it found that entrepreneurs have mostly low education, including low skills and knowledge related to logistics implementation. The importance of factors influencing logistics operations has been ignored. Further they lacked a creative system, process, and culture to support systematic adoption of logistics activities. In addition, they lacked efficient and effective integration of activities related to physical and information flows. Therefore, they urgently need to develop and improve understanding and knowledge of logistics to entrepreneurs. Including encouraging them for adopting new logistics techniques and management. Supports and assistances of government sectors still need with the aim is to building sustainable networks, including providing essential facilities and infrastructures.

Further Research

The study examines issues of Thailand's OTOP industry related to logistics implementation and its effectiveness, and it provides broad views of OTOP products (foods, cloths and gifts), but needs for focusing on logistics implementation on specific products are necessary so that the results can be effectively applied to specific OTOP products. Further, studies mostly use questionnaire survey to the respondents; it was found that it is difficult to make clearly understandable to entrepreneurs, who have mostly low education, through all items of questionnaire. Future research would find an appropriate methodology to elicit their attitudes and opinions based on research objectives.

The author's background

Dr Taweesak Theppitak got three bachelor degrees on political science, and marine engineering, and law. He also graduated on Master of Technology Management and Business Administration from Griffith University and University of Southern Queensland, Australia respectively. After graduated, he got scholarship from the CHE and Burapha University for studying in doctoral degree, and completely finished the DBA from University of South Australia. After having graduated, he completed two postdoctoral program under supporting scholarship from Thailand Research Fund (TRF).

He has currently been working as Associate Professor in Logistics and Supply Chain Management. His research focuses on areas related with management, Tourism Logistics, maritime business, logistics & supply chain, strategic management, port management. He has been now working as Director of Logistics and Management Research Centre, Faculty of Logistics, Burapha University.

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MANAGING LATERAL TRANSSHIPMENTS IN A SUPPLY CHAIN ENVIRONMENT

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Introduction

With the intense competition in the wholesale business sector, there have been significant developments and applications of various supply chain management strategies to streamline the flow of goods. The stochastic nature of retailer demand makes precise demand forecasts impossible, warehouses in turn, cannot plan inventory easily. For cost competitiveness, warehouses tend to maintain the inventory at a low level and face the challenges of satisfying customer expectation for minimized storage cost. Eventhough cost competitiveness has become an imperative in inventory management, hence the adoption of this low inventory strategy, when demand suddenly increases they need to backorder extra supplies from their suppliers or source extra from other wholesalers in the same region. The latter response is known as lateral transshipment which is faster but more expensive than sourcing from general suppliers. Inventory managers need to determine whether orders should be placed with a supplier or another wholesaler, and further, whether it should be in full or partly from a supplier and partly from another wholesaler. Such decisions are influenced by the requirement to minimize the total cost involved.

Previous research into wholesaler inventory management been problematic to adopt in real-world practice. There remains a need for simpler rules for lateral trans-shipment decisions. The method proposed by this study extends the work done by Axsater (2003), who developed a number of important alternative decisions for the wholesaler to consider in lateral trans-shippments. Axsater (2003) put a significant focus on future cost difference for a certain initial state and the highly mathematical analysis and probability assumptions may not be easily understood by ordinary managers. We extend the objectives of Axsater (2003) but deviate from them in deriving a decision rule that can be conveniently used by inventory managers without performing complex mathematical calculations. Our approach handles the cost difference issue raised above using an alternative approach mainly based on predicted holding and backorder costs in different time periods.

The next section briefly review the relevant literature followed by the development of the proposed mathematical model for total costs, including purchasing costs, backordering costs and holding costs that are encountered in inventory replenishment by wholesalers and develops the decision rules for trans-shippments. Next we discuss the effectiveness of the decision model.

Literature Review

Optimization in the supply chain network environment has been studied from different perspectives including supplier selection (Ghodsypour and Brien,2001); determining transshipment quantities (Herer et al.,2006) delivery scheduling and distribution (Torabi et al.,2006) and product family selection (Lamothe et al.,2006). Taking into account the minimization of the total cost of logistics, including net price, storage, transportation and ordering costs, Ghodsypour and Brien (2001) studied the supplier selection problem in a multiple sourcing environment and proposed an algorithm comprising the pure non-linear programming model as a solution. On replenishment strategies and transshipments, Herer et al. (2006) focused on minimizing the expected long-run average cost including the replenishment, transshipment, holding, and penalty costs with the objective of finding the transshipment and replenishment quantities. They demonstrated how the values of the order-up-to quantities could be calculated using a sample-path-based optimization procedure and how to determine an optimal transshipment policy, using a linear programming/network flow framework. In another study, Lamothe et al. (2006) focused on minimizing the total cost comprising fixed cost of existence of physical items, fixed costs of existence of facilities, resource lines, shipping channel, and variable manufacturing, inventory and shipping costs and a mixed integer linear programming model was used as the solution.

Archibald et al. (1997) proposed using a stochastic dynamic program to optimize the decision of whether to laterally trans-ship. According to Axsäter (1990), when a wholesaler cannot supply goods to a retailer, lateral trans-shipment can take place and he proposed a method for optimizing the control policy of inventory replenishment. His model developed decision rules for lateral trans-shipments, aiming to evolve an integrated approach for supporting decisions regarding trans-shipment of goods. The proposed decision rule by Axsäter (2003) is difficult to visualize the underlying concept and adopt practically. The evaluation of the decision rule suggested by Axsäter (2003) lacks proper illustrations of how to put it in real practice. Consequently, the practical implications of that model are limited due to the requirement of sound knowledge of mathematics for application. Mathematical complexity of methods developed in previous studies hinder the application and adoption by logistics practitioners causing wholesaler inventory managers still using adhoc methods to make decisions. This paper studies the sourcing decisions of a wholesaler in fulfilling retailer demand and provides a pragmatic approach deriving simple decision rules that are conveniently adoptable by wholesaler inventory management.

Developing the Model

We assume that all wholesalers apply a periodic review policy described by Rosenshine and Obee [18] to replenish from external suppliers.

We define the following notation used in the model development.

W_i = the i th wholesaler,

N_i = the total number of suppliers to the wholesaler W_i ,

S_{ij} = the j th supplier of the wholesaler W_i ,

P_{ij} = the unit selling price by S_{ij} to W_i ,

q_{ik} = the unit intra-shipment cost for W_i to intraship from W_k ,

b_i = unit back-order cost at W_i per unit time,

h_i = unit holding cost for W_i per unit time,

t_0 = start of the scheduling period, $t=0$,

$g_{ij}(t)$ = delivery lead time probability mass function of S_{ij} ,

L_{ij} = lead time of S_{ij} with duration equal to L_{ij} times unit time interval,

L_{ij}^{max} = the maximal lead time of S_{ij} ,

$d_i(0)$ = the initial retailer demand at $t=0$ appearing at W_i ,

$\lambda_i(t)$ = the retailer arrival intensity during the tth time interval at W_i ,

$f_{i,m}^n$ = the probability of n retailers arriving at W_i with a total demand of m,

$\hat{d}_i(t)$ = the expected retailer demand at wholesaler W_i in the tth time interval,

\hat{D}_{ij} = the expected retailer demand at wholesaler W_i over L_{ij}^{max}

Following Axsater [3], we assume retailer demand is a Compound Poisson process and retailers arrive at the wholesaler at an arrival intensity of λ . Assuming the probability of n number of retailers arriving at W_i wholesaler during a time interval of length t is $P_{d_{i,t}}(n)$,

$$P_{d_{i,t}}(n) = \exp^{-\lambda_i t} \frac{\{\lambda_i t\}^n}{n!} \tag{1}$$

If the conditional probability of n number of retailers requires m demand is given by

$P_{d_{i,t}}(m|n) = f_{1,m}^n$ then the probability of retailer demands at the W_i wholesaler during the time interval t is,

$$\begin{aligned} P_{d_{i,t}}(m) &= \sum_{n=1}^m P_{d_{i,t}}(m|n)P_{d_{i,t}}(n) \\ &= \sum_{n=1}^m e^{-\lambda_i t} f_{1,m}^n(n) \frac{\{\lambda_i t\}^n}{n!} \end{aligned} \tag{2}$$

The expected retailer demand at W_i wholesaler during a time t is given by

$$\hat{d}_i(t) = \sum_{m=1}^{\infty} m P_{d_{i,t}}(m)$$

Applying the function of $P_{d_{i,t}}(m)$ from equation 2,

$$\hat{d}_i(t) = \exp^{-\lambda_i t} \sum_{m=1}^{+\infty} \sum_{n=1}^m \frac{\{\lambda_i t\}^n}{n!} m f_{1,m}^n(n) \tag{3}$$

At $t=0$, demand with the wholesaler W_i , $d_i(0)$ is the outstanding demand carried forward from the previous scheduling period and that needs to be urgently fulfilled.

If the supplier, S_{ij} of the wholesaler W_i takes L_{ij} lead time to deliver the order and assuming that the probability mass function of delivery lead time of S_{ij} is $g_{ij}(t)$ then the expected lead time of $E(L_{ij})$ is given by

$$E(L_{ij}) = \int_{t=0}^{L_{ij}} t g_{ij}(t) dt$$

Let's consider that one scheduling period is the maximum lead time of Sij, L_{ij}^{max} . Then the expected demand at Wi during one scheduling period is

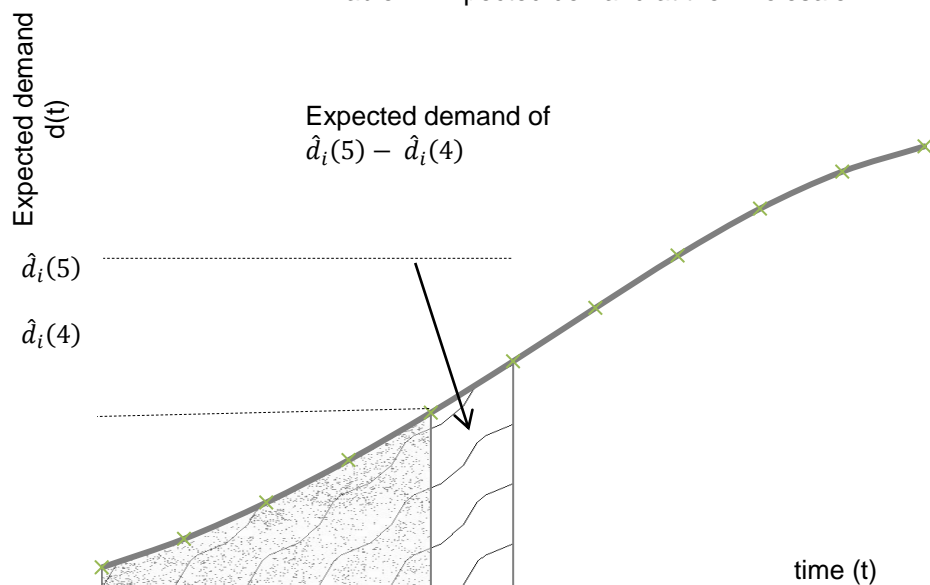
$$\hat{D}_{ij} = \sum_{k=1}^{L_{ij}^{max}} \hat{d}_i(k)$$

From equation 3,

$$\hat{D}_{ij} = \sum_{k=1}^{L_{ij}^{max}} e^{-\lambda_i k} \sum_{m=1}^{+\infty} \sum_{n=1}^m \frac{\{\lambda_i k\}^n}{n!} m f_{1,m}^n(n) \tag{4}$$

Time period	Expected demand
$[t_0-t_1]$	$\hat{d}_i(1)$
$[t_1-t_2]$	$\hat{d}_i(2) - \hat{d}_i(1)$
$[t_2 - t_3]$	$\hat{d}_i(3) - \hat{d}_i(2)$
...	...
$[(L_{ij}^{max} - 2) - (L_{ij}^{max} - 3)]$	$\hat{d}_i(L_{ij}^{max} - 1) - \hat{d}_i(L_{ij}^{max} - 2)$
$[(L_{ij}^{max} - 1) - (L_{ij}^{max})]$	$\hat{d}_i(L_{ij}^{max}) - \hat{d}_i(L_{ij}^{max} - 1)$

Table 1: Expected demand at the wholesaler Wi



- Expected demand during t=5 and t=0 , $\hat{d}_i(5) - \hat{d}_i(0)$
- Expected demand during t=4 and t=0 , $\hat{d}_i(4) - \hat{d}_i(0)$

Figure 1: Diagram of expected demand at the wholesaler Wi

Figure 1 presents a schematic diagram of the expected retailer demand at wholesaler W_i and Table 1 presents the expected demand for each time period. The calculations in the following sections refer back to these for better understanding.

Costs of Supply

Inventory costs of a wholesaler consist of three components: purchasing costs of P_{ijk} of the orders to suppliers and intra-shipments from the other wholesalers, backordering costs of B_{ijk} for unfulfilled retailer demands and holding costs of H_{ijk} for carrying inventory for potential demands.

$$C_{ijk}(x) = P_{ijk}(x) + B_{ijk}(x) + H_{ijk}(x) \quad (5)$$

We consider the maximum lead time taken by the supplier is the scheduling period for the wholesaler's decision. In our model, the period to update the wholesaler is set to the maximal lead time of the given supplier. So all the orders made should be received in the period. W_i therefore there will be no outstanding orders from its suppliers at the initial point of a new period, which will simplify the total cost model and decision rules for intra-shipment. So the inventory level of the wholesaler is equal to its inventory position.

Purchasing costs

The purchasing cost has two components depending on the source of supply: supplier or another wholesaler. If the unit cost of purchasing from the supplier S_j is p_{ij} , the unit cost of trans-shipping from the wholesaler W_k is q_{ik} and the trans-shipped quantity is x units then the purchasing cost of $P_{ijk}(x)$ is given by

$$P_{ijk}(x) = p_{ij}(d_i(0) - l_i(0) + \widehat{D}_{ij} - x) + q_{ik}(x) \quad (6)$$

Where $d_i(0)$ and $l_i(0)$ are the outstanding order quantity and the inventory level of the W_i at $t=0$.

Backordering costs

For the initial back-ordered quantity of $(d_i(0) - l_i(0) - x)$ the back-ordering time is the expected arrival time of order from the supplier. We assume that intra-shipping cost from another wholesaler is significantly higher than the purchasing cost from suppliers. Hence, only the urgent orders are intra-shipped and others are sourced from suppliers. We also assume that intra-shipped orders have zero lead time. Hence, at the beginning of the scheduling period, any outstanding order that cannot be fulfilled by the local inventory and intra-shipped orders, generate backordering costs, until the expected supplier order supply entry day. Subsequent retailer demands expected to arrive during the time range of $0 \leq t \leq E(L_{ij}) - 1$ are not fulfilled due to stock-out status and consequently they generate backordering cost depending on the back-order time.

Based on the expected retailer demand as shown in Figure 1 and Table 1, the following Table 2 presents the back-order time for the unfulfilled demand at the wholesaler, W_i .

Time period of demand	demand	Backorder period (e.g. number of days)
at t_0	$(d_i(0) - l_i(0) - x)$	$E(L_{ij})$
$[t_0 - t_1]$	$\hat{d}_i(1)$	$E(L_{ij}) - 1$
$[t_1 - t_2]$	$\hat{d}_i(2) - \hat{d}_i(1)$	$E(L_{ij}) - 2$
$[t_2 - t_3]$	$\hat{d}_i(3) - \hat{d}_i(2)$	$E(L_{ij}) - 3$
...
$[\{E(L_{ij}) - 2\} - \{E(L_{ij}) - 3\}]$	$\hat{d}_i(E(L_{ij}) - 2) - \hat{d}_i(E(L_{ij}) - 3)$	2
$[\{E(L_{ij}) - 1\} - \{E(L_{ij}) - 2\}]$	$\hat{d}_i(E(L_{ij}) - 1) - \hat{d}_i(E(L_{ij}) - 2)$	1

Table 2: Backorder time period for the unfulfilled demand

If B_{ijk} is the backorder cost for the wholesaler W_i for the orders placed with the supplier S_{ij} after the intrashipments from the W_k and b_{ij} is the unit back-order cost then ,

$$B_{ijk}(x) = b_{ij}(d_i(0) - l_i(0) - x)E(L_{ij}) + b_{ij} \int_{t=1}^{E(L_{ij})-1} \{\hat{d}(t) - \hat{d}(t-1)\} \{E(L_{ij}) - t\} dt \tag{7}$$

Holding costs

During the scheduling period, holding costs are incurred after the order is received at the expected lead time of the supplier and the outstanding demands are delivered i.e. during the time period of $E(L_{ij}) + 1 \leq t \leq L_{ij}^{max}$. Based on the expected demand as shown in Figure 1 and Table 1, the following table 3 presents the holding cost for the stock received from the supplier at $E(L_{ij})$.

Time period of demand	demand	Holding period (e.g. in number of days)
$\{E(L_{ij}) + 1\} - E(L_{ij})$	$\hat{d}_i(E(L_{ij}) + 1) - \hat{d}_i E(L_{ij})$	1
$\{E(L_{ij}) + 2\} - \{E(L_{ij}) + 1\}$	$\hat{d}_i(E(L_{ij}) + 2) - \hat{d}_i(E(L_{ij}) + 1)$	2
$\{E(L_{ij}) + 3\} - \{E(L_{ij}) + 2\}$	$\hat{d}_i(E(L_{ij}) + 3) - \hat{d}_i(E(L_{ij}) + 2)$	3
...
$\{L_{ij}^{max} - 1\} - \{L_{ij}^{max} - 2\}$	$\hat{d}_i(L_{ij}^{max} - 1) - \hat{d}_i(L_{ij}^{max} - 2)$	$E(L_{ij}^{max} - 1) - E(L_{ij})$
$L_{ij}^{max} - \{L_{ij}^{max} - 1\}$	$\hat{d}_i(L_{ij}^{max}) - \hat{d}_i(L_{ij}^{max} - 1)$	$E(L_{ij}^{max}) - E(L_{ij})$

Table 3: Holding period of the stock received from the supplier

If the total holding cost of H_{ijk} during the scheduling period and the unit holding cost of the W_i wholesaler is h_i then,

$$H_{ijk}(x) = \int_{t=E(L_{ij})+1}^{L_{ij}^{max}} \{\hat{d}(t) - \hat{d}(t-1)\} \{t - E(L_{ij})\} h_{ij} dt \quad (8)$$

Decision rule for intra-shipment orders

By substituting the functions of purchasing costs, backordering costs and holding costs in equation 5, the total cost during the scheduling period is given by,

$$C_{ijk}(x) = p_{ij}(d_i(0) - l_i(0) + \widehat{D}_{ij} - x) + q_{ik}(x) + (d(0) - l(0) - x)EL_{ij}b_i + b_i \int_{t=0}^{E(L_{ij})-1} \hat{d}(t) - \hat{d}(t-1) \{E(L_{ij}) - t\} dt + \int_{t=E(L_{ij})+1}^{L_{ij}^{max}} \{\hat{d}(t) - \hat{d}(t-1)\} \{t - E(L_{ij})\} h_i dt$$

$$C_{ijk}(x) = \{-p_{ij} - E(L_{ij})b_{ij} + q_{ik}\}x + p_{ij}(d_i(0) - l_i(0) + \widehat{D}_{ij}) + \{d_i(0) - l_i(0)\}E(L_{ij})b_i + b_i \int_{t=1}^{E(L_{ij})-1} \{\hat{d}(t) - \hat{d}(t-1)\} \{E(L_{ij}) - t\} dt + \int_{t=E(L_{ij})+1}^{L_{ij}^{max}} \{\hat{d}(t) - \hat{d}(t-1)\} \{t - E(L_{ij})\} h_i dt \quad (9)$$

With respect to the quantity of trans-shipment (x), the total cost function as shown in equation 9 is linear. When the tangent of the above linear function ($-p_{ij} - E(L_{ij})b_i + q_{ik}$) is negative the total cost decreases with the increasing number of trans-shipments.

Hence the decision rule for intra-shipments is

$$-p_{ij} - E(L_{ij})b_i + q_{ik} < 0$$

$$q_{ik} < p_{ij} + E(L_{ij})b_i \quad (10)$$

If the above decision rule shown in equation 10 is satisfied, the higher the quantity of trans-shipment the lower the total cost for the wholesaler W_i .

Discussion and Conclusion

The decision method proposed in this study assists the inventory management of wholesaler operations in making decisions on whether to trans-ship outstanding urgent retailer demands or back order from suppliers in full. The main benefit of this decision support system is the ease of application by wholesaler inventory management. The decision is driven by the important cost minimization objectives, the simplicity of the rules and the need for less cumbersome data inputs to the model, underpin the ease of adoption. The main decision rule needs only the unit purchasing cost from suppliers, unit trans-shipment cost from another wholesaler, own unit backordering cost, and the expected lead time from its suppliers. The proposed decision rule algorithm can be integrated as a module of the existing enterprise resource planning applications with the capability of extracting data from previous transaction records in the internal databases, thereby extending the capability of achieving more reliable and accurate expected costs in inventory management operations.

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NON-HIERARCHICAL CONNECTIONS IN A TRANSPORTATIONAL AHP MODEL

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ABSTRACT

The aim of this paper is to introduce an Analytic Hierarchy Process (AHP) model on a public transportation system. The original AHP model is amended by non-hierarchical connections of system elements, which can be considered as extra information for the final decision. The model has been tested on a Japanese city bus transportation system. The created model is applicable for complex transport system development decisions. Based on our findings, ANP (which is recommended in MCDM literature for considering both hierarchical and non-hierarchical connections in a decision) could be substituted by an AHP-ISM approach, which is easier and more realistic to apply. Moreover, the connections of transport system elements are dominantly hierarchical, so AHP structure is advisable to keep; non-hierarchical linkages are just extra information for the decision. The created model not only promotes the AHP idea by considering non-hierarchical linkages but also offers a more practical decision making procedure than ANP.

Keywords: public transport, AHP, ANP, ISM, MCDM

INTRODUCTION

In multi-criteria decision making (MCDM) the structure of the examined elements plays a key role in the final scoring. There are two basic cases: hierarchical and network types are distinguished in scientific literature. For the determination of the structure, many authors suggest Interpretive Structural Modeling (ISM). Gorvett and Liu (2007) claimed that before setting up the decision model it is advisable to pursue an ISM procedure to shed light on the linkages among the relevant factors. Huang et al (2005) applied ISM for examining network impacts among decision elements. Thakkar et al (2008) suggested using ISM combined with graph theory for gaining an overall view of the structure of decision issues.

Provided the structure is hierarchical (based on ISM or graph theory or simply, on experts' consensus) and qualitative and quantitative factors are also included, Analytic Hierarchy Process (AHP) is an effective tool to apply for the multi-criteria decision problem (Saaty, 1977, Duleba et al, 2012, Carlsson and Walden, 1995, Yang and Shi, 2002).

In case the evaluators are facing a network type structure, Analytic Network Process (ANP) is recommended for solving the decision problem (Saaty, 2004, Ergu et al, 2011, Niemira and Saaty, 2004).

However it is stated in several operations research papers (e.g. Ergu et al, 2011) that by the application of ANP, the matrices to be evaluated are more complex and the evaluation procedure requires more effort from the decision makers.

This paper aims to create a different approach. The examined structure of the decision (weighting the necessity of element-development in a public transport system) is basically

hierarchical, which has been proved by a conducted AHP research. In spite of that some non-hierarchical connections can be also detected, which are weaker than the dominant hierarchical ones. The objective is to consider these non-dominant linkages in the final weight score computation and to keep the original structure simultaneously. For this approach, ANP is not necessary to apply and AHP scoring can be kept.

THE AHP MODEL FOR PUBLIC TRANSPORT SUPPLY QUALITY

Having elaborated the relevant scientific references, the following hierarchical structure has been created for public bus transportation (Fig.1.):

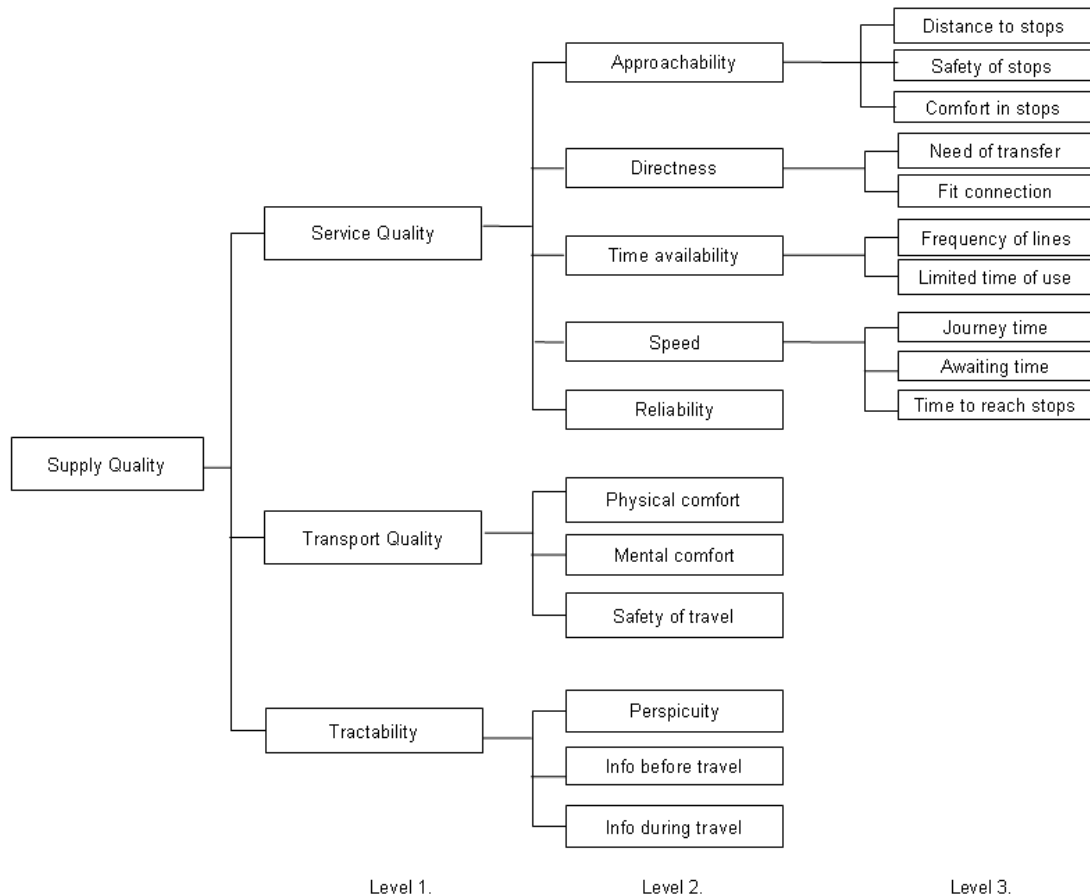


Figure 1 – The constructed AHP model

Then – following the AHP process – pair wise comparisons were made among the elements by constructing matrices within the groups of factors. After checking consistency, the individual evaluator scores were summarized by:

$$f(y_1, \dots, y_l) = \prod_{k=1}^l y_k^{\frac{1}{l}}, \quad l \geq 2, (y_1, \dots, y_l) \in I^l \quad (1)$$

Where “f” is the summarizing function, “l” is the number of the evaluators. y_k represents the proper indexed matrix element of the evaluator “k”. I^l is the set of positive numbers.

In the next step, eigenvectors of the aggregated matrices were computed as:

$$w_{ei} = w_{ij} w_j, i=1, \dots, n \quad (2)$$

w_j ($j=1, \dots, m$) normalized weight of the previous level

w_{ij} ($i=1, \dots, n$) normalized eigenvector-coordinate of the current level.

By this calculation, all weight scores could be determined for the structural elements. The higher the score has been, the more importance (in terms of its development) has been attained to the certain element. However this computational process considered only the hierarchical position and connections of each element.

ADDING NON-HIERARCHICAL LINKAGES TO THE MODEL

Evidently, the elements of Fig. 1. are not only hierarchically dependent. E.g. the factor of “frequency of lines” might have an impact on “physical comfort”, more frequently the buses are coming, less crowded is the vehicle. Another example is the effect of “frequency of lines” on “awaiting time”, etc.

Although these dependencies might be very important in terms of the decision making (the key question of this MCDM is: which element should be improved in order to gain the most improvement from passengers’ perspective), they are not considered in the AHP procedure.

For the consideration of these dependencies, external information is necessary from experts to nominate all non-hierarchical connections of the structural elements. Interpretive Structural Modeling (ISM) has been applied to highlight all relevant connections with the evaluation of 3 transportation experts.

For that objective, firstly the relation matrix has to be constructed. This is a binary and quadratic matrix (the number of rows and columns equals the number of structure elements), with the following principle:

$a_{ij} = 1$, if element “i” affects element “j”

$a_{ij} = 0$, otherwise

The general structure of a relation matrix (D):

Table 1 – The general structure of a relation matrix in ISM

	e_1	e_2	...	e_n
e_1	0	a_{12}	...	a_{1n}
e_2	a_{21}	0	...	a_{2n}
...	0	...
e_n	a_{n1}	a_{n2}	...	0

where

e_i is the i-th element of the system,

a_{ij} denotes the relation between i-th and j-th element.

Then the following step is to be taken:

$$RM=D+I \quad (3)$$

so unity matrix (I) is added, which makes the main diagonal consist all 1-s. By that RM, reachability matrix is gained.

At this stage however, ISM procedure has been stopped. Following the original ISM rules, final RM should have been created in order to gain transitivity among the linkages and then iterations should have been done in order to create a structure based on the overall linkages of the elements. For this MCDM, only the direct and additional (so non-hierarchical) connections were to be determined, so the ISM procedure must be stopped.

Let us denote

e_i the i -th element of the system, $i=1, \dots, n$

k_{ei} all non-hierarchical connections of the element e_i , $k=1, \dots, t$,

μ_{kei} the specific rate of connection k_{ei} , which is determined by experts, $0 < |\mu_{kei}| < 1$.

μ_{kei} represents the rate of impact which is caused by improving the element e_i on the affected element. E.g. if “frequency of lines” is improved in the system, the element of “physical comfort” is also improved, but certainly not by 100%, only e.g. 20%. Then the rate of this connection for element e_i will be: 0,2, so $\mu_{kei}=0,2$, if $k=1$ (in case it is the first non-hierarchical connection of “frequency of lines”).

Let us denote

e_{kei} the element which is affected by the element e_i in the connection of k_{ei} .

When $\mu_{kei}=0,2$, then we can modify the original weight score of the element e_i with adding the score of the affected element e_{kei} multiplied by the rate of the connection, so with μ_{kei} .

$$w_{ei}' = w_{ei} + \sum_{k=1}^t \mu_{kei} w_{kei} \quad (4)$$

Where

w_{ei}' denotes the modified score of element e_i

w_{ei} the original score of element e_i

μ_{kei} the rate of (non-hierarchical) connection k

w_{kei} the score of the affected element by the impact of connection k .

w_{ei} and w_{kei} denote the original AHP scores of the elements obviously.

As can be seen, the AHP score of each element is modified by the non-hierarchical impacts on other elements in the structure. Those factors, which affect several other elements positively, will gain higher scores than the other ones. Note that μ_{kei} sometimes can be negative, in case one element affects the other negatively, in this case, the final score will be decreased for the specific factor. Based on (4) the importance and the influence of the factors within an arbitrary structure might be integrated in the decision making process.

CONCLUSION

Even in a dominantly hierarchical structure, some non-hierarchical connections can be determined, which might affect the final scoring in a multi-criteria decision making procedure. AHP process should not be replaced in those cases with the much more complicated ANP methodology; more proper way might be to modify the original AHP scores by adding the non-hierarchical impacts to the weight scores of elements.

For detecting all extra linkages, ISM is recommended but only till the phase of constructing the reachability matrix (RM).

The modification procedure will most likely cause rank-reversal of the elements, those factors which have many and strong impacts on others will gain higher weight scores in the final ranking of importance, and the others will probably be ranked behind than the original position.

The introduced procedure and approach might be even more important because in management practice, it is very hardly to find a clear, only hierarchically connected structure of elements.

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OPPORTUNITIES AND CHALLENGES OF LOGISTICS IN A HYPER-AGED SOCIETY

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Introduction

The ageing population has been an important issue in recent all over the world. According to a report of World Health Organization (WHO, 2012), the world's population of people 60 years of age and older has doubled since 1980 and is estimated to reach 2 billion by 2050. The proportion of the world's population over 60 years will still double from about 11% to 22% between 2000 and 2050. Moreover, the number of people aged over 80 years will quadruple in the same period. By 2050 the world will have almost 400 million people aged over 80 years.

A country or a society is defined as an ageing society if the number of its people aged 65 years and over exceeds 7%. With 14%, the society is defined as an aged society. If the proportion reaches at 21%, it is referred as a hyper-aged society. Among the nations, Japan is the first country that stepped in a hyper-aged society, although "Aging Society White Paper" of Japan and several glossaries note that the definitions of those terms were not technically defined.

Although longevity is a reason for celebration, an ageing society has some challenges. Japan, as a hyper-aged society, has also some issues in the fields of health and welfare, pension, industry, and so on. This paper focuses on the last-mile issue of logistics. This is because there are so many people who have difficulties in buying something. They are called in Japan as "*shopping refugees*" or restricted shoppers. As the number of retailers has been decreasing specifically in rural areas due to decline of demand, older people appear to be in distress. There is a tendency that the elderly is referred as shopping refugees, although the elderly has been considered as a new considerable market.

Many studies on logistics have been released specifically to increase efficiency of logistics activities. Almost of them tend to cover from suppliers to retailers, but final customers are not covered. That might be because the final customers generally take the commodities home by themselves when they go shopping. In an ageing society, however, it is essential that logistics focus more on the process to the final customers, i.e. the last-mile. This paper, therefore, aims at identifying the opportunities and challenges of logistics in a hyper-aged society of Japan. Last-mile issues of logistics are addressed and the measures for the last-mile issues are reviewed. A possibility for a certification mark system is also considered after some challenges are discussed.

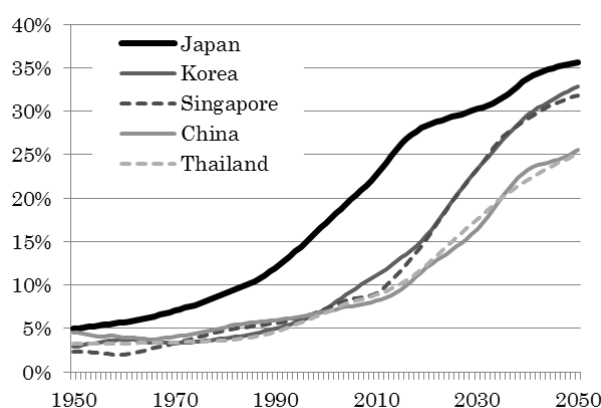


Figure 1: The proportion of 65 years and over in five Asian countries

Data: United Nations, Department of Economic and Social Affairs, Population Division (2011). World Population Prospects: The 2010 Revision, CD-ROM Edition.

Ageing population and last-mile issue of logistics

Ageing population

Japan was put on an ageing society in 1970. The proportion of people aged 65 years and over was 7.0% in 1970. The proportion has been increasing steadily and rapidly. The number went to 14.4% in

1995 and 21.4% in 2008. It is expected to increase to 35.6% in 2050. The trend of ageing population is not unique to Japan in Asia. United Nations estimates that Korea and Singapore will step in a hyper-aged society in 2027, China and Thailand in 2037. The proportion is expected to be 33% in Korea, 32% in Singapore, 26% in China and 25% in Thailand by 2050 (See Figure1). It is possible to say that those Asian countries will have the same issues of Japan in near future.

Declining retailers in Japan

The number of retailers in Japan hit the pick in early 1980s and has been decreasing steadily. They decreased by 34% to about 1.1million in 2007 from the peak (about 1.7million in 1982) and even by 24% from about 1.5 million in 1972(See figure 2). It is said that the decrease resulted from the decline of demand due to low birth-rate and ageing population. This is supported by comparisons over the proportion of the elderly, the change rate of populations, and the decreasing rate of the number of retailers. This paper examined their relations by area (47 Japanese prefectures) with data of the commercial statistics (METI, 1972~2007) and the population statistics (Statistics Bureau, 1970~2010).

When we pick up the top 10 areas by the highest proportion of the elderly, the highest decrease ratio of population, and the highest decrease ratio of retailers, respectively, we can see many areas that appears in all group, as shown in table 1. For instance, Akita prefecture has the highest proportion of the elderly (29.5%) as of 2010 and also has the highest ratio in decrease of population between 1970 and 2010 (-12.5%). The decrease ratio of the number of retailers in Akita appears -37.1% where is the second highest decline. In the same way, six areas among the top 10 aged areas are still observed in the top 10 areas of decreasing retailers. (See table 1)

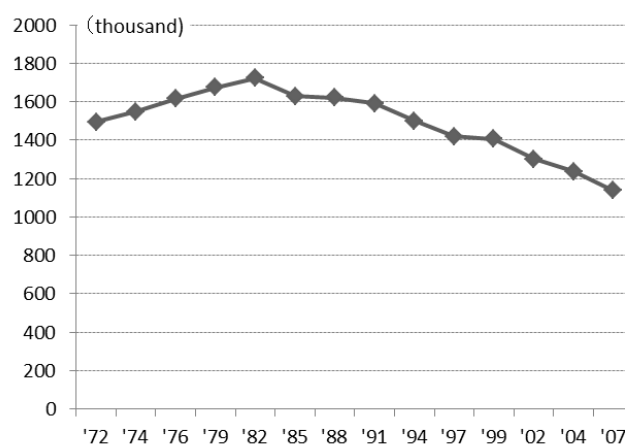


Figure 2: The number of retailers in Japan

Data: Commercial statistics, each year, METI (Ministry of Land, Infrastructure, Transport and Tourism)

Top 10 areas of the proportion of the elderly As of 2010 (A)			Top 10 areas of the decrease of population 1970/2010 (B)			Top 10 areas of the decrease of retailers 1972/2007 (C)		
No.*	Area Name	ratio	No.*	Area Name	ratio	No.*	Area Name	ratio
5	Akita	29.5%	5	Akita	-12.5%	36	Tokushima	-38.6%
32	Shimane	28.9%	42	Nagasaki	-9.1%	5	Akita	-37.1%
39	Kochi	28.5%	32	Shimane	-7.3%	35	Yamaguchi	-35.2%
35	Yamaguchi	27.9%	6	Yamagata	-4.6%	30	Wakayama	-34.8%
6	Yamagata	27.5%	35	Yamaguchi	-4.0%	16	Toyama	-32.8%
3	Iwate	27.1%	30	Wakayama	-3.9%	39	Kochi	-32.4%
30	Wakayama	27.0%	2	Aomori	-3.8%	37	Kagawa	-31.6%
36	Tokushima	26.7%	3	Iwate	-3.0%	6	Yamagata	-31.1%
44	Oita	26.5%	39	Kochi	-2.8%	32	Shimane	-31.0%
20	Nagano	26.4%	46	Kagoshima	-1.3%	38	Ehime	-31.0%

*Area no. is the given number of Japanese prefectures.

Table 1: Top 10 areas by elderly proportion, decrease of population and retailers

Last-mile issues of logistics in a hyper-aged society

Last-mile issues of logistics have been getting common in Japan. The last-mile refers to the process of delivering goods to end-users or the final customers. Regarding the last-mile issues, several studies in humanitarian logistics have been released with aiming at investigating how to deliver the relief goods to the victims of disaster such as the earthquake, tsunami, and so on. The victims appear in the middle of the area where disaster occurred. Transport networks around the disaster area are sometimes damaged or destroyed. That implies that the last-mile to the victims is the hardest and the most significant process in delivering relief goods in order to save them.

In addition to the last-mile issue in emergency, there is another last-mile issue in a hyper-aged society. That is called as “shopping refugees” in literal sense of Japanese or the restricted shoppers. Shopping refugees are those have difficulties in daily shopping because of the decreasing retailers in their neighbourhood, the shrink of public transportation network, and even their physical features. That is a critical issue of logistics because logistics has the mission to provide goods to the right place is needed. Unlike the victims of disasters, they always worry about their daily life because they cannot easily access retailer shops.

Meanwhile, unlike food deserts issue of Europe and U.S, shopping refugees derived from the increasing withdrawal of retail outlets and shrink of public transport in especially sparse rural area of Japan. Several studies call deprived areas with poor access to the provision of healthy affordable food as “food deserts” in Europe and U.S. There is the notion of social exclusion or social deprivation, from where disadvantaged people such as single-parent families and foreign workers are suffering (Wrigley et al., 2003; Yokohari, 2011; Mori, 2013). On the other hand, some studies on “shopping refugees” in Japan pick up the decreasing retailers as primary reason (METI, 2011; Tsurusaka, 2011; Lee, 2013). The trends in the decrease of retailers might continue once the ageing population would keep going as expected by 2050. Another issue in a hyper-aged society would be the burden of carrying goods to their house by the elderly even in a case they happened to access retailers’ stores. That is because older people could hardly lift a heavy item or big one and drive a car by themselves.

This paper, therefore, focuses on the matter of shopping refugees as the last-mile issues in a hyper-aged society and identifies the issues in two dimensions as shown in figure 3; (1) a limited accessibility to retail outlets and a difficulty in carrying goods from retail outlets. With those issues, this paper reviews the logistics measure based on the author’s previous research (Lee 2013) before considering the challenges of logistics in a hyper-aged society. A certification mark system for bolstering the logistics measures is also discussed.



Figure 3: Last-mile issues in a hyper-aged society from the viewpoint of customers

Logistics measures for last-mile issues

Proposed solutions for the shopping refugees

METI (Ministry of Economy, Trade and Industry 2011) proposed three basic ideas to support the shopping refugees; (1) to set outlets in near place of the shopping refugees, (2) to take goods to the shopping refugees, and (3) to add transportation modes in the shopping refugees’ area. There are several municipalities that support private sector to provide a new service based on the above ideas.

To set retail outlets is concerned with commercial policy, while to raise the transportation modes with transport policy. It is not naturally efficient to spend funds in order to lure retailers and transport service into unprofitable areas. Akashi (2011) also points out that it would make no sense for government to commit in attracting retailers to where other retailers are suffering from no profits. Thus, this paper focuses on the ideas to take goods to the shopping refugees and reviews mobile shops and delivery service based on several experiences (Sugita, 2008; Lee, 2013).

Mobile shop

Mobile shops refer to movable outlets literally. It is not built-in so that it can be driven when it is required. This measure appears in types of tailgate outlet and makeshift outlet. The outlets can be operated near or in the very front of customers' door, which gives shopping refugees a physically direct access to outlets and laboriously significant alleviation of carrying goods to their places. Imagine that retailers come close to customers in figure 3.

According to Japan catering car association, tailgate outlets in Japan started in 17 century (the Edo-era) in a practical sense. Almost of them, now, serve cooked food such as lunch box, light meals, and bread and many of them are running around dense cities. On the other hand, some have been operated primarily in sparse areas by local supermarket or grocery stores since late in 1980s. They handle various categories such as fresh foods including meats and vegetables, frozen foods and miscellaneous goods. Sun Plaza, for example, is a local-based supermarket. It introduced mobile shops named Happy Liners in 1985 to drive to sparse areas. Happy Liners used to be one of discrimination strategies to capture a niche market in order to compete against a large-scaled supermarket. Happy Liners use an altered small bus with a refrigerator in it (See Picture1). In addition, mobile convenience stores appeared in sparse areas after the East Japan earthquake in March 2011. They were put into the affected areas from humanitarian perspective. Seven-Eleven Japan, for instance, started introducing a mobile convenience store in May 2011. It operates 34 specially developed vehicles in 16 prefectures as of March 2013. Mobile department stores also appeared.



Picture1: Happy Liner and its inside

Source: Sun Plaza Website (permitted by Sun Plaza)

Another type of mobile shops would be makeshift outlets. This is not necessary to be a building-based outlet. Makeshift outlets have been common in Japan. There are few cases for shopping refugees, though. Here is a case introduced at the request of public side. Nisshin-city asked some grocery retailers to give a makeshift outlet at a park around a housing estate in where many the elderly lived. The outlet is open at 2 points on every Wednesday except a rainy day.

Home-delivery service

Delivery service can be used both when the elderly has no accessibility to retail outlet and when they have heavy goods at a store. Elderly people order goods on the phone, facsimile, or internet and even in person at a store. They, then, only wait the goods in their home. Home-delivery service is carried out by retailers and logistics providers. Delivery service is operated in several types with respect to the delivery fees; no charge with minimum payment, no charge for only the elderly, a specified amount per use, and monthly fee with unmetered use.

Delivery service is common in Japan for e-commerce has been getting popular. Now, it is proposed as one of customer service of retailers. Several large-scaled retailers, for instance *Aeon* and *Itoyokado*, have their own on-line store as well as off-line store and they do delivery service by themselves. Customers can go on-line shopping to get daily convenience goods at their home. They also use the delivery service when they bought speciality goods at off-line store.

Meanwhile, there is an experiment conducted by several small private stores as a type of co-delivery system. Sugita (2008) introduce the experiment of "delivery community" organized by 10 stores in a

shopping plaza in a rural area of Chiba. Firstly, customer i ordered through phone directly to store m and n . Secondly, stores pass the commodities to delivery community. Finally, a delivery man delivers the commodities to customer i (See Figure 4). Elderly people can use this service for no charges. Since almost users of this service are the elderly in this area, delivery community cannot enjoy the profit. The community says that this service is more like volunteer work for neighbours.

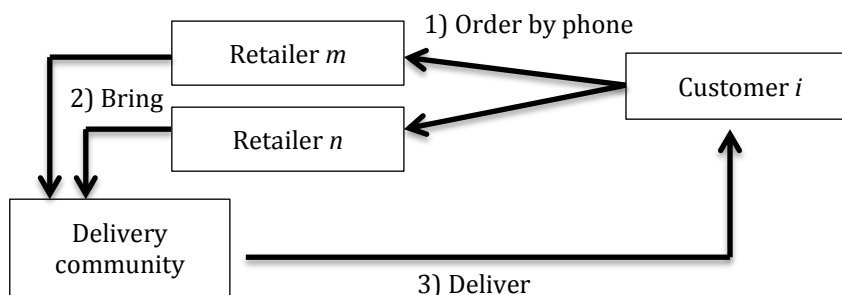


Figure 4: Co-delivery system in an experience of “delivery community”

In recent, meal delivery service has expanded nationwide. Many municipalities have conducted meal delivery service as one of welfare programs. That has an effect on the increase in the number of business. In 2000, Seven-Eleven Japan started meal delivery service named *Seven Meal*. CO-OP also has started the service in 2007 before introducing mobile shops in 2009. *Izumiyu*, a franchising supermarket, has just started meal delivery service in 2012.

Challenges for the last-mile issues

Profitability

Measures for the last-mile issues have some challenges although they should be taken for ageing population. It would be profitability that makes retailers hesitate to take the measures. Retailers such as supermarket, who operate physical stores in a self-service type, have won the customers through the customer satisfaction, i.e., the price competitiveness and various categories of commodity. That has been subject to motorization. Customers drive to a large-scaled store and they can purchase whatever they want at the single store. Large-scaled store used to be located in the suburbs with a lot of parking lots and customers could use free parking during their shopping.

In a hyper-aged society, however, parking lots would not be an important matter any longer. It is because the elderly do not drive a car due to their physical features. Retailers have to shift their business strategies corresponding with the times. Nemoto (2013) points that retailers have enhanced to attract customers to the stores but retailers in a hyper-aged society should try to come close to customers. Shopping refugees, unfortunately, would be a significant market. Retailers will fade out unless they support the shopping refugees now, as Nemoto emphasized. Mobile shops will be a new type of retail outlets in a hyper-aged society, under the concept of coming to customers. E-commerce also has been expanding its business and is expected to be more popular way for shopping in Japan.

It is generally true that the measures for the last-mile issues or shopping refugees' issues are prone to be thought as less-profitable business in Japan. There are, though, some companies that have developed a new business model for the elderly and have increased the revenue and profits of the business. For example, *Watami* launched the meal home-delivery business after the acquisition of *Takushouku* in 2008, and according to IR report of FY 2012, *Watami* enjoyed a year-on-year 48% increase of sales and 25% increase of profits in meal delivery business. The meal delivery business accounts for 26% of total sales and also 26% of total profits in 2012. The numbers increased from 20% and 22% respectively in 2011.

Corporate social responsibility

After the East Japan earthquake occurred in 2011, many researches on emergency logistics have been taken. These are from the perspective of humanitarian logistics. They focus more on delivering relief goods in speed than reducing cost or expanding profit. Humanitarian logistics is required to go beyond profitability (Ernst, 2003) because its mission is to alleviate the suffering of vulnerable people (Thomas and Koczak, 2005).

Retailing as well as logistics is recognized as an infrastructure for a society, which have an impact on the mission of retailers. The *Seven & i* group, for example, states that “we aim to be a corporate group that contributes to building an even better society by focusing on measures to resolve social issues and strategically developing them into business.” It adds that “seven & i group has attempted to create new services for supporting daily shopping, utilizing the store networks, and the logistics and information systems that has developed over many years.”

The corporate social responsibility (CSR) has been promoted, focusing on the environment issue for a decade or two in Japan. Companies were managed to develop the measures for environment protection. With regard to greenhouse gas emissions, for instance, companies have to take special equipment on their vehicles or replace with other vehicles that are fuelled by natural gas or electric power. In addition, large-scaled companies also have to make a plan to reduce the emission of CO₂ and submit the report on the result. Companies should follow regulations and social requirements from the perspective of CSR, in spite of the fact that those activities often results in cost increases. Many companies, moreover, make another investment to appeal their activities to society.

CRS has repeatedly changed in response to the situation of a society. It is essential that the last-mile issues should be significantly considered in a hyper-aged society. In other words, the measures for the last-mile issues are necessary to be identified again from the perspective of CSR.

Workforce

Measures for the last-mile issues have another big challenge. From the above experiences, it is found that the workforce has an important role on conducting the measures. The drivers for mobile shops are also charge in sales, cash register, and sometimes customer service. They often restrain themselves from leaving the working point because there is no one to be working with. It is not easy to reinforce investment in the measures with adding staffs. Volunteers are strongly helpful to take the measures.

In humanitarian logistics, there are many stakeholders such as government, aid agencies, other NGOs, volunteers, donors, logistics providers and occasionally military. Last-mile issues in ageing society would be improved with volunteers' workforce. In early 1980s, Asai et.al (1983) points out “volunteers have a central role in community since there is an increase of the aged in Japan”. In the practical sense, some retailers tell that they are operating mobile shops and/or home delivery service as a volunteer's activity from the humanitarian perspective with their mission to contribute to society.

Aoyama (2003) shows an experience that volunteers are involved in a meal delivery service of welfare center. The delivery is operated by a couple of a staff of the center and a volunteer. Volunteers participate just one time a week, which means volunteer member is fixed on the day of the week. The staff drives to elderly person's house and the volunteer hands the meal to elderly person. Volunteers can realise changes in elderly person and make a report to the center, which leads to a prevention of incidents.

We have a question how volunteers can be recruited. A survey on volunteer activity asked 354 citizens of *Hirosaki* city “do you participate in welfare-related volunteer activity?” and got responses of 9% of proactive involvement, 35% of involvement if asked, 32% of want but cannot right now, and only 7% of do not want (Rausch 1996). Suzuki et.al (2003) also clarified many volunteers and networks of NPOs for disaster relief were established after the Great Hanshin earthquake in 1995. That implies people have willingness to participate in volunteer activity if they know the information.

Another resource for volunteers would be seniors. Old people themselves also can make important contributions to society as volunteers and active participants in the workforce. It is also possible to involve young people. Asai and Hattori (2012) indicate that education programs for helping the shopping refugees. They show practical experiences of mobile shops on bicycle-drawn cart that managed by college students and high school students.

A consideration of a certification mark system for last-mile logistics

Eco-rail mark and eco-ship mark system

Logistics originated from military activities and has extended its application to business activities. In early 2000s, environment-friendly logistics or green logistics has been identified in Japan. Basic directions of logistics policy in Japan are presented in Comprehensive Logistics Policy that settled in

1997. Japanese government presented a policy direction to “logistics for social demand” in its 1st revision in 2001. Since social demand includes global warming, environmental concerns and resource circulation, the term of “green logistics” firstly appears as a policy direction in the 2nd revision in 2005.

Under these basic directions, environment-related acts were revised to regulate the emission of greenhouse gas, which have a significant impact on transportation. Companies are forced to endeavour to raise the transportation efficiency with a high loading ratio and/or cooperative transportation. Government and industries, whereas, tried to develop a certification mark system to promote modal-shift. They provide this system as one of incentives. If a company is certified as an environment-friendly business with its efforts for modal-shift, the company can use the certification mark such as *eco-rail mark* or *eco-ship mark* to appeal its efforts to customers (See figure 5). The company expects that customers choose its products from the credit of CRS. Related to eco-rail mark system, Japanese government (MLIT) say that “the eco-rail mark system aims to contribute to the ecology movement by encouraging more consumers to support businesses who actively use railway freight transportation”.



Figure 5: Eco-rail mark (left), Eco-ship mark (center) and Eco-mark (right)

Source: website of MLIT and JEA

A consideration of application to Humanitarian logistics

The above mark system tends to include all stakeholders on supply chain, i.e. government, companies, and customers as public. Companies respond to public demand and the public prefer those companies' products, under the regulation and incentives of government. This structure would be applied to encourage the last-mile logistics measures. Unfortunately, the effects of the mark system on business profits or customer's behaviour are not reported yet. That might be because eco-rail mark system started in 2005 and eco-ship mark system in 2008.

We can refer to eco-mark system started earlier than eco-rail mark. Eco-mark system has been operated by Japan Environment Association (JEA) since 1989 (See figure 5). According to the JEA's customers monitoring survey on eco-mark items, about 18% of consumers (N=929) in 2000 consciously make a decision to buy things by eco-mark. The ratio goes up to about 23% (N=1665) in 2002 and 54% (N=553) in 2004 (the latest survey). The survey in 2002 tells that about 37% of consumers (N=1184) are willingly buy eco-mark items even a bit more expensive than the same type of product and about 53% in the same price. The similar results are observed in another survey. A questionnaire in 2005 (N=125) by Yoshioka and Horisawa (2006) shows the result that 19% of consumers buy eco-mark items even in higher price and 62% in the same price.

In recent, humanitarian logistics or relief logistics have been considered worldwide, as mentioned earlier. Japan, an earthquake-prone country, also is discussing logistics in emergency. Now is the time to identify the humanitarian logistics again in a hyper-aged society. There are many people who have difficulties in daily life as well as at the time of disaster. As the efforts on the environment-friendly logistics have been made by all stakeholders, the efforts on the last-mile logistics should be made from the humanitarian perspective by all stakeholders including volunteers.

One of the trials could be a certification mark system as learned from environment-friendly logistics. Some companies are now trying to provide essential goods to restricted shoppers, struggling for the mission of logistics against business performance. When their efforts are recognized to public and the recognition links to the companies' competition, more companies would try to take measures for the last-mile issues as one of humanitarian logistics and finally vulnerable people would less appear.

Conclusion

This paper reviewed the measures for the last-mile issues. The measures are expected to be opportunities of new business model in a hyper-aged society although they have some challenges in operation. There is a positive possibility to resolve the challenges with all stakeholders of humanitarian

logistics from the lessons of many logistical experiences. The most important thing is the recognition of the humanitarian logistics in ageing world. WHO (2012) points out that 80% of older people in the world will live in developing countries by 2050. The quicker some measures of logistics are taken in Japan as the first hyper-aged society, the more countries could apply.

For further study, suitable items and areas for specific measures such as mobile shops and delivery service or others will be identified. In addition, it is necessary to clarify how to involve all stakeholders in the last-mile logistics. Moreover, it is also desirable to discuss the ways in more detail to conduct the measures.

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OUTSOURCING IN HUMANITARIAN LOGISTICS IN THAILAND

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Abstract

Purpose: Humanitarian relief organisations (HROs) may outsource their logistics needs to logistics service providers (LSPs). The purpose of this paper is to determine to what extent LSPs are used in humanitarian logistics in Thailand.

Design/methodology/approach: A literature research was conducted LSPs and commercial outsourcing of logistics services, and outsourcing as a strategy in humanitarian logistics. Logistics officers of HROs located in Bangkok, Thailand were interviewed about their usage of LSPs.

Findings: Of those HROs interviewed that have needs to transport or store goods in Thailand, some used their own vehicles for regular transportations, but all outsourced to commercial truckers for irregular transportations such as for donation goods or in emergency situation. Their decisions are based on financial reasons, or level of control. From initial observation it can be said that the criteria under which HROs outsource their logistics needs is not different from commercial companies.

Research limitations/implications: This research has been conducted with interviewees based in Thailand. Even though many HROs interviewed are international organizations, the findings may not be generalizable.

Originality/value: To our knowledge, no such research has ever been conducted in Thailand. It is an important research as part of the mapping of the role of commercial logistics providers in humanitarian logistics. A practical model has been developed to help understand the mechanism of the decision-making process, which can be used as a guideline for Thailand-based HROs and also logistics companies interested in providing services to them.

Paper type: Research paper

Introduction

There is ongoing humanitarian effort in Thailand, which is a developing middle-income country located in South-East Asia. Thailand is higher developed than the neighbouring countries Cambodia, Laos and Myanmar, which are classified as Least Developed Countries (UN, 2013). The relatively higher economic development, the existing infrastructure and the geographical location makes Thailand, and the capital Bangkok in particular, an ideal location for regional offices of the UN, the ICRC and many NGOs.

Humanitarian efforts in the region include disaster relief operations, such as in the aftermath of the Indian Ocean Tsunami 2004, Cyclone Nargis in Myanmar 2008, or the floods in Thailand, Laos and Cambodia in 2010. In addition, there are refugee camps on the Thai-Myanmar border sheltering ethnic tribes. These humanitarian operations require logistics for relief goods, medicine and food.

This research asks how these goods are moved to the locations where they are needed or consumed. A difference is made between regular transportation, such as for daily food needs, and emergency response.

Literature Review

In the commercial world, logistics services are often outsourced to specialised logistics service providers (LSPs). One research suggests that 77% of the Fortune 500 companies in the US outsource their logistics needs (Lai et al., 2004). The reasons for this have been identified as cost savings and

improving performance, and access to skills that are not available in-house (Beaumont and Sohal, 2004).

If a company gives the important logistics function into outsider's hands, they have to carefully weigh the criteria. Banomyong and Supatn (2011) identified 24 attributes which they classified into six dimensions: reliability, assurance, tangibility, empathy, responsiveness and service cost, where "accuracy of the documents" (which falls under reliability) is the most important dimensions for the customer, followed by "reasonable cost". The relationship between the customer and the LSP can be viewed as relationship-based (Panayides and So, 2005), in which the integration between customer and LSP plays an important role (Panayides and So, 2005a), or as resource-based (Lai, 2004). He classified the LSPs into four categories: Traditional freight forwarders (TTF), transformers (TMR), full service providers (FSP) and nichers (NCR). This was expanded by Lai et al. (2004) to develop an empirical taxonomy but no reference to HROs was made.

There is little literature on how Humanitarian Relief Organisations (HROs) or the military use outsourcing in logistics. Wal-Mart made headlines when it delivered relief goods to the victims of hurricane Katrina in 2005 in the US, but they were not officially contracted as an outsource. On the other hand, Banomyong et al. (2009) developed a model for Thailand in which the government's control center directly contracts discount stores for supply and logistics in a disaster situation. A fast response is required in emergency logistics (Banomyong and Sopadang, 2010). Discount stores have many of the required supplies on stock anyway, and they have supply chains including warehouses, distribution centers and transportation set up all over the country and are therefore suitable to respond quickly (Banomyong et al., 2009). However, this model has not been implemented in practice.

The United Nation's World Food Program is delivers 5 million metric tons of food per year, have 60 aircraft in the air, 40 ships on the water, and 5,000 trucks on the road on any given day (Quinn, 2010). However, not all of this is handled in-house; WFP has been working closely with commercial logistics service provider TNT since 2002 (Jones, 2003; TNT 2012). In the aftermath of the Japan tsunami in 2011, WFP received logistics support from Agility Logistics, UPS, TNT and Maersk (Agility, 2011).

The United Nations Office for Coordination of Humanitarian Affairs (UN OCHA) closely cooperates with DHL to form Disaster Response Teams (UNOCHA, n.d.; DHL 2013).

According to Agility (2008), commercial logistics companies were first integrated into a WFP Logistics Cluster during the relief efforts after Cyclone Nargis in 2008. The idea of the Logistics Emergency Teams (LET) was created by the World Economic Forum in 2008 (WEF, 2013). These teams consist of volunteers employed by the commercial logistics companies Agility, AP Möller-Maersk, TNT and UPS (Logistics Emergency Teams, 2013).

DHL, TNT and Agility provided logistics support to UN OCHA in Dubai for the floods in Pakistan (The National, 2010).

The concept of Logistics Clusters, along with clusters in other operational areas, was introduced by the UN Emergency Response Coordinator in 2005 through UN OCHA (Logistics Cluster, 2013). WFP was appointed as the lead agency which in the areas of operations, information management, coordination, training and tools between UN agencies, international organisations and I/NGOs. In this context, non-governmental organisations do not only mean humanitarian organisations, but also commercial companies, as part of Logistics Emergency Teams (LETs).

Logistics Emergency Teams provide the following services as part of the Logistics Cluster lead by the WFP, as described by Frank Clark of Agility, head of the Logistics Emergency Teams:

1. **Secondments of individuals (to a cluster member)**
2. **Specific functions (e.g., airport management, road transport management, warehouse management, customs management, information/communication, etc.)**
3. **Service provisions (e.g., full transportation services from one location to another, including all relevant elements such as warehousing, transport, etc.)**
4. **Asset deployments (e.g., warehouse/truck capacity, forklifts, pallets, etc.)**

Table 1: Services provided by the LETs
Source: Clark (2010)

There are different types of Logistics Emergency Teams, listed here:

The Logistics Emergency Team concept can support as follows:

- (1) **Advance storage provision** – Support to the pre-positioning of critical relief material and supplies, support to the HRD concept
- (2) **Air Freight Emergency Teams** – Support to airport handling operations at the selected airport near the disaster zone: receive relief goods/unload airplanes, manage inventories, organise logistics solutions to next staging posts
- (3) **Transport Emergency Teams** – Support to coordination and contracting of fleets in disaster prone zones. This could also involve pro bono services from L&T companies with their own local capacities
- (4) **Warehouse Emergency Teams** – Support to storage and value added services palletising/labelling/etc at the airport and at the first staging posts in the disaster zone. This could also involve pro bono services from L&T companies with their own local capacities
- (5) **Supply Chain Emergency Teams** – Support with specific logistics expertise to enhance the overall efficiency of the ‘supply chain’ for emergency relief in areas like the management of sourcing and collecting supplies, packaging, customs, information technology, communication, reporting, etc

Table 2: Types of LETs
Source: Clark (2010)

It is therefore an established fact that today, commercial companies are part of international humanitarian logistics efforts. The question remains how involved local and multinational logistics companies are in the local humanitarian activities, and what this means for the beneficiaries.

Methodology

Semi-structured interviews were conducted with 11 Bangkok-based officers of humanitarian relief organisations. This included four UN agencies (UNICEF, IOM, WFP and FAO), five International NGOs (World Vision, CRS, Oxfam, Plan International and Save the Children the latter based in Singapore), the local office of the ICRC, and one Thai NGO (School for Life). The questions focussed on why or why not they involved commercial logistics companies, and what was the reason for their decision.

Findings

One organisation does not have any ongoing projects in Thailand but their Thailand office only serves as the regional office. Therefore, they do not have any transportation needs.

One organisation does not have operations in Thailand, but they do have operations in Laos and ship donated goods via Laem Chabang port in Thailand (Laos is landlocked and does not have any seaports). They use commercial truckers to transport the goods from Laem Chabang to Laos, and the frequency is about one or two times per year.

Three organisations focus on education and development and have no need for the transportation of goods.

Of the seven organisations that have needs to transport goods, there was a difference as to whether they had regular transports or not. All of these organisations that had needs to transport goods only in emergency situations outsourced these to commercial truckers. The reason mentioned was that it would not make financial sense to keep and maintain vehicles if they are not used on a regular basis.

Organisations that receive donations on an irregular basis have two options: Either they hire a trucker to ship the goods to the site where they are needed, or they ask the donor (or the supplier, in case they buy the goods) to deliver to the site. In one case, they outsource to a regular trucker which charges below the market rate, which in itself is a donation of trucking services. One agency that

sometimes uses an outsourced trucker and sometimes asks the supplier to deliver the goods advised that the decision will be based on time, especially in an emergency situation such as the Thai floods in 2010. One organisation responded that they will always ask the donor to deliver the donated goods to the site.

Three organisations own trucks. Two of them own pick-up trucks, and one uses it to deliver mail to the post office, the other to pick of foodstuff from the market and deliver home-grown herbs and spices to the market. Both of them outsource to commercial truckers when they need to move donated goods. The third organisation is the only one that responded that they own trucks (including 6-wheel trucks) to move the goods, as this way, they have more control over the transportation resources. The respondent of this organisation is based in Mae Sod on the Thai-Myanmar border, where the availability of commercial trucking services is more limited than in Bangkok.

Only one of the HROs interviewed store goods in Thailand. This is rice, which needs to be bought on regular basis and will be bought in larger quantities than the daily fresh foodstuff. They store the rice on their own premises and do not outsource this to a commercial company.

Conclusions

HROs in Thailand with transportation needs will use their own trucks for regular transportation needs, such as daily foodstuff pick-up, will own vehicles for two reasons: Firstly, it makes financial sense, and secondly, they have more control.

HROs in Thailand that have irregular demand for transportation needs (either for irregular donations or only in emergency situations) will not own vehicles as it does not made financial sernse and they received good response when they need trucking resources.

Those HROs that do not own vehicles may outsource their transportation needs to commercial truckers, or they may ask the donor to deliver the goods. The decision is either based on the organisation's policy (they might not want to get involved in the logistics), the speed (in case of emergency) or the required level of control over the transportation resources.

We can summarise the findings as follows:

<u>Transportation needs and method used</u>	<u>Number of HROs interviewed using this method</u>
No operations in Thailand	1
Operations but no transportation needs	3
Using own vehicles for regular transportation	3
Using outsourcing for regular transportation	1
Using own vehicles for donations	1
Using outsourcing for donations	2
Asking the donor to deliver	1
Using own vehicles in emergency response	0
Using outsourcing in emergency response	3

Table 1: Own vehicles vs. outsourcing by HROs in Thailand

Source: The authors

Modelling these findings into a decision tree, we arrive at the following graph:

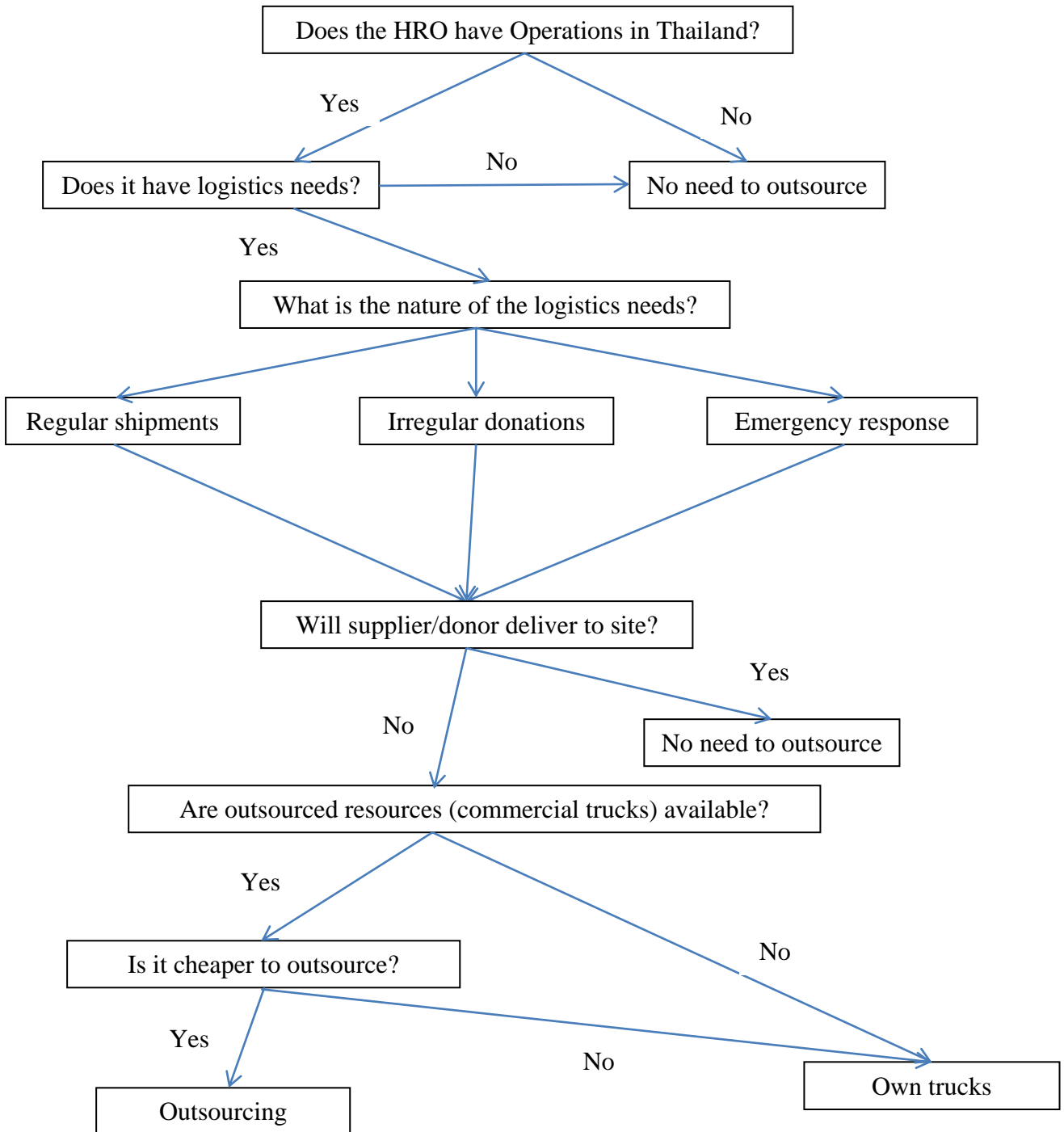


Figure 1: Outsourcing considerations
Source: The authors

It is obvious that those organisations that do not have operations in Thailand or do not move any goods will also not have any logistics needs. The logistics needs that of those HROs that need trucking services fall into three categories: Regular shipments (this includes food deliveries to camps or orphanages), irregular donations, and emergency response. The decision whether to own vehicles or to outsource is based on two factors: Availability of commercial trucks and cost. If vehicles are not easily available, for example in remote areas or in emergency situations where speed is of the utmost importance, own vehicles are chosen. If vehicles are available, cost will be considered as the key factor.

This decision tree is not much different from how a commercial company, for example a factory, would decide. However, the environment is different, as a commercial company would seek a location where the infrastructure is developed and trucks are readily available, whereas the HROs chose locations where their services are needed. This is often in areas where the infrastructure is not as developed. Therefore, it is more likely that the HROs will encounter non-availability than commercial companies would. Therefore, while the decision tree is similar, the results will be more likely for the HROs than for commercial companies to own and maintain trucks for their own shipments.

In conclusion, we can say that from initial observation the decision-making process for HROs whether to outsource their trucking needs is the same as for commercial companies.

Limitations and future research

The limitations of this research is that it is focused on Thailand, which is a middle-income country with a relatively developed commercial trucking infrastructure.

Future research should include the neighbouring least-developed countries, where there is more regular activity by HROs and a less developed commercial trucking and warehousing infrastructure. Furthermore, a future research in the region should have a larger sample size to verify the initial observation.

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PERFORMANCE OF TRANSPORTATION SERVICE PROVIDER: A LITERATURE REVIEW

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Introduction

An effective and efficient logistics system played an important role in achieving business goals of the organization that is crucial in the current situation of intense competition in the global business. Nowadays logistics has a tendency of rapid long-term growth driven by the occurrence of global international logistics market and the continuation of outsourcing in the field of manufacturing. Outsourcing has made moving business and economically and efficiently ways. The cost of labour is the primary motivator for outsourcing of the organizations. There are many factors involving the growth of logistics outsourcing, such as the globalization of business, which is viewed as the most famous driving force (Foster and Muller, 1990; Rao et al., 1993; Sheffi, 1990; Trunick, 1989). Consequently, the third party logistics (3PLs) has led to more complex supply chains Bradley (1994) and a greater need for transportation and distribution management in international logistics. Currently, the widespread use of logistics service provider (LSP) has been increasing because of the globalization of supply chain and firm outsourcing the demands for LSPs (Ellinger et al., 2008). Consequently the LSP role is extending rapidly as the number of firms outsources their logistics function to LSPs has increased (Lai et al., 2008). These have extended to the role of LSPs from transport business to logistics service provider business. Some recent logistics literature has focused on understanding the roles and competitive advantages of LSPs (Fabbe-Costes et al., 2009; Wong and Karia, 2010) suggest that it is necessary for LSPs to increase and transform the right resources into significant logistics performance (Lai et al., 2008; Yang et al., 2009; Wong and Karia, 2010). It is important for LSPs to consider these different approaches for achieving sustainable competitive advantage through operating at lower cost and managing better than other competitors. In a recent day, there are many different types of outsource. The purpose of this paper is to propose a new framework to measure the performance of TSPs to affecting on customer satisfaction. The remainder of this paper includes: review of performance measurement, research on logistics service provider (LSP) and measuring the performance, the propose framework for measuring the performance of transportation service providers, hypothesis, methodology and conclusion.

Review of Performance Measurement

Performance has focused on determining the effect of business process in supply chain members on performance. It helps providing the information on how resources and efforts should be allocated to ensure effectiveness. However, concerning the appropriate performance, outcomes was appeared when measuring the effectiveness of such initiatives (Anderson and Oliver, 1987; Lewis and Lambert, 1991; Kumar et al., 1992). Mentzer and Konrad (1991) defined performance measurement as effectiveness and efficiency in accomplishing a given task in relation to how well a goal is met. Performance measurement is critical to the success of most any organization because it creates understanding and improves competitiveness. Fawcett and Cooper (1998) and Neely et al. (2002) defined performance measurement as the process of quantifying the effectiveness and efficiency of action. Effectiveness is the extent to which a customer's requirements are met and efficiency measures how economically a firm's resources are utilized. Chan (2003) described the feedback of performance measurement or information on activities with respect to meeting customer expectations and strategic objectives. It reflects the need for improvement in areas with unsatisfactory performance.

There are many studies about the performance measurement tools. Gunasekaran et al. (2001) and Espino-Rodriguez and Padron-Robaina (2004) classified performance measurement tool into two groups; financial (e.g. cost, ROI) and non-financial (e.g. quality, flexibility). Chan (2003) identified performance measurement based on quantitative such as cost, and resource utilization and qualitative such as quality, flexibility, visibility, trust, and innovativeness. In addition to, many researchers studies on the relationship of the various factors that affect to performance. Beamon (1999) presented an overview and evaluation of the performance measures used in supply chain models and also presents a framework for the selection of performance measurement systems for manufacturing by identified three types of measure, namely resources, output and flexibility. Result showed that flexibility is an important consideration in supply chain performance. Stank et al., (1999) used structural equation model for studied relationship between service quality and profitability in service operation. They founded that factors impact on service supply chain performance consistent quality, productivity and

efficiency respectively. Guan and Ma (2003) studied the role of the seven innovation capability consist of learning, R&D, manufacturing, marketing, organizational, resources exploiting and strategic. This study used multiple regression analysis. They confirmed that reliable, delivery and the shortening lead-times are correlated significantly and positively with a firm's performance. While, Wilding and Juriado (2004) investigated customer perceptions on key logistics outsourcing. It found that the use of 3PLs has usually had a positive impact on companies' performance on cost.

However, there are some studies on the factors that affect to the performance of logistics services provider. Yeung (2006) found a relationship between a shipper and third party. The results reveal that the timeliness of the service; pricing; and the quality of delivery of 3PL service providers are positively related to the users' logistics and or export performance. Afterwards, Yeung et al., (2012) further studied about the impact of third-party logistics providers' capabilities on firm's performance. This study used structural equation modelling to empirically test. Results showed that 3PL providers' augmented capabilities and exporters' competitive advantage are strong mediators, supporting the theorized model underpinned by RBV. Furthermore, Bolat and Yilmaz (2009) studied the impact of outsourcing, and to examine the relationship between the outsourcing process and organizational performance in hotels. The result founded that outsourcing process has factors effect to firm performance consists; organizational effectiveness, productivity, profitability, quality. This study used a paired-sample t test, correlation and regression analysis to analyze the data.

Research on Logistics Service Provider (LSP) and Measuring the Performance.

Research on logistics service providers focus on the firm's core competencies (Bhatnagar et al., 1999; Bolumole, 2001; Lim, 2000) has stated that firms that used to adopt the approach are beginning to realize that having a provider take charge of the company's overall supply chain presents a more effective and efficient way of managing the logistics of the business. They pointed out that performance is essential for firm to successfully operate efficient and effective international facilities networks. Stank et al., (2003) suggested that reliability and cost performance are order qualifiers instead of differentiators in the eyes of users. In the logistics service industry, provider adds value to user by improving operation efficiency and/or sharing resource and information (Berglund et al., 1999). A logistics service provider (LSP) is a provider of an industrial logistics service that specializes in providing various types of logistics such as transportation, warehousing and freight forwarding (Karia, 2011; Murphy Jr., 2004; Lau, 1999). These definitions are further expanded by Ellinger et al. (2008) who describe LSPs or 3PL as firms that specialize in managing a wide range of service-related logistical activities for clients, included warehouse management, shipment consolidation, customs brokerage, transportation/distribution management and customer service (Daugherty and Pittman, 1995; Mentzer et al., 2000). The concept of 3PL has been developed from the need to provide transportation services by transportation companies to its customers. Basically, 3PL might be identified as outsourcing of transport and logistics activities to outside (Vasiliauskas and Jakubauskas, 2007).

Transportation Service Providers (TSPs) has been a source of competitive advantage and a common practice by most companies. TSPs have currently diversified by offering various services and activities. Most companies refer to greater flexibility, operational efficiency, improved customer service levels, and a better focus on their core businesses. More investigation on competitive advantage of TSPs is needed (Lai et al., 2002 & 2004) as well as theories and solutions for TSPs to achieve sustainable competitive advantage (Wong and Karia, 2010). For this reason, previous performances are important to select TSPs to meet the needs of businesses looking to take the lead in the competition. However, up to date, the issues have not been received enough concentration.

Venkatraman and Ramanujam (1986) identified two dimensions of business performance: operational performance (i.e. quality, flexibility, on time delivery) and financial performances. Huo et al., (2008) suggested that operational performance can be further classified into two major dimensions: cost and service performances. Cost performance is related to cost and price, while service performance is related to service reliability, speed, variety, and so forth. Stewart (1995) identified four key operational areas including delivery, flexibility and responsiveness, logistics cost, and asset management to evaluate performance. Consistent with the study of Sink et al., (1996); Larson and Kulchitsky (1999); Skjoett-Larsen (2000); Brah and Lim (2006); Yeung (2006) use the flexibility factor for performance measurement. Daugherty et al. (1996) identified six areas used to measure the performance; customer service, quality, productivity, costs, strategic focus and cycle time. Hensher and Brewer (2001) pointed out that many factors included reliability; cost and delivery times are key performance

indicators that providers use in promoting their services and facilities. Lai et al. (2002) investigated measures for evaluating supply chain performance in transport logistics based on the supply chain operation reference model. They point out that factors impact on supply chain performance in transport logistics consists: service effectiveness (e.g. reliability, responsiveness and flexibility) and operation efficiency (e.g. cost and assets). Lai et al. (2004) used the same factors to study in three transport logistics industry, i.e. air and sea transport, freight forwarding and third-party logistics services. They performed a one-way analysis of variance (ANOVA).

Brah and Lim (2006) studied the effect of technology and TQM on the performance of logistics companies. Previous studies used cost factor to studied view point of financial performance for measure the performance of logistics provider (Closs and Thompson, 1992; Skjoett-Larsen, 2000; House and Stank, 2001; Vaidyanathan, 2005; Panayides and So, 2005a&b; Yeung, 2006). Furthermore, Tan and Wai (2012) pointed out those four criteria such as delivery, cost, quality and flexibility important for decision making select a 3PL provider. The analytical hierarchy process (AHP) was used to compute the criteria weights. The researchers studied the performance measurement of logistics provider by using reliability (House and Stank, 2001; Panayides and So, 2005a&b; Yang et al., 2009). Some researchers using responsiveness to measure the performance consists (Gunasekaran and Ngai, 2003; Knemeyer and Murphy, 2004; Panayides and So, 2005a&b). At the same time, Yang et al. (2009) used assets (ROI) for studied the performance measurement.

From literatures reviews, the measurement of performance from the users of LSPs such as cost, customer service, delivery, quality, productivity and strategy has been accepted (Daugherty and Pittman, 1995). Moreover, Myers et al. (1996) recommend innovation, cost and customer service (flexibility, delivery and quality). Fawcett and Cooper (1998) measure logistics performance in terms of cost, service, productivity, asset management, and customer and employee satisfaction. Larson and Kulchitsky (1999) propose relations, customer service, efficiency and flexibility as logistics performance measures for users of LSPs. Some of the literature from the provider perspective has tried to measure various types of performance (e.g. Lai and Chen, 2003; Chapman et al., 2003; Mentzer et al., 2004; Stefansson, 2006; Fabbe-Costes et al., 2009), and examine the roles of physical and information technology in adding value (Lai et al., 2006; Lai et al., 2008). Some examine the roles of relationship orientation (Panayides and So, 2005a & b; Panayides, 2007a & b).

According to the literature reviews of logistics service provider performance measurement, there are two gaps of the study needed to be explored. The first gap, the literature reviews finding the important factors that affect to performance of logistics service providers only on customer perspective or provider perspective. For this research, it will be led to study simultaneously customers' and providers' perception. The final gap is that previous logistics literature has examined the impact of service effectiveness and operation efficiency on customer satisfaction.

The Propose Framework for Measuring the Performance of Transportation Service Providers

Transportation Service Providers (TSPs) performance are two elements definition which consists of effectiveness and efficiency. Effectiveness relates to the preference of the end-consumer and the sole indicator is consumer satisfaction. Efficiency indicators measure an output level against an input level (Wang and William, 2007). TSPs indicators are grouped into two main categories. First, service effectiveness consists of six sub-elements such as reliability, responsiveness, flexibility, quality, delivery and time. Second, operational efficiency indicators include two sub-elements such as cost and assets. A research model is formulated to identify the direct and indirect factors influencing to impact of the TSPs performance. Figure1 shows the framework of the TSPs performance affects to customer satisfaction. The indicators of performance are defined as follows:

Reliability, poor reliability can definitely decrease customer satisfaction and their repeat consumption in both short and long term. It may also damage the image of the company from customer point of view and even reduce the sales revenue (Chan et al., 2006).

Responsiveness, the willingness of transportation service providers to help customers and provide prompt service (Parasuraman et al., 1988). According to Supply-Chain Council (2006) responsiveness refer to order fulfilment cycle time that mean the average actual cycle time consistently achieved to fulfil customers order.

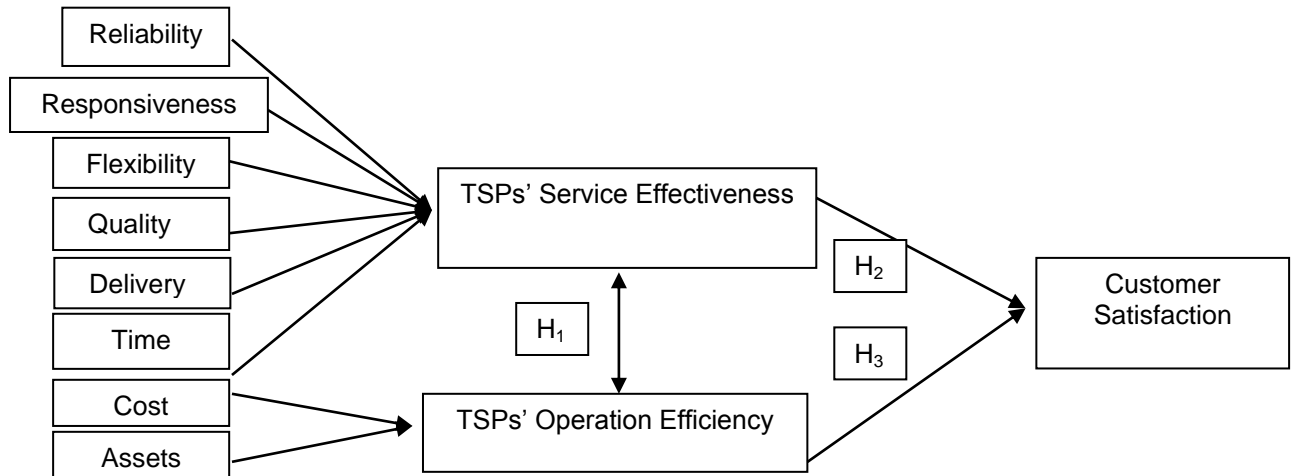


Figure1: The framework of the transportation service providers (TSPs)

Flexibility, shows the degree to which the supply chain can react to a changing environment and unusual customer requests (Beamon, 1999; Aramyan et al., 2007). According to Vickery et al. (1999), flexibility has a close relationship with environmental uncertainty, overall firm performance and functional interfaces; therefore, it should be understood by managers and all employees of company when making decision in all aspects (Chan et al., 2006).

Quality, indicates the ability to achieve low defect rates, offering safe products and creation of environmentally friendly products had consistently been felt as a very important competitive priority (Grunert, 2005). According to Neely et al. (2005), quality has been defined in terms of conformance to specification and hence quality-based measures of performance have focused on issues such as the number of defects produced and the cost of quality.

Delivery, Novich (1990) mention the various factors that can influence delivery includes vehicle speed, driver reliability, frequency of delivery and location of depots. Stewart (1995) explains the increase in delivery performance is possible through a reduction in lead time attributes. Another important aspect of delivery performance is on-time delivery that reflects whether perfect delivery has taken place or otherwise and is also measure of customer service level. Tan and Wai (2012) explain delivery refers to on-time delivery, right quality and right place delivered.

Time, has been described as both a source of competitive advantage and the fundamental measure of manufacturing performance (Stalk, 1988; Drucker, 1990). Under the just-in-time (JIT) manufacturing philosophy the production or delivery of goods just too early or just too late is seen as waste (Potts, 1986). Similarly, one of the objectives of optimized production technology (OPT) is the minimization of throughput times (Goldratt and Cox, 1986). Chan et al.(2006) mentioned that time must be considered since more cost is involved if more time is spent. Time is also important to reveal the degree of improvement since dynamic environment may reduce its effectiveness.

Cost, the lower cost of production can enhance their competitiveness and organization should have an abundant amount of capital for continuous operation. Measurement is based on the ability to provide an adequate sum of capital for continuous operation. Cost must be considered for both long and short-term operation. In short-term, cost of the alternative is important in terms of improving the existing situation only. Long-term operation of the alternative may affect the future strategy and development (Chan et al., 2006).

Assets, specificity indicates "a specialized investment that cannot be redeployed to alternative uses or by alternative users expect at a loss of productive value" (Williamson, 1996). Transaction-specific assets invested by the provider enable the usage of efficient processes and procedures to generate third-party services (Williamson, 1996). Moreover, assets specificity is a precondition to meet the specific requirements of the customer and to efficiently support recurrent transactions (Williamson, 1984; Williamson, 1985). According to Chan et al. (2006), assets show the efficiency in utilizing assets can enhance productivity at a competitive price and quality.

Hypothesis

The proposed framework for measuring the performance of TSPs in this study is presented in Fig. 1. The customers' and providers' perception of service effectiveness and operational efficiency are portrayed as co-varying antecedents of satisfaction. While the literature provides little guidance on the relationship between service effectiveness and operational efficiency, it is reasonable to anticipate that performance on these items will move together. This expectation leads to first hypothesis.

H₁: Service effectiveness has a positive relationship with operational efficiency.

The literature reveals a link between service effectiveness and operational efficiency and customer satisfaction. Service effectiveness and operational efficiency are positively highly correlated measures for supply chain performance (Lai et al., 2002 & 2004). These findings provide the theoretical basis for two hypotheses.

H₂: Service effectiveness has a positive relationship with customer satisfaction.

H₃: Operational efficiency has a positive relationship with customer satisfaction.

In summary, this model focuses on intermediate relationships as a first step in understanding the relationship between service effectiveness and operational efficiency on customer satisfaction. The model is based on the assumption that service effectiveness and operational efficiency performance in TSPs may directly impact business performance through the customer satisfaction linkage.

Research Methodology

This study has combined both qualitative and quantitative methodologies which mixed research method or methodological triangulation (Gill and Johnson, 2010). Creswell and Plano Clark (2007) classified the triangulation design into five main types, in this study use a one-phase model, the convergence model. The convergent parallel design (also referred to as the convergent design) occurs when the researcher uses concurrent timing to implement the quantitative from questionnaire survey and qualitative by interview based on semi-structured interview, strands during the same phase of the research process. The data collection focuses on transportation service providers (TSPs) in Thailand. This concurrently meets the research objective for understanding the factors impact of the performance of TSPs using customers' and providers' perception. It means that the research context is TSPs. The data analysis used to formulate the descriptive statistics, factor analysis and use SEM for analyzing the relationship between latent variable affect to customer satisfaction. The population frame for this research is constructed from the directory of 240 Transportation Service Providers (TSPs) from Thai Federation on Logistics and their customers. In this research, the sampling in this research is all of population.

Conclusion

This paper reviews the main factors influencing the performance of TSPs and proposes a new framework to measure the performance of TSPs which affects the customer satisfaction. This proposal is focused on the views of both service provider and service user perception. The proposed framework for measuring the performance of transportation service provider is designed to identify the direct and indirect impact of the TSP performance. The TSP performance indicators are grouped into two main categories: the service effectiveness and the operational efficiency indicators. The service effectiveness consists of six sub-elements including reliability, responsiveness, flexibility, quality, delivery and time. The operational efficiency indicators include two sub-elements: cost and assets. In particular, the measurement of the performance of Thai transportation service providers will be able to help the improvement and development TSPs in Thailand further.

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SUPPLY CHAIN NETWORK DESIGN UNDER RFID ADOPTION

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Introduction

Due to the global sourcing and markets, international companies commonly use multi-echelon supply networks to support their manufacturing and distribution. For example, Wal-Mart and Target have complex supply networks in the United States. When products arrive at international seaports, they are delivered to retail stores through multi-echelon supply networks. The design and management of multi-echelon supply network in today's competitive business environment is one of the most important and difficult problems that managers face.

Several studies have focused on the area of supply network design. Shen (2007) conducted a complete review of the supply chain design literature and discussed future research topics. Recently, Pujari et al. (2008) used a continuous approximation (CA) procedure to determine the optimal number and size of shipments when considering issues of location, production, inventory, and transportation. Murat et al. (2010) provided a CA framework for solving location-allocation problems with dense demand. Li and Ouyang (2010) provided a continuous approximation approach for solving the reliable facility location design problem under correlated probabilistic disruptions. Murat et al. (2011) formulated the two-facility location-allocation problem as a multi-dimensional boundary value problem and developed a multi-dimensional shooting algorithm to solve this problem. Tsao and Lu (2012) designed a supply chain network considering both distance discount and quantity discount for transportation cost. In this paper we use a continuous approximation technique to formulate the supply network model. The proposed solution defines the input data in terms of continuous functions and can formulate these functions for a data set of any size.

Radio-frequency identification (RFID) is the use of a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object. Ngai et al. (2008) has presented an excellent literature review of academic journal papers that were published on the RFID subject between 1995 and 2005. Sarac et al. (2010) has made a review about the impacts of RFID on the supply chain management. They concluded that RFID technologies could improve the level of supply chain management through reduction of inventory losses and increase of the efficiency and speed of processes and improvement of information accuracy. RFID has being adopted in many supply chains, especially for the universal of Internet of Things (IoT). IoT deals with integrating and enabling information communication technologies including RFID, wireless sensor networks, machine-to-machine systems, mobile apps, etc. RFID is said to revolutionize supply chain management, releasing great values. Therefore, it is essential to consider the RFID adoption when designing a supply chain network.

The main purpose of this research attains a four-fold goal: First, we want to highlight the importance of RFID adoption in the supply network design problem. Second, we incorporate the RFID adoption decision into the supply network design model. Thirdly, we want to discuss the effects of RFID adoption on the supply network design. Fourth, we want to provide solution procedures for solving the supply network design problem considering RFID adoption. The objective of the model is to determine the optimal distribution center influence area, replenishment cycle time and RFID adoption decision to maximize the total profit.

Model Formulation

The network studied in this paper is a three-echelon supply chain with an outside supplier selling goods to DCs. The DCs are located at level two, and help to consolidate shipments arriving from the supplier and deliver them to the retailers. The retailers at the downstream meet the demands from end customers. Goods flow from upper-stream facilities to the downstream facilities. This study uses the following notations:

T_i : replenishment cycle time for each DC in cluster i , where $i=1,2,\dots,n$ (decision variable)

A_i : influence area for each DC in cluster i , where $i=1,2,\dots,n$ (decision variable)

F : facility cost of opening each DC

- δ_i : store density in cluster i , where $i=1,2,\dots,n$
 λ_i : demand rate for retail store in cluster i , where $i=1,2,\dots,n$
 ξ : length of the planning horizon
 c_T : transportation cost per unit distance per item
 f : constant that depends on the distance metric and shape of the DC service region
 S : ordering cost for DC
 h : inventory holding cost for DC
 C_i : service area in cluster i , where $i=1,2,\dots,n$
 c : unit purchasing cost
 p : unit selling price
 τ : unit RFID adoption cost
 θ : efficiency of the replenishment process with respect to satisfying consumer demand
 μ_N : the mean of the lead time without RFID adoption
 σ_N : the standard error of the lead time without RFID adoption
 μ_{RFID} : the mean of the lead time with RFID adoption
 σ_{RFID} : the standard error of the lead time with RFID adoption
 ν : factor by which order quantity must be increased relative to demand when RFID is not used, where $\nu \geq 1$
 r : unit process cost for reverse logistics
 χ : fixed fraction of items needing to go into reverse logistics process
 t_N : average process time for reverse logistics without RFID adoption
 t_{RFID} : average process time for reverse logistics with RFID adoption

The mathematical model in this study is based on the following assumptions:

1. Demand per unit time for retail store in cluster i is an independent and identically distributed Poisson process with rate λ_i .
2. Each DC's influence area is close to circular. Moreover, each DC is located in the center of the influence area.
3. Each retailer is assigned to a particular DC and served only by that DC.
4. RFID technology can improve information sharing, cut logistical operations time and reduce lead-time. In this paper the mean of lead time and the standard error of lead time under RFID adoption are assumed to be less than those without RFID adoption, i.e. $\mu_{RFID} < \mu_N$ and $\sigma_{RFID} < \sigma_N$.
5. Without RFID adoption, the products are subject to shrinkage due to damage, theft, or other incidents. Therefore, the DCs should replenish more products when RFID is not adopted. This means $\nu > 1$ when RFID is not adopted.
6. The average process time for reverse logistics without RFID adoption is larger than the average process time for reverse logistics with RFID adoption, i.e. $t_N > t_{RFID}$.
7. RFID adoption affects the efficiency of the replenishment process with respect to satisfying consumer demand. When RFID is adopted in the supply chain, $\theta=1$; otherwise, $0 < \theta < 1$.

This study uses a continuous approximation technique (Tsao *et al.*, 2012) to divide the network into smaller regions over which the discrete variable can be modeled using the slow varying functions. Using the method the given service region is covered with clusters i , $i=1,2,\dots,n$. Clusters i , $i=1,2,\dots,n$, exist within the given service region such that the store density is nearly constant over each cluster.

The total network profit is

$$\Pi(A_i, T_i) = \begin{cases} \Pi_N(A_i, T_i), & \text{if RFID is not adopted;} \\ \Pi_{RFID}(A_i, T_i), & \text{if RFID is adopted.} \end{cases} \quad (1)$$

The total network profit without RFID adoption $\Pi_N(A_i, T_i)$ is

$$\begin{aligned} \Pi_N(A_i, T_i) = & \sum_{i=1}^n (p - \nu c) \theta \xi \lambda_i \delta_i C_i - \sum_{i=1}^n \left(F \frac{C_i}{A_i} \right) - \sum_{i=1}^n (c_T f \sqrt{A_i} \theta \xi \lambda_i \delta_i C_i) \\ & - \sum_{i=1}^n \left(\frac{h \theta \xi \lambda_i \delta_i C_i T_i}{2} + h Z_\alpha \sqrt{\mu_N \theta \xi \lambda_i \delta_i \frac{C_i^2}{A_i} + \sigma_N^2 (\theta \xi \lambda_i \delta_i C_i)^2} \right) \\ & - \sum_{i=1}^n \left(\frac{S C_i}{T_i A_i} \right) - \sum_{i=1}^n r \chi \theta \xi \lambda_i \delta_i C_i - \sum_{i=1}^n h t_N \chi \theta \lambda_i \delta_i C_i, \text{ where } i=1, 2, \dots, n. \end{aligned} \quad (2)$$

The total network profit with RFID adoption $TNC_{RFID}(A_i, T_i)$ is

$$\begin{aligned} \Pi_{RFID}(A_i, T_i) = & \sum_{i=1}^n (p - c - \tau) \xi \lambda_i \delta_i C_i - \sum_{i=1}^n \left(F \frac{C_i}{A_i} \right) - \sum_{i=1}^n (c_T f \sqrt{A_i} \xi \lambda_i \delta_i C_i) \\ & - \sum_{i=1}^n \left(\frac{h \xi \lambda_i \delta_i C_i T_i}{2} + h Z_\alpha \sqrt{\mu_{RFID} \xi \lambda_i \delta_i \frac{C_i^2}{A_i} + \sigma_{RFID}^2 (\xi \lambda_i \delta_i C_i)^2} \right) \\ & - \sum_{i=1}^n \left(\frac{S C_i}{T_i A_i} \right) - \sum_{i=1}^n r \chi \xi \lambda_i \delta_i C_i - \sum_{i=1}^n h t_{RFID} \chi \xi \lambda_i \delta_i C_i, \text{ where } i=1, 2, \dots, n. \end{aligned} \quad (3)$$

The crucial decisions are the location of the DCs, the manner in which to assign retail stores to DCs, inventory policy at DCs, and the RFID adoption decision to maximize total profit. Since each DC is assumed to locate in the center of the influence area, the location and allocation decisions can be decided by determining the DC influence areas.

Decision Making

The problem analysed here is to determine the optimal influence area for each DC A_i^* and replenishment cycle time for each DC T_i^* to maximize total network profit $\Pi(A_i, T_i)$, $i=1, 2, \dots, n$. The problem is a two-branch nonlinear function with $2n$ variables. To solve the problem, we first find the maximal values of $\Pi_N(A_i, T_i)$ and $\Pi_{RFID}(A_i, T_i)$ respectively. Then the optimal A_i^* and T_i^* are chosen to maximize $\Pi(A_i, T_i)$, i.e. $\Pi^*(A_i^*, T_i^*) = \max\{\Pi_N(A_i^\Delta, T_i^\Delta), \Pi_{RFID}(A_i^\diamond, T_i^\diamond)\}$, where A_i^Δ and T_i^Δ are the values to maximize $\Pi_N(A_i, T_i)$ and A_i^\diamond and T_i^\diamond are the values to maximize $\Pi_{RFID}(A_i, T_i)$. This is $\Pi^*(A_i^*, T_i^*) = \text{Max}\{\Pi_N(A_i^\Delta, T_i^\Delta), \Pi_{RFID}(A_i^\diamond, T_i^\diamond)\}$.

Numerical Example

To illustrate the algorithm described above, consider the parameters of a commodity in a supply chain: $F=5000$, $n=3$, $C_1=8000$, $C_2=10000$, $C_3=12000$, $h=1$, $c_T=5$, $r=2$, $S=500$, $f=0.01$, $\tau=0.4$, $\lambda_1=11$, $\lambda_2=10$, $\lambda_3=9$, $\xi=12$, $\delta_1=0.06$, $\delta_2=0.05$, $\delta_3=0.04$, $Z_{0.95}=1.645$, $\nu=1.05$, $\mu_{RFID}=0.5$, $\sigma_{RFID}=0.05$, $\mu_N=1$, $\sigma_N=0.1$, $\chi=0.02$; $t_{RFID}=1$, $t_N=1.5$. When adopt RFID technology ($\theta=1$), the influence areas for DCs in cluster 1, cluster 2 and cluster 3 are $A_1^\diamond=1017.63$, $A_2^\diamond=1215.75$ and $A_3^\diamond=1501.14$

respectively; the replenishment cycle times for DCs in cluster 1, cluster 2 and cluster 3 are $T_1^\diamond=0.352$, $T_2^\diamond=0.370$ and $T_3^\diamond=0.393$ respectively; the total profit $\Pi_{RFID}=289418$. When $\theta=0.9$ (without RFID adoption), the influence areas for DCs in cluster 1, cluster 2 and cluster 3 are $A_1^\Delta=1088.66$, $A_2^\Delta=1300.76$ and $A_3^\Delta=1606.32$ respectively; the replenishment cycle times for DCs in cluster 1, cluster 2 and cluster 3 are $T_1^\Delta=0.359$, $T_2^\Delta=0.377$ and $T_3^\Delta=0.400$ respectively; the total profit $\Pi_N=254821$. Therefore, in this case, the maximal profit is \$289418 when the RFID is adopted.

Conclusion

This study designs a supply chain network models considering RFID adoption. The crucial decisions are the location of the DCs, the manner in which to assign retail stores to DCs, the manner in which to set the inventory policy at DCs, and the RFID adoption decision to maximize total profit. This study formulated the supply chain network design problem as a two-branch nonlinear model and proposes a solution approach to solve the problem. Numerical study demonstrated the solution procedures. Further research on this topic may consider other practical scenarios, such as capacity limitations on DCs or deteriorating item supply networks.

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TARGETING INDUSTRY FOR THAILAND EAST-WEST ECONOMIC CORRIDOR

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Abstract

Greater Mekong Subregion's East-West Economic Corridor is the physical logistics and investment linkage of Myanmar, Thailand, Lao PDR and Vietnam. Where Thailand is geographically located in the center and posses high potential in terms of economic and industry, the research aims to identify the target industry for this regional development. The identification criteria includes key production factors and national policy, with 3 constructing steps of selection, i.e., (i) Preliminary Screen, (ii) Policy Screen and (iii) Industry Selection. The study leads to 2 targeting industries, i.e., foods and energy. In addition, other strong industries are also identified.

1. Introduction

1.1 Greater Mekong Subregion

Greater Mekong Subregion (GMS) is an Asian Development Bank (ADB) program that aims to cooperate economic of 6 countries along Mekong river, i.e., Cambodia, the People's Republic of China (PRC, specifically Yunnan Province and Guangxi Zhuang Autonomous Region), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Viet Nam (see Figure 1). Whilst the area is bounded together, it covers more than 2.6 million square kilometers and a combined population of 326 million. GMS program launched in 1992 with the collaboration in the area of transport, energy, telecommunications, environment, human resource development, tourism, trade, private sector investment, and agriculture. With the plentiful human and natural resource, GMS is one of the global economic's great potential. [1][2]

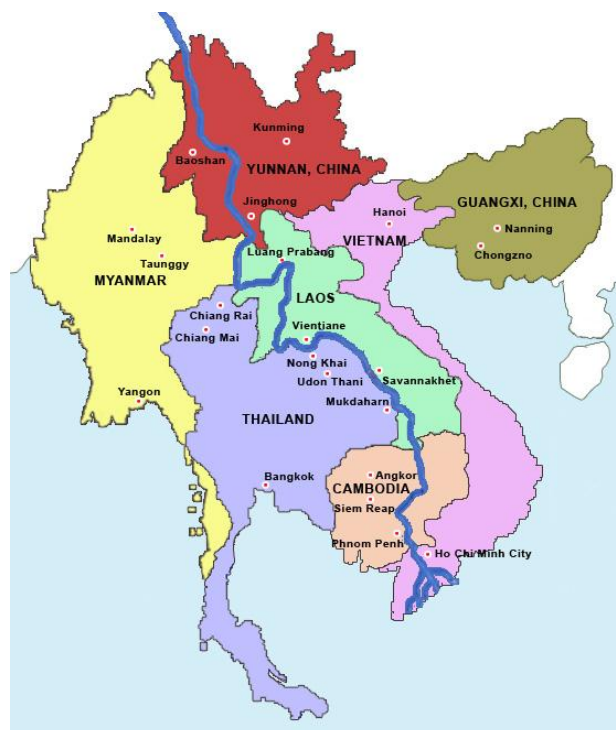


Figure 1: Greater Mekong Subregion

Source: [3]

Upon GMS economic development, the development of so-called "Economic Corridors" is one of the key projects by which it can lead to improve and enhance investments in multi-sectors, i.e., transport,

energy, telecommunications, tourism, trade, private sector investment, and agriculture in the subregion. The economic corridor development is not only focusing on strategic nodes particularly at border crossings between two countries, it highlights specific regional area, to concentrate infrastructure development and to simplify and borderlessen the area. [1][2][4]

The GMS's Economic Corridors were officially agreed to 3 economic corridors, i.e., [1]

- 1) The North-South Economic Corridor (NSEC) involves three routes along the north to south axis of the GMS geography:
 - (i) The Western Subcorridor: Kunming (PRC) – Chiang Rai (Thailand) – Bangkok (Thailand) via LAO PDR or Myanmar
 - (ii) The Central Subcorridor: Kunming (PRC) – Ha Noi (Viet Nam) – Hai Phong (Viet Nam) which connects to the existing Highway No. 1 running from the northern to the southern part of Viet Nam
 - (iii) The Eastern Subcorridor: Nanning (PRC) – Ha Noi (Viet Nam) via the Youyi Pass or Fangchenggang (PRC) – Dongxing (PRC) – Mong Cai (Viet Nam) route.
- 2) The East-West Economic Corridor (EWEC) runs from Da Nang Port in Viet Nam, through Lao PDR, Thailand, and to the Mawlamyine Port in Myanmar.
- 3) The Southern Economic Corridor (SEC) comprises the following subcorridors and intercorridor link connecting major towns and cities in the southern part of GMS:
 - (i) The Central Subcorridor: Bangkok-Phnom Penh-Ho Chi Minh City-Vung Tau;
 - (ii) The Northern Subcorridor: Bangkok-Siem Reap-Stung Treng-Rattanakiri-O Yadov-Pleiku-Quy Nhon;
 - (iii) The Southern Coastal Subcorridor: Bangkok-Trat-Koh Kong-Kampot-Ha Tien-Ca Mau City-Nam Can; and
 - (iv) The Intercorridor Link: Sihanoukville-Phnom Penh-Kratie-Stung Treng-Dong Kralor (Tra Pang Kriel)-Pakse-Savannakhet.

Of interest of the paper is the East-West Economic Corridor (EWEC) that run across from Viet Nam, through Lao PDR, Thailand, and to Myanmar.

1.2 East-West Economic Corridor

The economic corridor is created based on a road of 1,450 km with the west end at port city of Mawlamyine (Myanmar), crossing Kayin Division, Thai provinces of Tak, Sukhothai, Phitsanulok, Phetchabun, Khon Kaen, Kalasin and Mukdahan and Laotian provinces of Savannakhet, Vietnamese provinces of Quang Tri, Thua Thien-Hue Province and Da Nang city as the east end. [5]

The specific objectives of EWEC development are to further strengthen economic cooperation and to facilitate trade, investment, and development among these four countries; to reduce transport costs in the project area by making the movement of goods and people more efficient; and to reduce poverty by supporting economic development in rural areas and border regions, especially via agro-industry and tourism.

ADB as well as 3 countries estimateldly invest in the establishment of EWEC on infrastructure and related development at US\$ 2.5 billion. Such projects are, for example, road rehabilitation, development of Special Border Zones and deep-sea port. [6]



Figure 2: Greater Mekong Subregion's East-West Economic Corridor
Source: [6]

1.3 Thailand's East-West Economic Corridor

In Thailand, of interest in this paper, EWEK cut across 9 cities, ie, Tak, Sukhothai, Phitsanulok, Phetchabun, Chaiyaphum, Khon Kaen, Mahasarakham, Kalasin and Mukdahan. Table 1 summarises basic information and economic of these cities.

City	Area (Sq.km.)	Population (1,000 person)	GPP (million THB)	GPP per Capita (THB)
Tak	16,406	535	34,550	64,610
Sukhothai	6,596	630	33,440	53,058
Phitsanulok	10,815	851	63,984	75,157
Phetchabun	12,668	1,041	57,856	55,562
Chaiyaothum	12,778	1,201	46,899	39,049
Khon Kaen	10,885	1,896	155,272	81,884
Mahasarakham	5,291	1,031	41,000	39,776
Kalasin	6,946	1,012	43,293	42,775
Mukdahan	4,194	346	18,732	54,170

Table 1: Summary of Basic Information and Economic of Thailand EWEK Cities – 2011
Source: [7]

All 9 EWEK cities are very distinct in term of area, population and economy. EWEK cities cover 17% of area of Thailand and 13% of total population of Thailand. However, comparing to the whole country GPP per capita at 164,512THB, EWEK cities are rather poor. Yet, with the opening gateway to the East and West with this EWEK, EWEK cities are possessing high potential and connectivity.

2. Target Industry Selection Criteria

Based on industry database of Ministry of Industry, currently, there are 21 industries, i.e., chemical/ chemical product, furniture, wood/ wood product, printing, electronic/ electric appliances, machine/ mechanics, basic metal, paper/ paper product, metal, petroleum, agricultural, plastic, non-metal, automotive/ components, leather/ leather product, rubber/ rubber product, textile, garment, drink, food and other industries. At present, classified in these 21 industries, there are 7,193 factories registered in EWEK area. [8]

Of interest of the study is the selection of the targeting industry where the promotion policy should be placed. Therefore, the basic requirement of the selection is the industry potential. Whilst the promotion can be divided into phase such as urgent, short-term, long-term, the study focus on the urgent. Here, the strong industry should be selected as the offensive policy is needed. Therefore, it is the task to identify the dominant industry. Hence, how to identify.

Where the criteria can be vast, the multi-criteria selection and screening process are used. The selection process is therefore design as; (i) Preliminary Screen, (ii) Policy Screen and (iii) Industry Selection. Figure 2 illustrates process of selection.

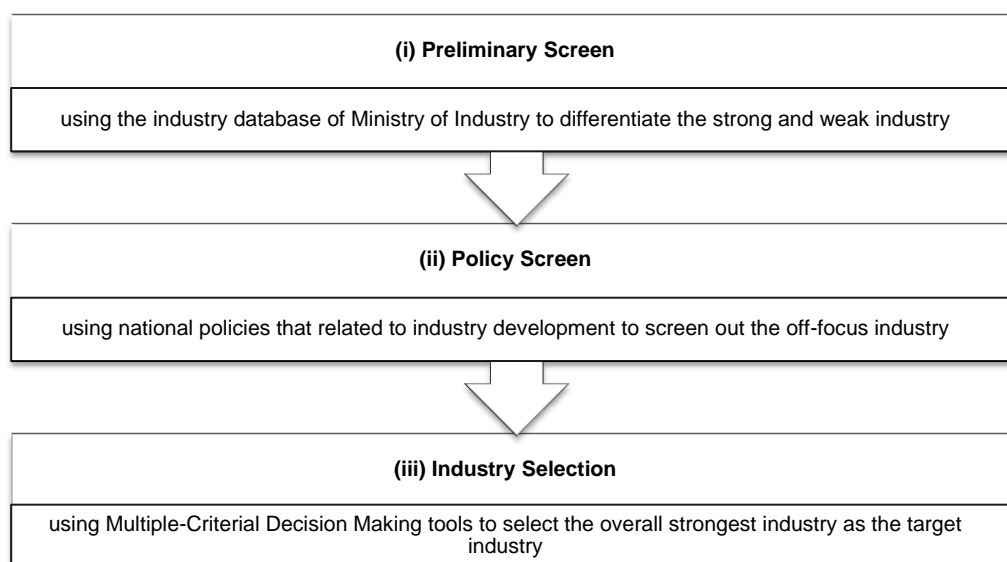


Figure 2: Industry Selection Process

The following topic elaborates the selection process and result.

3. Result

3.1 Preliminary Screen

Process of preliminary screen use the industry database of Ministry of Industry to identify the current strength of those registered 22 industry. The selection criteria of the screening is based on key information available on the database itself, i.e., number of factory, machine cost, revolving fund, investment cost, machine horse power and number of labor. These criteria are more-or-less reflect the current status of each industry.

Whilst each criteria possess different indicators, e.g., number of factory, THB, hp, number of people, therefore, the comparison on multi-dimension are not possible. Here, the ranking of each criteria is used. Then the combine rank of each criteria is used to summarise overall rank (see Table 2).

Industry	(a)	(b)	(c)	(d)	(e)	(f)	Summation of Rank (a+b+c+d+e+f)	Overall Rank
Chemical/ chemical product	13	13	19	15	17	17	94	18
Furniture	9	19	16	19	13	9	85	15
Wood/ wood product	8	10	13	12	8	11	62	10
Other	6	1	3	2	2	6	20	3
Printing	16	21	20	20	21	21	119	21
Electronic/ electric appliances	18	15	5	10	18	8	74	11
Machine/ mechanics	7	18	14	16	12	13	80	13
Basic metal	21	17	4	11	9	18	80	14
Paper/ paper product	15	3	9	5	4	14	50	8
Metal	5	14	15	13	14	15	76	12
Petroleum	17	11	18	17	16	19	98	19

Industry	(a)	(b)	(c)	(d)	(e)	(f)	Summation of Rank (a+b+c+d+e+f)	Overall Rank
Agricultural	1	5	2	3	3	4	18	2
Plastic	12	16	17	18	15	12	90	17
Non-metal	3	6	7	7	7	5	35	4
Automotive/ components	2	9	6	6	10	7	40	5
Leather/ leather product	20	12	12	14	20	10	88	16
Rubber/ rubber product	14	20	21	21	19	20	115	20
Textile	11	7	11	9	5	2	45	6
Garment	10	8	10	8	11	1	48	7
Drink	19	4	8	4	6	16	57	9
Food	4	2	1	1	1	3	12	1

Note: (a) Rank of Number of Factory, (b) Rank of Machine Cost, (c) Rank of Revolving Fund, (d) Rank of Investment Cost, (e) Rank of Machine Horse Power and (f) Rank of Number of Labor

Table 2: Criteria Rank and Overall Rank of Industry

Here, 12 weak industries (ranked 11-21) are screened out. Therefore, only 10 industries, i.e., food, agricultural, other, non-metal, automotive/ components, textile, garment, petroleum, drink and wood/ wood product will be considered in the next step. However, when inspect these 10 industries in detail, there are some adjustment made as follow:

- When talking about textile, garment is always included. [9] Therefore, it is then textile and garment industry.
- When talking about food, , agricultural and drink is always included. [9] Therefore, it is food industry.
- When inspecting into other industry (ranked 3), most of the industry are energy related. Therefore, it is then called energy industry.

Here, only 7 industries are considered in policy screen process, i.e., food, non-metal, energy, automotive/ components, textile/ garment, petroleum and wood/ wood product.

3.2 Policy Screen

After the preliminary selection, the policy screen is conducted. By which national policies that related to industry development is used to screen out the off-focus industry, the following summarises the findings.

Here, national policies of interest are Thailand's Industry Master Plan 2012-2031, Thailand's 11th National Economic and Social Development Plan 2012-2016 and Thailand's 2trillion THB logistics infrastructure investment plan. Where the Industry Master Plan highlight the development of food, automotive/ component, garment and energy, the economic and social development plan address directly to food and energy industry as the target industry of Thailand. On the other hand, the logistics infrastructure investment plan does not rule out or promote any industry in specific. [9][10][11][12][13] Therefore, the preferred industries, for the next selection step are food, automotive/ component, textile/ garment and energy.

3.3 Industry Selection

The industry selection is based on Multiple-Criteria Decision Making tools. It is to select the overall strongest industry as the target industry. Where 5 factors of interest are 1) material, 2) labor, 3) investment and machine, 4) market and cluster and 5) economic, social and environment. In detail, there are 20 sub-factors constructing these 5 factors. (see Figure 3) It shall be noted that these criteria are agreed based on literature [14][15][16] and upon the Ministry of Industry agency who is funding the project as well as stakeholders upon interviews.

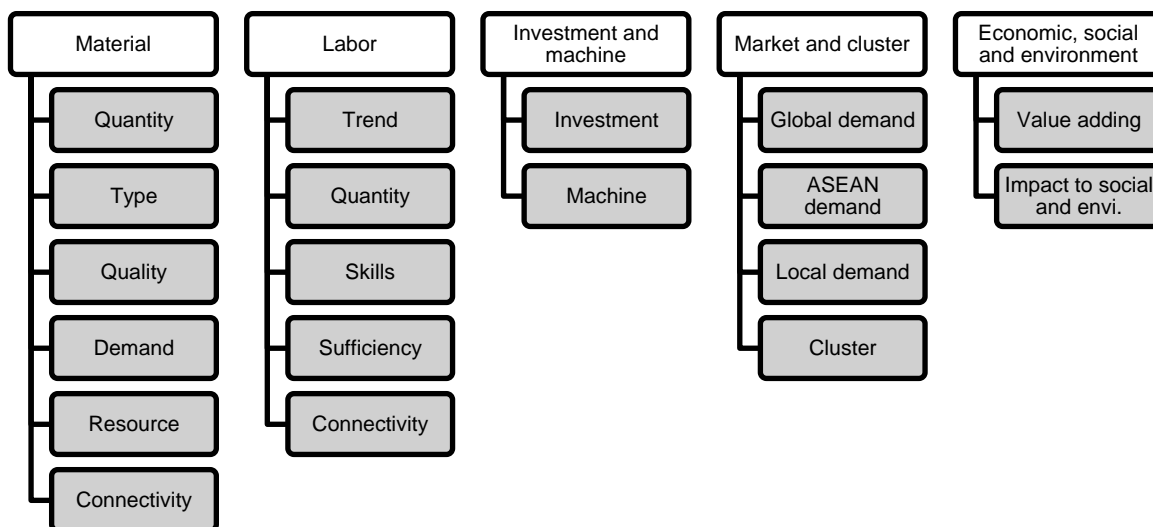


Figure 3: Industry Selection Criteria

Here, technique of Fuzzy Analytical Hierarchy Process (FAHP) is used for determine the significance of each factor. [17][18][19] The AHP pair-wise questionnaires is developed and distributed to stakeholders in these EVEC cities. Upon the data collection, seminar on related topics and interviews, 35 questionnaires are completed. The consistency ratio is tested and the result is to be accepted. Figure 4 illustrates weight per AHP pair-wise calculation.

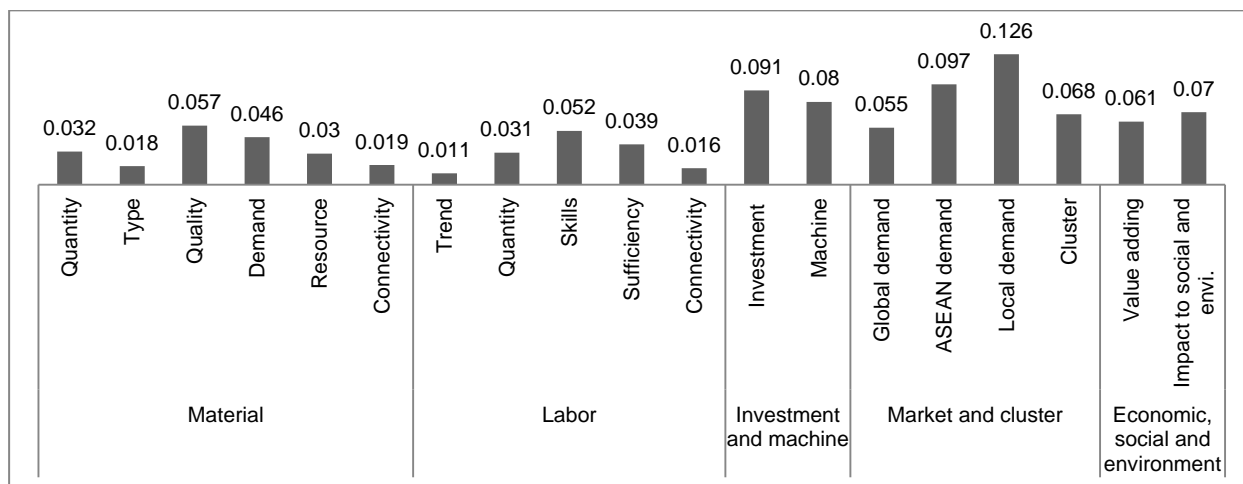


Figure 4: Sub-Factors Weight

Then, another questionnaire is developed to collect the perception to each factor of interest. The score level of 1-5 is used to reflect the strength and weakness of each industry in each sub-factor. The potential of the industry is determined by the total score, which is a summation of score multiply by weight (from FAHP) of each factor. The result is shown in Table 3.

Factor	Sub-Factor	Total Score (weight x score)			
		Food	Energy	Automotive/Component	Textile/Garment
Material	Quantity	0.010	0.009	0.006	0.006
	Type	0.008	0.004	0.003	0.003
	Quality	0.021	0.014	0.011	0.011
	Demand	0.019	0.011	0.009	0.008
	Resource	0.011	0.008	0.005	0.006
	Connectivity	0.006	0.006	0.003	0.004
Labor	Trend	0.003	0.003	0.003	0.002
	Quantity	0.010	0.007	0.007	0.007

Factor	Sub-Factor	Total Score (weight x score)			
		Food	Energy	Automotive/ Component	Textile/ Garment
	Skills	0.015	0.013	0.011	0.014
	Sufficiency	0.011	0.010	0.007	0.010
	Connectivity	0.005	0.005	0.003	0.003
Investment and machine	Investment	0.023	0.029	0.019	0.020
	Machine	0.023	0.022	0.014	0.021
Market and cluster	Global demand	0.016	0.015	0.011	0.014
	ASEAN demand	0.026	0.033	0.020	0.018
	Local demand	0.038	0.049	0.023	0.017
	Cluster	0.021	0.018	0.014	0.015
Economic, social and environment	Value adding	0.017	0.018	0.014	0.013
	Impact to social and environment	0.019	0.021	0.018	0.012
Total Score		0.302	0.294	0.201	0.204
Rank		1	2	4	3

Table 3: Industry Selection – Multiple-Criteria

Here, it can be seen that food is ranked 1 at total score of 0.302 and energy is ranked 2 at total score of 0.294. Here, it can be seen that food and energy industries are generally and comparatively strong in terms of material, labor, investment and machine, market and cluster and economic, social and environment.

Textile/ garment and automotive/ component are ranked 3 and 4, at score 0.204 and 0.201, respectively. These two are also strong, in comparison to other screen-out industries in earlier steps.

4. Conclusion

The research aims to identify targeting industry in Thailand EWEC cities. Where strong industries are to be promoted for EWEC development, the multi-criteria selection and screening process are used. The process starts from the preliminary screen that uses the industry database of Ministry of Industry to differentiate the strong and weak industry. Therefore, 7 strong industries are identified. Then the policy screen that uses national policies that related to industry development to screen out the off-focus industry. 4 industries are selected. Finally, with the industry selection that uses Multiple-Criterial Decision Making tools to select the overall strongest industry as the target industry, food and energy industries are selected.

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THE ANALYSIS OF INFORMATION ARCHITECTURE MODEL OF TOURISM LOGISTICS WEBSITES

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Purpose: This paper analyse information architecture of top tourism logistics websites in order to develop the most efficient framework. In tourism industry, each web needs a different architecture to suit their users. The information architecture influences the performance of information flow. The efficient information flow can enrich information sharing across the supply chain. It is clear to see that the Information flow provides opportunities and challenges for the tourism industry. Information is often distributed via common tools include travel documents, television advertisements, online videos and websites. Among those tools, websites are the most common one.

Design/methodology/approach In this paper, the top tourism website is analyzed based on the research methodology applied from SAM (Software Process Analysis Method) which is previously applied for the analysis of well-known software processes and e-commerce websites. Firstly, detailed information architecture of the websites is elaborated via elaboration process. Secondly, the main components of information architecture are discovered from the normalization process. Lastly, the abstract model of tourism website is generated.

Findings: This paper proposes conceptual model for building of tourism website based on their processes and elements.

Practical implications: The model obtained can be used as a recommended model for adopters. The models suggest key characteristics needed for a tourism website. As a result, design and development time as well as required labour are reduced. This further results in cost reduction and more customer satisfaction.

Originality/value: This paper applies an existing analysis method onto the domain of tourism logistics.

Keywords: Tourism website, Travel website, Tourism logistics, Tourism logistic supply chain, Information flow, Information system, Information architecture model

Introduction

Logistics was introduced before 1950s and was first implemented in procurement, maintenance and transportation processes (Ballou 2007). However, its usefulness and applicability encourage the adaptation in other areas, i.e. hospitality, catering and tourism (Kordel 2008).

It is obvious that tourism is the key force that drives the world's economy (Cooper 2008) and destinations' economy. The fact that tourism industry is extremely competitive (Crouch & Ritchie 1999) comes at no surprise. Therefore, tourism destinations or tourism companies are influenced by the competitive environment and are forced to take advantages of information technology in order to enrich their competitive and economical advantage (Zhang et. al 2009). Examples in using information technology in tourism businesses include seeking destination and car rental information, comparison of airfare costs, booking accommodation, and etc. One of the recommended strategies for increasing competitiveness is applying supply chain management concepts to tourism (Zhang et. al 2009). TSCM (Tourism Supply Chain Management) is a set of approaches to manage the process of tourism supply chain (TSC). The generic tourism supply chain model that shows flows and processes of TSCs (Piboonrunroj & Disney 2009) is shown on Figure 1. The TSC model represents three flows. It starts with the customer flow that is initiated since customers make decisions for a trip. Thus, stimulates the information flow and physical flow.

An efficient information flow can enrich information sharing across the supply chain. Besides, the further the information flow penetrates to the upstream (i.e. suppliers), the better the improvement in the supply chain's behavior. It is clear to see that the Information flow provides opportunities and challenges for the tourism industry (Gupta 2012). Furthermore, the faster and easier information flow increases confidence in customer flow (Nath & Menon 2005). Undoubtedly, the Information flow effects performance of the whole supply chain (Yang & Burns 2003).

There are several advantages when users have control over information flow via the information system (Ariely 2000), i.e. improves task performance and users can be more confident in decision making tasks. Ariely (2000) performed experiments on levels of control over information flow. The results showed that the increase in performance is associated to increased information control rather than because of the agent or task.

The information flow involves giving and receiving data and information via distribution tools. Common tools include travel documents, television advertisements, online videos and websites. More and more online tools are accessed and used daily for travel and tourism purposes, since information technology becomes readily available and easier for almost everyone. Among those tools, websites are the most common one.

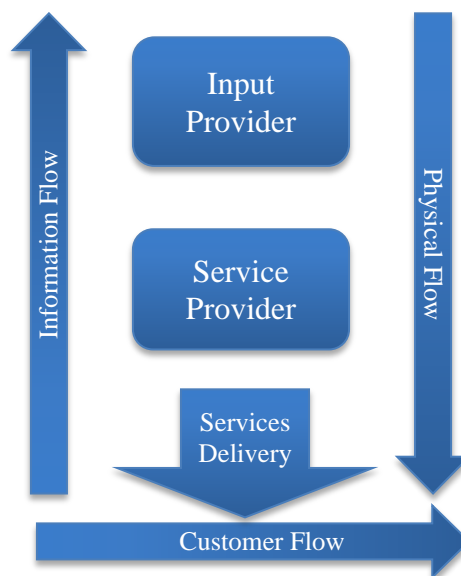


Figure 5: The generic tourism supply chain model (Piboonrunroj & Disney 2009).

Website Evaluation

Websites should be evaluated from time to time to ensure the usefulness of contents and that it meets usability goals (Law et. al. 2010). General measures for website evaluation are efficiency and effectiveness (Morrison et. al. 2005). Law and colleges (2010) report that there are over 70 studies on evaluation of tourism websites during 1996-2009. These studies implement various approaches for website evaluation. Yet, their successes were moderate. There are still searches for the suitable evaluation approach to gain sufficient insight into web performance.

Website evaluation reflects comprehension and how well the websites function, and allow us to learn more about the problems. The solutions to those problems are not always known. While website evaluation is an act to find out what is the current status of the existing information infrastructure, the other approach known as information architecture, that emphasizes in building a solid structure of website, is an entirely different act that tackles website from the development stage where the foundation of usefulness and efficiency can be initiated. When such foundation is in place, the ultimate goal of information architecture development, and that is findability, can be accomplished. Findability can also be accomplished on usable websites. Hence, it is reasonable to suggest that websites with well-planned information architecture can result in usable websites, and therefore encourages findability.

Information Architecture

Each website has a blueprint like buildings have architectures. Hence, each website needs a different architecture. A good website information architecture is simple and clear to make it easy for users to use a website (Van 2003). Poor websites cause problems such as not finding information or lack of details. The worst case is giving up on it before the whole page is downloaded, or leaving for another website after scanning the first few lines on the page.

Information architecture of websites covers organization, navigation, labeling, searching and indexing.

It represents physical architecture, terminology, connection and how pages can be found. The organization system defines the physical appearance shared across the site, logical grouping and relationship between content items. The navigation system provides evidences of findability and availability of choices. Labels and indexes focus on representation of information to enable efficient communication. Well-organization information architecture significantly benefits customers (customer flow) and providers (physical flow) (Moville & Rosenfeld 2008).

Tourism websites

The term "Tourism website" is sometimes used interchangeably with "travel website" in many publications. For example, Judith and Susan (1999) used these words for the same meaning. They classified tourism/travel websites into groups based on similarity and functionality, i.e. mega sites, travel information, accommodation and transportation. Alternatively, Paiboonrungrroj and Disney (2009) identified distinct and related activities between tourism industry, hospitality industry and travel industry. While hospitality industry focuses on providing accommodation, food and recreational services for tourists, travel industry focuses on transportation. Tourism industry deals with destination, destination marketing, travel trading, planning and development. The links between tourism industry and the other two industries are also provided in their model.

In this paper, tourism websites are chosen based on the definition of tourism given by Paiboonrungrroj and Disney (2009). A tourism website referred in this paper is, therefore, defined as a website that offers information concerning destinations, marketing of destinations, and support in tourism planning and development.

The tourism websites are chosen from the world's top tourism destinations ranked by UNWTO (United Nations World Tourism Organization) 2013 edition (UNWTO 2013). Countries are ranked by international tourist arrivals. In this study, we chose to analyze the information architecture of Franceguide.com (US version), as France is the world #1 by tourist arrivals. The findings are presented and discussed after methodology section.

METHODOLOGY

SAM (Software Process Analysis) is a method originally designed for the analysis of software development models (Ramingwong et al. 2009). The analysis was performed on well-known software development including Waterfall model, Spiral model, Extreme programming, Scrum, for examples. The findings revealed the true characteristics of the models, and served as a recommendation for software development model selection and adoption. In the original method, SAM classified all software processes into six phases, i.e. Planning, Specifying, Designing, Coding and Testing, Delivering, and Supporting.

In previous studies, the final model is based on a reference model called abstract model. However, in this study, the reference model is not yet available. Consequently, the model obtained from this study is used as the reference model which shows the structure of information on the website being analyzed. The model can be modified later to reflect well-defined information architecture.

In this work, SAM involves three steps: (1) elaboration, where each navigation item is mapped cover details specified on the page it is linked to, (2) normalization, that involves replacing unfamiliar terms to common terms, and (3) Abstraction, involves combining similar items and from clusters of information that will turn to a model.

Analysis of Tourism Websites Information Architecture

Firstly, the content items on website are identified and their labels are recorded in the content inventory. Secondly, the organization, navigation, labeling, searching and indexing scheme are identified and analyzed based on information architecture's components defined from the book by Moreville and Rosenfeld (2008). Each system is broken down into subcategories, which are described next.

Organization schemes define how information can be divided. Websites may have an exact organization scheme, less exact scheme or hybrid scheme. The three most used exact schemes are alphabetical, chronological and geographical schemes. Unquestionably, exact organization scheme

schemes are easy to use. The less exact organization schemes include topical, task-oriented, audience-specific, metaphore-driven. Despite the fact that less exact organization schemes may be difficult to use, people find it more useful.

Several types of navigation systems are often used in a website. Even though the principal navigation system is hierarchical, there are limitations. A global navigation system is often used in addition to the hierarchical navigation. Local navigation systems may be used to support the global navigation system. Occasionally, ad hoc links are used alongside other navigation systems. A navigation system can be implemented using navigation bars (hyperlink/graphic/frame-based) or pull-down menu. Alternatively, users may navigate websites from other navigation elements such as table of contents, indexes and guided tour.

Labeling systems deals with labels that are typically used in two ways, either as part of a navigation system or as headings. Labels could be used within a navigation system, as index words or as links.

Whereas organization, navigation and labeling systems put emphasis on creating the effective browsing system, searching systems concentrate on techniques to make searching works. Recommended techniques are (1) joining searching and browsing systems, (2) offering different kinds of information search, (3) making search options stand out and clear, (4) choosing an appropriate search engine for users, (5) displaying search results wisely, (6) relevancy search, (7) providing feedback and (8) creating search zone.

In this paper, the organization and navigation systems are analyzed. Searching and labeling systems are not covered in this paper. Table 1 and 2 shows the analysis result of Franceguide.com based on SAM.

Original content labels	Normalized labels	Abstracted labels
<i>Home</i>	<i>Home</i>	<i>Home</i>
- News	- News	- Regions
- Articles on France from the American press	- Publications	- Travel
- Discover France	- Regions	- Activities
- Lost in Francelation	- Trip Planning	- Trip planning
- Organizing your trip	- Weather	- Weather
- Weather forecast	- Social network	- Latest information
- E-News letter	- Recommended activity	- Travel trade
- Join the Franceguide communication	- Updated information	- Marketing
- What to do	- User personal information	- News
- France by Islands	- Travel trade	- Publications
- Stay up to date	- Marketing	- Social networks
- Publication	- Website in another language	- Users
- Organize your trip		- Information
- MyFrance		- Feedback
- France for Professionals		- Other language
- Language		
<i>Destinations</i>	<i>Destinations</i>	<i>Destinations</i>
- Region	- Region	- Region
<i>What to do</i>	<i>Recommended Activities</i>	<i>Activities</i>
- Art & Culture	- Art & Culture	- Art & Culture
- Cities	- Cities	- Regions
- Cruises	- Recreation	- Recreation

- Golf
- Mountain air
- Winter mountain
- Nature
- Overseas
- Seaside resort
- Wine & Cuisine
- Youth
- Wellbeing
- Gay
- Romance
- Special needs
- Spring in France
- Ecotourism
- Religious tours
- Jewish

Deal & Contests

- Top deals
- Flight deals
- Package deals
- Accommodation
- While in France
- Contests

Practical Info

- Transportation
 - Transportation in France
 - Flying to and around France
 - Renting a car and driving in France
 - Traveling to, from, and around France by train
- Know Before You Go
 - Entry requirements
 - French diplomatic bureaus in the United States
 - French public and school holidays
 - Regional climates in France
 - Accommodations – Hotel information
 - Financial matters
 - Tourism tax
 - Other FAQs
- While in France
 - Tax-Free shopping
 - Prices of everyday items in France
 - Meals

- Sport
- Attractions
- Local destinations
- Accommodation
- Food
- Healthcare
- Specific travelers
- Highlight

Deal & Contests

- Travel deals
- Transport deals
- Accommodation
- Recommended activities

Practical Info

- Transportation
 - Ground transport
 - Air transport
 - Driving and car rental
- Travel preparation
 - Entry requirements
 - Local calendar
 - Accommodation information
 - Financial information
 - Tax
 - FAQ
- During your stay
 - Shopping
 - Living expenses
 - Meals and specialties
 - Emergency contacts
 - Healthcare information
 - Communication information
 - Entertainment information
 - Time information
- Regions
- Latest information
- Recommended activity

- Sport
- Attractions
- Accommodation
- Food
- Healthcare
- Travelers
- Highlight

Promotions

- Travel
- Transport
- Accommodation
- Activities

Practical Info

- Transportation
 - Ground
 - Air
 - Driving
 - Car rent
- Travel preparation
 - Entry requirements
 - Calendar
 - Financial
 - Emergency contacts
 - Healthcare
 - Communication
 - Time
 - FAQ
- Travel planning
 - Accommodation
 - Transport deals
 - Accommodation deals
 - Shopping
 - Meals
 - Entertainment
 - Events & Planning

- In case of emergency
- Staying healthy during your visit to France
- Keeping in touch by Mail, Phone, Internal, and Fax
- Entertainment
- Time zones
- Discover Regions
- Stay up to date
- What to do
- Multimedia
- My France
- Fly over France
- Organize your trip
 - Plane
 - Train
 - Hotel
 - Apartment/Villa
 - Restaurant
 - Need help?
 - French specialist
- Plan your events
 - Events & Festivals
 - Tickets
- Publications
 - Brochures
 - E-newsletter
 - Franceguide Magazine

Magazine

- Where you can find our magazines
- Our Cartes postales
- Club France
 - Subscribe to our E-newsletter
 - Browse our e-news archives
 - Events & Festivals
 - RSS feed
 - Post your comments
- Other online publications
 - Franceguide for Jewish traveler
 - Franceguide for Gay traveler
- Brochure by regions
- Download FranceGuide
 - Franceguide in English
 - Franceguide in Spanish
 - Franceguide for Jewish

- Additional multimedia
- User personal information
- Map
- Trip planning
 - Transport deals
 - Accommodation deals
 - Restaurants
 - Travel agents
 - Events
- Publication
 - Destination information and promotion

Publication

- Where to find?
- Brochure order
- Community
 - E-newsletter
 - News achieve
 - Events
 - Updated news & development
 - User feedbacks : Comments
- Others
 - Guide for specific audience
 - Brochure by regions
 - Guide Access
 - in other languages
 - for specific audience
 - User feedbacks : Survey
 - in other languages

- Restaurants
- Travel agents
- Regions
- Latest information
- Activities
- Media
- User information
- Map
- Publication
 - Destination information
 - Promotion

Publication

- Location
- Brochure order
- Community
 - Newsletter
 - News
 - Events
 - Updated information
 - User feedbacks
- Guide for specific audiences

- traveler
 - Franceguide for Gay traveler
 - Our reader survey
 - Take our survey in English
 - Take our survey in Spanish

Table 1: Content Inventory of Franceguide.com

<i>Page</i>	<i>Home</i>	<i>Navigation item</i>	<i>Destination</i>	<i>Navigation item</i>
Organization scheme				
<i>Alphabetical</i>				
<i>Chronological</i>	X	<i>Articles on France</i>		
<i>Geographical</i>			X	<i>Regions</i>
<i>Topical</i>	X	<i>Global navigation</i>		
<i>Task-oriented</i>	X	<i>Trip planning, Regions, Marketing</i>	X	<i>Trip planning</i>
<i>Audience-specific</i>	X	<i>Global</i>		
<i>Metaphor-driven</i>	X	<i>Body</i>		
<i>Frequency</i>	6		2	

Table 2: Analysis of organization scheme and navigation systems of Franceguide.com

Findings and Conclusions

Table 1 presents the information from Franceguide.com with the original navigation labels, normalized labels and abstracted labels. The abstract labels obtained establish the baseline for tourism websites. The main page, which is called home, should be presented with regions information, travel planning information (activities, weather, latest information and travel trade) and marketing tools (i.e. news, publication, social networks). User information and language should also be noticeable.

Before reaching the home page, users should be presented with localization options; thus, users would be redirected to the content organized for their country. This is an example that demonstrates the extent to which international success can be contributed from localization.

It is interesting to note that a tourism website audience should encourage as much specific information (i.e. religious, ecotourism or special need travelers) as possible. It is essential for international tourism destinations to serve a wide variety of user needs.

The home page should emphasize the main aspects of tourism and the selected tourism website covers that very well. Hospitality, travel and other logistics information should also be presented nearby where users can easily reach when they want to. In this study, these information are found to be directly linked on from the home page and can be found on the bottom of each page.

Finally, publication information should be available both online and offline. Users should be able to choose how to receive tourism information and a tourism website should provide them the way they can interact with the website. In this case, the selected tourism website allows users to give comments and upload videos.

In this paper, the information architecture, especially the organization and navigation systems of the top tourism website, Franceguide.com, is studied and modeled. The abstract model provides insights to what kind of information a tourism website should host and how they can be represented. To serve different needs and purposes, a hybrid organization scheme should be developed.

A future study should be done with other elements of information architecture, and more websites should be studied. Thus, more insights could be gained.

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THE CONCEPT OF HALAL LOGISTICS – AN INSIGHT

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Introduction

Recently, the market of halal products has received much attention worldwide. Therefore, the demand for halal products is increasing tremendously not only from Muslim countries but also non-Muslim countries. The term of halal logistics has arisen in the logistics industry in Malaysia since 2000, in fact some of the logistics service providers have also offered halal logistics services such as MILS Sdn Bhd and Kontena Nasional Sdn Bhd. Meanwhile, the Malaysian government have also given incentives to the companies that venture into the halal industry. Halal hub, which is a dedicated area in each state in Malaysia, has been designated in assisting the halal products producers to boost the halal industry. In addition, the halal antoyyiban assurance pipeline (HTAP) is the Malaysian standard for halal logistics that cover the warehousing, transportation, and retailing aspects.

The component of halal industry can be classified into three areas, namely services, food and non-food (Ministry of Industrial and Trade, 2006). Therefore, halal logistics is categorized in one of the components, namely the service component.



Figure 1. The component of halal industry (Ministry of Industrial and Trade, 2006).

Meanwhile, the development of halal industry is not only concentrated in the ASEAN countries such as Thailand, The Philippines, Malaysia, and Brunei, but it has also expanded to the Middle Eastern

countries such as United Arab Emirates, Western countries such as the United States of America, and Europe such as France, which are also really keen in the halal market. Despite the potential growth of the halal industry, the concept of halal logistics is not really understood by the logistics service providers. Therefore, this study is deemed important to develop a conceptual framework and suggest the most feasible terminology for halal logistics. Finally, the paper will discuss the issues and challenges in providing a more concrete and focused concept of halal logistics.

Background of the study

Understanding the Concept of Halal

Halal is an Arabic word that means lawful or permissible. The term halal is used by the religion of Islam to guide Muslims in everyday life. Muslims believe that Allah (The God) is the Creator and Muhammad (The Prophet) is the final Messenger of Allah. Halal refers to all that is permitted and Haram refers to all that is prohibited according to the guidelines given by Allah in the Qur'an and explained (Sunnah) by the Messenger of Allah (PBUH). The Islamic dietary laws are derived primarily from the Qur'an and the Sunnah of the Messenger of Allah (PBUH). The basic principle is that all foods are halal except those prohibited in the Qur'an and the Sunnah. This reflects that no one has an authority to declare halal and haram except Allah. The foods that are not permissible are namely swine or pork and its by-products, carrion or improperly slaughtered halal animals, animals killed in the name of anyone other than Allah, carnivorous animals with fangs such as lions, dogs, wolves, and tigers, birds of prey such as falcons, eagles or owls, snakes, domesticated donkeys, mules and elephants, pests such as rats and scorpions, insects excluding locusts, blood and blood by-products, alcohol and intoxicants of all kinds, all poisonous plants and poisonous aquatic (unless the poison is removed before consumption), and food which is contaminated with any of the products mentioned above (Lodhi, 2010). In Islam, each of these foods has its own argument of why it is forbidden to the Muslims as Islamic dietary laws strictly adhere to quality, cleanliness, and safety of the food that they consume. Generally, the specific reasons of Haram in Islam are to (1) preserve the purity of the religion, (2) safeguard the Islamic mentality, (3) preserve life, (4) safeguard property, (5) safeguard future generations, and (6) maintain self-respect and integrity (Ahmad, 2008).

Nevertheless, recently Muslims realize that the halal concept is not only confined to food as it also includes the process of distribution, handling, packaging, and storage. The concept of halal and also *toyyiban* as 'wholesome' as stipulated in Islam covers nutrition, quality, cleanliness, and safety for everyone and not meant only for the Muslim society which can be practised in food production. For instance, the halal authentication of food products must cover the source of raw materials to the consumers. Accordingly, any activities along the supply chain such as handling, storage, and distribution must be shariah compliant in which *halalantoyyiban* concept can be applied. Any halal products cannot be mixed with haram products and must be segregated (Jaafar et al., 2011a). This has formed the halal supply chain as significant, broadly accepted, and acquired by the consumers that will also increase the demand for halal logistics among the halal food industry players.

In addition, recently consumers are not only concerned on the halal status of the product itself but also the processes that are involved with it. Consumers choose to buy the particular halal products as the products have gone through the 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 understand the concept of halal logistics and is frequently being misunderstood by the industry players. For them halal logistics means adding extra cost such as compartmentalizing the warehouse, food segregation according to its nature, and others. Thus, companies will be reluctant to apply for halal logistics and this will create a barrier to the implementation of halal logistics in the halal food industry. Furthermore, awareness of halal logistics needs to be inculcated and exposed to the industry players and as well as to the public.

In 2000, various authors (Arham, 2010; Sandikci & Rice, 2011; Sula, Kartajaya, 2006; Wilson & Liu, 2011; Wilson, 2012) had identified that the Islamic marketing is an innovation in the social science discipline. The Islamic marketing highlights the shariah compliance of the marketing function (Alserhan & Alserhan, 2012), marketing of Islamic brand (Alserhan, 2010) and the need of the Muslim markets (Temporal, 2011). Similarly, halal logistics has also created a new contribution and knowledge to the logistics and supply chain discipline.

Previous studies on halal have looked into the aspects of intention on halal purchase ([Shaari & Arifin, 2009](#)), satisfaction towards halal products ([Danesh et al., 2010](#)), institutional issue ([Othman et al., 2009](#)), quality aspects of food industry ([Omar et al., 2008](#); [Talib et al., 2009](#)), traceability in the meat chain ([Gellynck et al., 2002](#)), slaughtering influencing product quality ([Petracci et al., 2010](#)), and consumption of halal food ([Hamlett et al., 2008](#)). Meanwhile, in the area of food research, studies have been done on the effective management of food safety and quality ([Manning & Baines, 2004](#)), quality assurances in the food supply chain ([Manning et al., 2006](#)), the traceability of data management for food chains ([Folinas et al., 2006](#)), and agri-food ([Da Xu, 2011](#); [Hobbs & Young, 2000](#)). Halal logistics research focused on information technology ([Bahrudin et al., 2011](#)), applying halal in the supply chain management ([Tieman, 2011](#)), the 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 & Jaafar, 2011](#)). As a result, this research differs from other studies on halal and food chain which have been identified previously.

From the publications that have been reviewed from 2004 until 2013 (Table 1), only 11 publications have been published based on the main theme of halal logistics. Since there are not many academic journals in the area of *halal* logistics, this paper goes further into publications which emphasize on halal supply chain. Therefore, these concepts need to be explored further in other types of publications including theses, proceedings, and other published articles. This is important to address the confusion of terminologies, concept, and practices of *halal* logistics. Indeed, it is shown that due to limited publication in the area of halal logistics, it has been revealed that the area of halal logistics and supply chain largely contributes to the gap and adds to the body of knowledge through the knowledge advancement in the logistics and supply chain discipline. In addition, several authors consider Islamic marketing as an innovation in the social science discipline (Arham, 2010; Sandikci & Rice, 2011; Sula & Kartajaya, 2006; Wilson, 2012). This has also created a new contribution to the logistics and supply chain discipline.

Types of publication	2004 - 2013	
	Halal Logistics	Halal Supply Chain
Journal	5	6
Proceeding	6	3
Total	11	9

Table 1: The Number of Publication Reviewed Based on the Area of Halal Logistics and Halal Supply Chain

Since research on halal logistics is practically lacking, therefore, most concepts are borrowed from the logistics literature and the Islamic law will be applied to the logistics discipline. Although the concepts of logistics and halal are overlapping, it does not appear to be many interactions between the Islamic and logistics researchers exploring this topic. Tieman and Ghazali (2013) also highlighted the role of purchasing in the halal food supply chain and the value chain has been largely understudied and poorly understood. Due to the above reason, Mohamed Amin (2010) has stressed that the areas of growth or potential opportunities in freight logistics will be halal logistics, contract logistics, and reverse logistics. Thus, halal logistics is also one of the components on the Malaysia Logistics Council Agenda 2010. Indeed, there are various initiatives done by the Malaysian government in order to turn out Malaysia to be a global halal hub such as stated in the Tenth Malaysia Plan, Third National Agricultural Policy (1998-2010), Small and Medium Industries Development Plan (2001-2005), Ninth Malaysia Plan (2006-2010), and the Third Industrial Master Plan (2006-2020). Thus, this paper integrates the logistics and halal area of discipline, namely halal logistics.

Halal logistics include the physical activities of storing and transporting, which provide a set of data for communication and management between successive links (up and down) along the food supply chain (Kamaruddin, Iberahim, & Shabudin, 2012) and apply the shariah concept along the chain. On the other hand, the basic principal of halal logistics is to ensure the segregation of halal cargo from non-halal cargo. This is to avoid cross-contamination and ensure that the logistics system is aligned to the expectations of Muslim consumers and the halal integrity is thus protected along the whole supply

chain (Ministry of Industrial and Trade, 2006). Hence, the most feasible terminology for halal logistics is the application of shariah law to the logistics process. Starting from the beginning of the logistics process until the final consumers, the shariah law must be followed. This is to ensure the halal product that is halal must also go along the halal logistics and in ensuring the halal logistics, the halal integrity among the channel members must be applied. This will include proper segregation and proper logistics system of the products throughout the logistics process.

Halal logistics could be referred to the application of the *halalantoyyiban* principles along the supply chain activities, which means that all the activities ranging from the source of supply, storage, transportation, manufacturing, handling, and distributing should adhere to the concept of *halalantoyyiban* as underlined by Islamic law. This means that the *halal* products should not be mixed with the non-*halal* products throughout the logistics activity to ensure that the *halal* status of a product could be maintained. As a result, figure 2 envisages the proposed conceptual framework of the *halal* logistics.

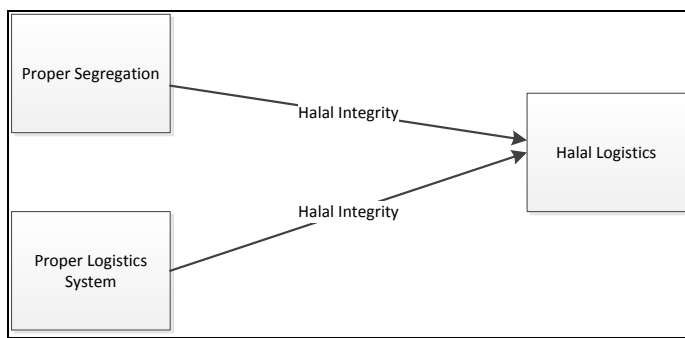


Figure 2. Proposed conceptual framework of the *halal* logistics

Moreover, *halalantoyyiban* supply chain is the concept of applying syariah principles in the supply chain management. The concept of *halalantoyyiban* along the supply chain will begin from the sourcing aspect to the point of consumption. In the *halalantoyyiban* supply chain activities, all aspect of halal and *toyyib* must be deliberated (everything must be halal and *toyyib*) in order to ensure final consumers will be getting *halalantoyyiban* products. Indeed, halal logistics is part of supply chain in order to ensure the whole concept to be realized, *halalantoyyiban* supply chain would be the most feasible term compare to halal logistics. In applying the halal logistics or *halalantoyyiban* supply chain concept become realize various issues and challenges will be facing by the industry players, consumers and the government.

Issues and Challenges

In ensuring the implementation of halal logistics, the logistics players, consumers, and government will be facing various issues and challenges such as the following:

1. The legal status of halal and the protection of halal status are always unclear in the logistics activities. Therefore, it is difficult for the Muslims to ensure the integrity of the halal products.
2. Not many industry players are really keen to practise the halal logistics due to incurred additional cost in the logistics. Thus, the expected standard of halal is not practised by the industry players as well as food industry players.
3. About 90 per cent of halal products are being produced in non-Muslim countries; therefore, the halal status and halal logistics of the halal products are uncertain. This is because halal products are a lucrative market to the industry players.

4. There are not many experts in the halal logistics and therefore the training for halal logistics is important to the employees that are involved in handling halal products. The three dimensions that have been highlighted by Pahim, Jemali, and Mohamad (2012) as important in the need for training in halal logistics are people, demand, and level of awareness.

5. The traceability of halal products is deemed important in ensuring the status of halal products during the process of halal logistics.

Conclusion

This paper develops a conceptual model that takes into consideration the halal and logistics aspects. 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 parameter in establishing the halal logistics industry.

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 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 consumers.

In conclusion, the logistics players who want to venture into the new area as well as sustaining in the market are recommended to offer halal logistics services. This is to capture the new demand from the consumers towards the halal products that goes along the halal logistics in ensuring that only halal products with halal logistics will be accepted by the consumers worldwide. Currently, the concept of halal logistics which has been implemented by existing logistics players has increased the attention of the consumers especially from the Middle Eastern countries. Due to the reason, it has been suggested to the logistics providers to invest more in the halal logistics as it is a worthwhile investment. Therefore, it is recommended that proper strategies for the halal logistics need to be developed for use by the global halal industry.

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THE CONCEPTUAL FRAMEWORK OF LEAN LOGISTICS IN MALAYSIA

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Introduction

The term “Lean production” was first identified by Jim Womack, Daniel Jones and Daniel Roos (1991), *The Machine That Changed the World*. In the book, based on a five-year research, USD5 million study of the automobile industry, Womack, Jones and Roos took an in-depth look at the Japanese manufacturing system, exemplified by Toyota, which combined the best features of craft production (high-quality, individualized, custom-made products) with mass production (manufacturing in large quantities to satisfy broad consumer needs at lower prices). The book, which was one of the first to thoroughly examine Toyota’s highly successful business system, concluded that Toyota was dominating the automobile industry because it optimized the value delivered to customers while minimizing the time, human effort and capital required creating this value. Lean Logistics was basically derived from the Toyota Production System (TPS). In the early 1930’s Toyota Motors of Japan aimed at reducing costs, coupled with continuous improvement, and finally customer satisfaction right from its offices through the entire production line until the delivery of the vehicle to its customers. In order to realize this vision, Taiichi Ohno, conceptualized a system where all these Toyota Motor requirements could be met. Now, TPS has set a benchmark in production for all automotive companies that produce repetitive and high value goods (Ohno, 1988).

Logistics Background in Malaysia

Malaysia has a well-developed logistics relevant infrastructure, support and systems. However, comparing with other developed countries like United Kingdom and USA, Malaysia still has to improve significantly in terms of its logistics operations.

The logistics and distribution sector in Malaysia traditionally operates at a very low cost as compared to other countries in the region, with comparable performance. The vehicles and handling equipment tend to be aged, maintained to a standard that keep them just roadworthy. The education level of the drivers are low, and many of them lead a ‘semi-nomadic’ living i.e. living with their vehicle and this sector also has a reputation for pilferage and organized theft including hijacking. However, during the past five (5) years, there has been some notable changes in this sector:-

- The emergence of increasingly professional suppliers with improved tracking and performance monitoring capabilities;
- Increased policing of non-roadworthy and over-loaded vehicles;
- Abolishment of duty on imported goods vehicles; and
- Increased service expectations, spurred on by the arrival of demanding foreign retailers and tighter economic environment.

‘Lean’ in Logistics Services – No Longer Just for Manufacturing

A new logic was examined by Womack & Jones (1996). A natural starting point is with value creation – from the customer’s perspective the only reason for a firm to exist. If subjected to a careful review, many of the steps required in the office to translate an order into a schedule and many of the steps required in the factory physically to create the product, add little or no value for the customer. Jones, D.T., Hines, P. & Rich, N. (1997) in their article ‘Lean Logistics’ discussed about the ‘new business solution’ created over the past 15 years where each has contributed a new perspective, and assume that each of them have their own business solution. These include:

- the Tom Peters approach which brought the customer back into prime focus and told us to “thrive on chaos” and break up traditional management structures;
- the TQM movement, often incorrectly labelled Japanese management, which advocated the power of variance analysis and control and the necessary involvement of shop floor teams in eliminating root causes of variance;
- the production control perspective which sought to solve the chaos and variance problems in supply chains by better forecasting and materials requirements planning (MRP)-type planning and control systems;
- the purchasing emphasis, which involved a transformation to partnerships with suppliers rather than the previous adversarial style relationships; and
- the business process re-engineering (BPR) viewpoint which stressed the importance of the process and offered ways of automating these processes to cut costs.

‘With hindsight, all of these tended to be partial solutions focused somewhat narrowly on particular aspects of the complex process of running a business’. Popular criticisms of such approaches are that:

- Total quality management (TQM) raised morale on the shopfloor but could not cumulate the gains to real bottom-line savings while buyer-supplier partnerships again often failed to deliver;
- MRP and MRP II created monolithic systems that cannot respond to rapidly changing demand or unpredictable interruptions and add cost while failing to improve process utilization; and
- BPR’s credibility was undermined because it was used as a crude headcount reduction device, particularly in the USA.

The concept and acceptance of ‘lean’ concept as a set of principles is fairly rooted in the literature (Jones et. al., 1996; Womack, 1990; Krafcik, 1988; Monden, 1983) cited in Lamming (1996). The principles behind lean production are not in themselves new which many of them can be traced back to the work of pioneers such as (Deming 1986; Taylor, 1988; Skinner, 1969) and more recently in the United Kingdom such as (Hill, 1993; Voss, 1994; Lamming, 1993). However, although the concept of lean production as now understood could have modeled from this literature, it was not until the Japanese auto industry was studied (Jones, 1996), that the total concept became clear.

The Conceptual Framework – Overview

The lean concept has established a framework for increasing quality and economic competitiveness of an organization. To date, this concept has primarily been limited to manufacturing operations. Many changes are occurring in the supply chain that is creating opportunities to apply lean concept throughout manufacturing, distribution and logistics. As a result of several factors, the traditional arenas of manufacturing and distribution will merge and bring new value-add processes into distribution.

Lean is one such factor. Taylor (2002) summarized his write-up on ‘lean’ where he found that the roots of lean were established in the Japanese automotive industry in the early 1970s by Toyota. Lean, originally labeled ‘Just-in-Time’ was used as production strategy to reduce inventory, shorten cycle times and improve quality. Lean is also commonly described as a process to eliminate waste where waste can be divided into seven (7) categories: processing, waiting, motion, overproduction, inventory, transportation and defects.

Applications of lean concept have spread widely to construction, administration and distribution sector. Published examples of lean in distribution sector are limited but shall grow substantially with market demands and increased understanding of successful applications. There are current best practices in distribution centers that fit the definition by eliminating waste of time and motion.

Kleber (2003) stated that transformed service companies will have significantly reduced lead-time and costs, improved productivity and improved customer responsiveness. Jayaraman (1995) also came out with the same opinion as Kleber where he described in his paper that service logistics aims at the most efficient utilization of facilities, minimizing the cost of excess capacity, while making the service more responsive to customers’ demand.

A microeconomic study describes how the firm seeks to maximize profits given resources constraint (Eckert, 1997). Logistics organizations regularly face with the dilemma of determining appropriate level of service, the output of logistics. In an effort to set themselves apart from rivals, firms are increasingly looking to logistics-driven customer service as their competitive weapon.

While there are some voices of discontent (Gordon, 1995; Berggren, 1992), cited in Lamming (1996) to the adoption and ultimate effectiveness of lean production, nonetheless many case examples exist to demonstrate how companies are changing their production methods and management practices to become leaner and fitter. Indeed lean manufacture has been extended to encompass the whole spectrum of activities in the business such as world-class companies are seeking to become “lean enterprise” (Lamming, 1993; Harrison, 1992; Jones; 1994).

The desirability of transferring manufacturing logic and practices to service operations, strongly advocated by (Levitt, 1972) cited in Lamming (1996) in two (2) classics Harvard Business Review articles, is now commonly challenged by both service researchers and practitioners (Bowen, 1998). In the early 1970s, the services sector has largely been ignored by management scholars, who were long accustomed to basing their research and models of management on studies of manufacturing firms. This had made sense, because the economy had, to that point, been dominated by manufacturing. However, in the 1970s, services were on the rise, as there were frustrations over inefficiencies, poor quality and low productivity characteristics of the sector. Unfortunately, services management models were emerging much more slowly than the sector, itself. In this context, Levitt argue that services would benefit from the efficiency-oriented thinking of mass manufacturing.

Levitt (1972) cited in Lamming (1996) maintained that services were primitive and inefficient relative to mass production manufacturing operations. This inefficiencies derived from a “long standing service culture of servitude and ministration” (Bowen, 1998). Levitt’s conclusion to his production-line approach to service (1972) contained the summary argument for transferring manufacturing logic to service.

“...if customer service is consciously treated as manufacturing in the field, it will get the same kind of detailed attention that manufacturing gets...More important, the same kind of technological, labour saving, and systems approaches that now thrive in manufacturing operations will begin to get a chance to thrive in customer service and service industries”.

Increasingly, service companies need to focus on delivering service and quality that meet or exceed customers’ expectations. Customers, of course, expect no less, and inevitably, they will go where they can get it (Allway et al., 2002). Service companies that deploy the lean approach rapidly gain control of the key processes that deliver customer service, apply sustainable breakthrough improvements to their processes, and generate tangible benefits for customers and measurable cost-benefit for the organization (Allway et al., 2002).

The lean framework shall illustrate what is called the dominant model in logistics (Whitley, 1984); logistics practice affects an organization’s performance, but how it does so is mediated by environmental factors. The foundation of this approach is that good or interesting practices may be identified by those which give good or interesting results. Figure 1 shows the basic model to form the lean conceptual model:-

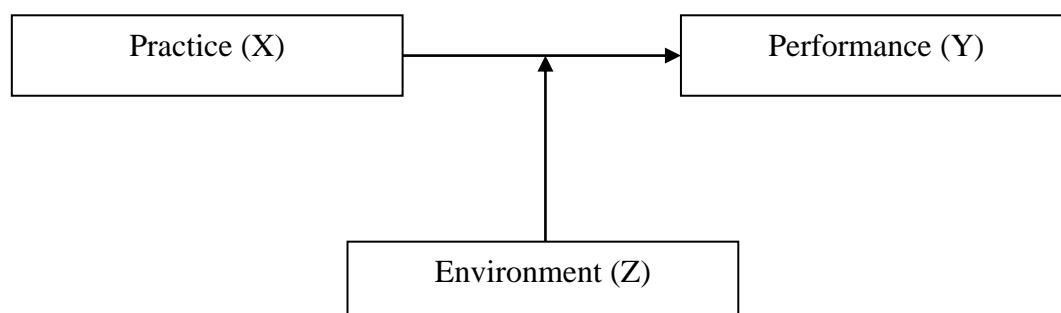
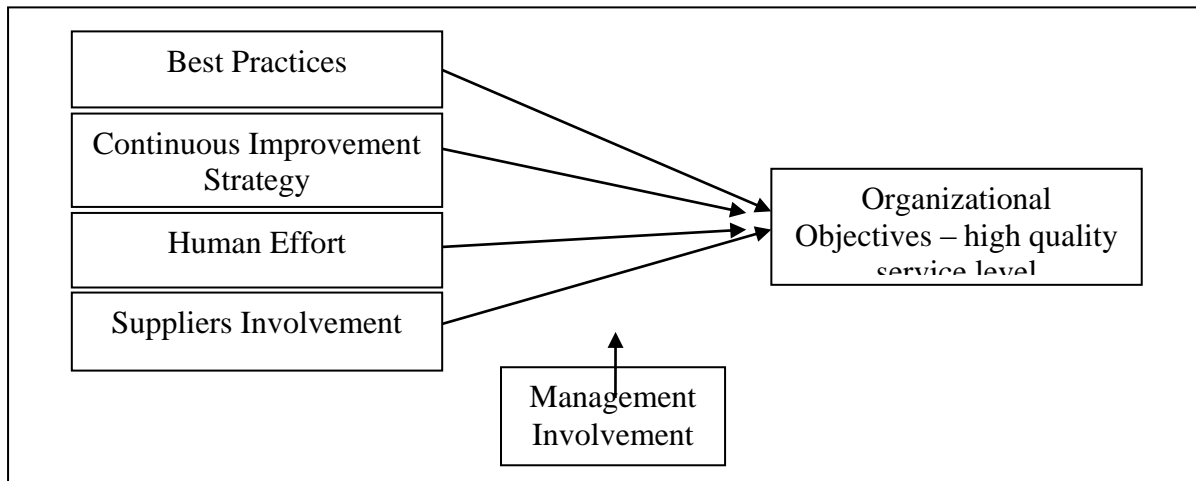


Figure 1: Dominant Logistics Model (X causes Y, mediated by Z)
Source : New, S.J. (1995)

Via this model, managers may choose different type of practice. Some of the practices may be the 'best' practices and will provide optimum level of performance for the business, but may have to be adapted to different situations. This model shall define and measure performance; identify and idealizing practice; deciding on what aspects the environments are important.



Source: Author

The Lean Logistics Company – The Transformation

The lean enterprise concept represents a new paradigm in the way businesses are managed in highly competitive market environments. This concept embodies a collective set of principles, tools and application methodologies that enable companies to remove waste from the system and achieve dramatic competitive advantages in speed to market, cost, quality and delivery performance.

Lean enterprise uses time and the 'relentless pursuit of waste elimination' as competitive leverages. It also seeks to make value flow from raw material through consumption i.e. using least amount of resources including time, people and material. In long-term, lean enterprise creates a culture of never-ending improvement at all organization levels.

In the Toyota Production System (TPS), Ohno (1988), reveals that there are two (2) significant ways to increase efficiency: (1) increase production quantity or (2) reduce the number of workers.

The characteristics of the lean company and the lean supply chain are described clearly in the book *Lean Thinking – Banish Waste and Create Wealth in Your Corporation* by Womack and Jones (2000). This book provides a vision of a world transformed from mass production to lean enterprise. The authors highlight the huge amounts of waste that occur in most organizations and show that a systematic attack on waste, both within companies and along the supply chains, can have tremendous benefits to the short run profitability and long term prospects of companies and organizations. *Lean Thinking* by Womack (2001) distills the essence of the lean approach into five key principles and shows how the concepts can be extended beyond automotive production to any company or organization, in any sector, in any country. The five lean principles are listed down as follows:-

1. Specify (what does and does not create value from the customer's perspective and not from the perspective of individual firms, functions and departments)
2. Identify (all the steps necessary to design, order and produce the product across the whole value stream to highlight non value adding waste)
3. Make those actions that create value flow without interruption, detours, backflows, waiting or scrap
4. Only make what is pulled by the customer.
5. Strive for perfection by continually removing successive layers of waste as they are uncovered.

These principles are fundamental to the elimination of waste. They are easy to remember (although not always easy to achieve!) and should be the guide for everyone in the organization who becomes involved in the lean transformation.

For service sector, if we take the Toyota Production System's definition of waste, many activities carried out within a service provider such as a bank, insurance firm or retailer add no value. However, as many of these activities are useful, they might be referred to as service value adding even if strictly speaking they are reducing the (potential) cost to the customer rather than adding value. They could, therefore, be included within the necessary non-value adding category. The reason why they should not be included as value adding activity is that this will direct attention away from their long term improvement or development.

Conclusion

In this paper, it represents the overview on conceptual framework of lean logistics in Malaysia. It also represents the first application of lean logistics model to the logistics service industry in Malaysia. Logistics has, in the past, been considered a narrowly-defined functional activity concerned with tasks such as transportation, warehousing, inventory and materials management. Changes in the logistics capabilities and management techniques have allowed logistics to become a primary mechanism for integrating and coordinating activities across the stages of supply chain. The competitive environment for logistics firms has changed drastically and considering this factor, one should develop a framework to further improve the current way of doing things i.e. through best practices and 'perfect process'.

It is viewed that the changes in the competitive environment necessitate a rethinking of the role of logistics. This paper has proposed a framework that will provide a conceptual basis for research to explore this area empirically. The results of this research shall enable the development of concepts that explains how lean logistics can provide a competitive advantage in today's changing business environment.

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Author's Biography

Azlina Hj Muhammad graduated in BBA (Transport) from UiTM in 1996 and pursued a degree in MSc International Transport from Cardiff University of Wales, United Kingdom and graduated in 1998. She has gained a tremendous industry experience when she joined Kontena Nasional Berhad (KN) in 1999. Early in her career, she was trained as a strategic and corporate planning professional and moved on to a new and higher level later on within the industry. Her industrial background consists of more than 10 years of successful experience and skills in strategic and corporate planning field. She was also responsible for the setting-up of the Halal Business Unit at KNB and managed to obtain the recognition for KNB as the first Halal logistics provider in the Country. Whilst in the industry, she was heavily involved in the development of various projects via her feasibility studies skills and expertise. Some of the projects that she involved directly were the feasibility study on Cross-border logistics between Malaysia and Thailand, establishment of dry port at Hiep Phuoc Vietnam and development of temperature-controlled distribution centre facilities in Japan. She was also involved with various Government agencies representing Kontena Nasional for her inputs in the initial establishment of ASEAN Multimodal Framework and other works related to ASEAN initiatives. Azlina set herself up as a strategic and corporate planning professional and progress her passion in the same field for getting a job well done. She is also a member of the Chartered Institute of Transport and Logistics (CILT) since 2002.

THE DELAY COST OF TRUCK AND FREIGHT PRICING PRACTICES

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Abstract:

This research analyses the pricing and delay cost of truck on the Interstate highway 15 (I-15) in Utah. A practical framework uses the data source from Utah Department of Transportation (UDOT), Freight Analysis Framework version 3 (FAF³) and American Transportation Research Institute (ATRI) to estimate the delay cost of truck. Compared with Uship, the online shipping marketplace in the US, and the average truck operating costs per mile, the markup of freight price can implicitly be derived. The seasonal factor is also introduced to adjust a regular freight price, particularly during the winter season. The empirical studies have indicated that a trucking company could lose a profit on the Washington-Box Elder route because a significant delay cost is imposed. On the Washington-Salt Lake City, Iron-Davis and Iron-Weber routes, a truck operator is taken an opportunity cost by cutting or providing limited services during the winter season. The results of this study are primarily to support freight transport research and policies and to provide a more accurate cost of annual truck congestion for commercial vehicle operators on the interstate highways.

Keyword: delay cost of truck, Average Annual Daily Truck Traffic (AADTT), markup pricing, delay cost estimation, seasonal adjustment factor

1. Introduction

The objective of this research represents a practice for estimating the delay cost of truck and analyzes the markup of freight price on the Interstate highway 15 (I-15) in Utah, the United States. To perceive a benefit of congestion and traffic variation database, three majority sources of data: UDOT, FAF³ and ATRI are undertaken in a process of valuation. The outcome points out the critical links of traffic cost and O-D aggregate links effected to markup pricing. According to U.S. Department of Transportation (U.S.DOT, 2004) Utah is the 15th of top capacity bottlenecks on freeways used as intercity truck corridors in 2004. The collecting data show the bottleneck location and the essential information: number of lanes, Average Annual Daily Truck (AADT), Average Annual Daily Truck Traffic (AADTT) and the percentage share of truck, and annual hours of delay by all truck. The result points out the area closed to the county of Weber that is the most of traffic congestion, and 25% accounted for trucking. The annual of delay time by trucks shows 48,088 hours. AADTT by Utah Department of Transportation (UDOT, 2007) provides the 2007 AADTT surveyed data and 2040 data estimation. Each individual link of all 221 links provides a distance range, average speed, AADT, AADTT and Functional Class (FClass) due to the speed regulation design. The directed transport costs of truck are described by American Transportation Research Institute (ARTI, 2008). ATRI develops a beta-tested and distributes a survey to a cross-section of for-hire motor carriers for representing the predominant industry sectors. Survey responses are aggregated and analyzed in the costs per mile (CPM) then converted to costs per hour (CPH) by using an industry accepted average operating speed. The result shows a total marginal cost for the industry \$1.73 per mile and \$83.68 per hour (Trego, 2010). The vehicle's value of time (VOT) has been evaluated more than 40 years, since it was one part of the economic transportation analysis to the difference objectives (Bruzelius, 1979). The VOT for trucks is estimated between \$20 per hour to \$190 per hour (Wheeler, 2010). In contrast to a value of freight travel time savings in congestion, the survey studies with freight carriers in California categorized by 4 types of industry group. The result estimates value of travel time saving with the commodity time sensitive. The value is found in a range between \$144.22 and \$192.83 per hour (Small et al, 1999). Smallkoski and Levinson (2002) indicate the considerable importance of freight transit time and cost. They estimate VOT for commercial vehicle operators in Minnesota to quantify the effects of spring load restrictions policy. In contrast to the cold region areas the government policy usually focuses on the pavement design for the severe winter condition. Due to the season of spring in Minnesota, thaw of roadway introduces a saturated condition of the soil under the pavement. The load-bearing capacity on the saturated road is reduced a burdened limit because over load truck can cause an additional damage of pavement. The interview method survey is conducted by using an Adaptive Stated Preference (ASP) to estimate value of time in dollars per hour and \$49.42 explains in a fleet operation.

The research also quantifies freight cost under the restriction of policy. The comparison shows a marginal operating cost of commercial vehicles: shift the seasonal timing of shipments, reduce load size per vehicle (resulting in more trips), change vehicle type or change routes (to longer but less restricted roadways) and the benefit of extending time to repair and maintenance the pavement damage. Haning and McFarland (1963) explain the speeds improvement. An Increasing speed can be contributed more profit of vehicle movement. The difference between the base condition and the improved speed condition is the value of time saving. Two additional methods for estimating cost of time are determining the cost of providing time saving and the willingness to pay methods (Adkins, Ward and Mc Farland, 1967). The Puget Sound Regional Council (PSRC, 2008) interested in the traffic choices study and began to collect Global Positional System (GPS) data since year 2005. They study the driving behavior of truck responded to the variable of toll costs. The data are analyzed and identified the VOT represented to the variety of market segments. The result reveals by the PSRC regional travel demand forecasting model. The estimated truck VOT is identified in a range of \$28 to \$73 per hour. Brownstone and Small (2005) work with two projects of California road pricing in areas of I-15 High Occupancy Toll (HOT) Lanes, San Diego and the State Route 91 (SR91) facility in Orange County. The estimate VOT saving is improved by travel time reliability. The empirical results confirm the estimated VOT \$20-\$40 per hour. The most important cost drivers of road transport are; distance, vehicle speed, type of road, drivers' characteristics (driving behavior, experience, speeding), traffic speed and volume, time of day (day/night) and interaction with weather conditions (ERSO, 2006).The directed transport costs of truck are described by American Transportation Research Institute (ARTI, 2008) The details based on the result of the analysis are shown in the Table 1. This ARTI estimated will be applied to calculate delay cost on I-15 in this study.

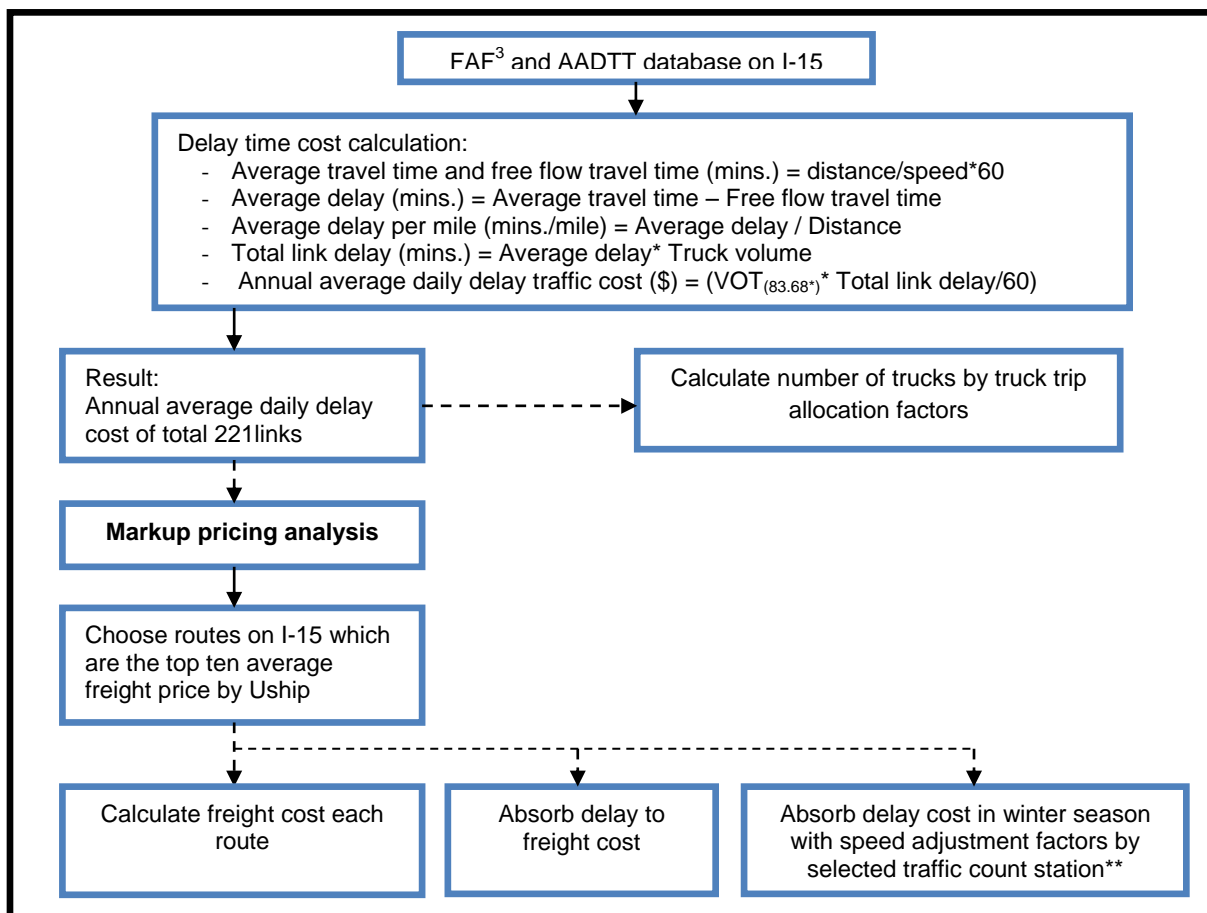
Table 1 The component of marginal costs in the United States

Motor Carrier Marginal Expenses	Costs per mile	Percentage per mile	Costs per hour
Vehicle-based			
Fuel-oil costs	.634	36.65	\$33.00
Truck/trailer lease or purchase payments	.206	11.91	\$10.72
Repair and maintenance	.092	5.32	\$4.79
Fuel taxes	.062	3.58	\$3.23
Truck insurance premiums	.06	3.47	\$3.12
Tires	.03	1.73	\$1.56
Licensing and overweight-oversize permits	.024	1.39	\$1.25
Tolls	.019	1.10	\$.99
Driver-based			
Driver pay*	.441	25.49	\$16.59
Driver benefits	.126	7.28	\$6.56
Driver bonus payments	.036	2.08	\$1.87
Total marginal costs	\$1.73	100	\$83.68

* CPH figures are based on respondents' actual driver hourly pay rates

Congestion cost affected to transportation is a one part of the external costs. Business owners could not take that cost to the accounting record. But congestion cost is helpful for decision making of business operation especially price quotation which due to businesses' profit and loss. In addition the estimated value of congestion cost also benefits for government policy. The best practice to estimate congestion cost is based on speed-flow relations, value of time and demand elasticity. Incident of Congestion is due to the capacity and density of transport system also depending on the mode of transport, type of users, infrastructure characteristics, local travel time, and activity alternatives. Travel time increasing is the majority factor of congestion. The standard valuations of travel time show 90% of total economic congestion costs. Under situation of congestion, vehicles consume 10% additional fuel costs under stop-and-go conditions by normal free flow traffic (IMPACT, 2008). The estimation of congestion fee computes by total delay or access costs (INFRAS, 2004). The best estimation practice of congestion costs is based on speed flow relations, value of time and demand elasticises. In generally the Marginal External Congestion (MEC) cost represents a current traffic volume in vehicle per hour. MEC cost depends on the price elasticity of demand and the slope of speed flow function. Speed flow variation describes the effect of the additional vehicle on the transport system due to the transport cost. Speed flow curves depend on infrastructure characteristics, topography, whether conditions, the network arrangement, available travel alternatives, regulations (speed control, ramp metering, etc.) and driving habits. The result fulfils the condition that the demand or willingness to pay curve equals the average time cost plus the MEC costs.

University Transportation Center for Mobility (UTCM, 2011) evaluates the Value of Delay (VOD) for commercial vehicle operator due to highway congestion. The VOD is primary information of construction and tolling policy. It includes affecting factors such as direct operational cost, travel length, travel time variation, inventory holding and warehouse management. Two methods are adapted to estimate VOD: Stated Preference (SP) survey and the carrier fleet operational simulation. The congestion reveals a range of VOD from \$94/hr. to \$121/hr. in a case of central depot and \$80/hr. to \$84/hr. in a case of two depots. Gillett (2011) calculates a delay cost for long haul single unit and combination trucks to assess the highway performance by identifying the congested locations where current or future delay are likely to occur. An Interstate-75, 160 miles from Macon to the Georgia-Florida border is studied. The delay cost is calculated by taking speed, volume, distance, types of truck, and types of commodity into account. In order to obtain the value of freight by truck and commodity types, the FAF³ is used as the data source together with the average truck speed surveyed by ATRI and traffic volume collected by Georgia Department of Transportation (GDOT). To calculate the delay cost and markup pricing analysis, the AADTT, FClass and average speed each link from UDOT, the 43 Standard Classification of Transported Goods (SCTG) commodity flow survey moved by truck from FAF³. For this research approximate 401 miles corridor are used to estimate value cost of delay combining data source by UDOT, ARTI, and FAF. The methodological framework shows in Figure 1.



* According to American Transportation Research Institute (ATRI) estimated truck operation cost for one hour travelling is \$83.68 reference year 2008

** The AADTT traffic volume from November to February 2007 survey data by UDOT are used to calculate seasonal adjustment factors in winter condition

Figure 1 Methodological and Experimental method

2. Data collection

Truck traffic volume

According to the input data for calculating delay cost, FAF³ and UDOT data extraction; AADT and AADTT 2007 surveyed base and 2040 estimated data are initiated for analyzing truck traffic volume on each network links. Figure 2 shows the comparison of total average traffic count on network link between AADT, AADTT and FAF³ on I-15 in Utah. The difference of volume between

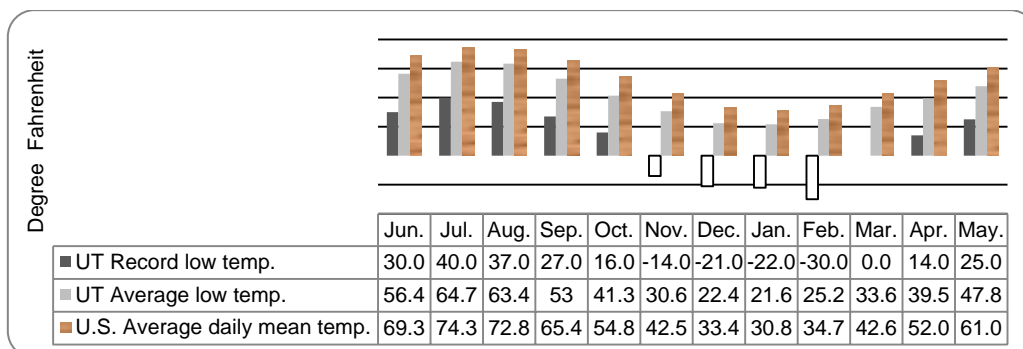


Figure 4 The climate monthly for Utah compared with U.S. average daily mean in degree Fahrenheit (1981-2010) (source: wikipedia.org)

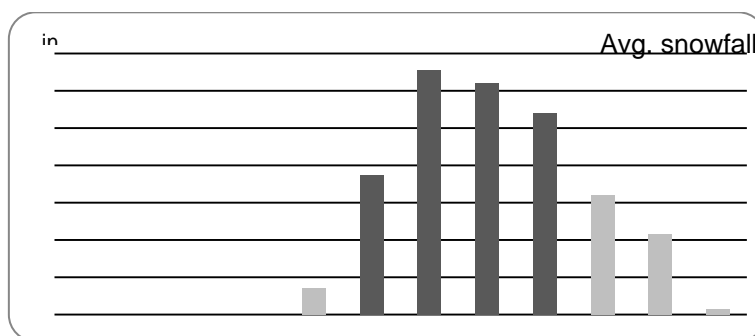


Figure 5 Monthly average snowfall for Salt Lake City international airport (source: wikipedia.org)



Figure 6 Snow plow working in winter condition for Utah (source: UDOT)

Driving in snowing requires many skills e.g. watchful eyes and common sense for winter conditions. Especially, the areas which crossing mountains a weather driving conditions change rapidly as storms pass through. For that reasons UDOT attempts to maintain crews on the job statewide plowing, applying, anti-icing and deicing chemicals, applying sand where needed to keep Utah’s roads safe for winter driving. Together with the real time information as a current weather and road way temperature also additional information as winter driving tips are provide on UDOT website. Picture in Figure 6 shows the crews when they operate their job in winter condition. To capturing the climate affects on the pavement for calculating adjustment factor to delay cost in the winter condition, we assume that the delay cost varies opposite of the traffic volume and speed in the winter condition. From the literature review the drivers reduce the speed to pay more attention and carefully drive and avoid accident with snow plow vehicle on the difficult pavement. In addition the increased of delay cost is concern with an opportunity cost as; a risk of customer satisfaction, loss and damage of perishable goods, and the opportunity to get more travel trips. An accident, depreciation and fuel cost are also increasing in winter condition Due to FHWA’s road weather management program summarizes the various weather evens affected to driver capabilities and traffic flow. The reduction of road way capacity can be caused by snow accumulation and wind-blow also in winter condition. Weather events can reduce mobility on arterial routes, speed reductions can range from 10-25 percent on wet pavement and from 30-40 percent with snowy or slushy pavement. Average arterial traffic volumes can decrease by 10 to 30 percent depending on road weather conditions and time of day. Saturation flow rate reductions can range from 2-21 percent. Travel time delay on arterials can increase by 11-50 percent (Goodwin, 2002). Kim *et al.*(2008) study the spatial and temporal analysis of urban traffic

volume explores traffic patterns in the Twin cities metropolitan area from 1997-2006. In terms of the monthly traffic volume pattern, August has the highest traffic volume whereas January has the lowest traffic volume. The difference in monthly fluctuation is mainly due to weather conditions. The traffic volume in the winter season (November-February) is relatively lower than traffic in other seasons. The average traffic volume in the winter season is 0.5 percent lower than average of other seasons. Iowa Department of Transportation and Iowa Highway Research Board (IHR, 1998) collect the storm data from I-29 and I-80 by hourly traffic counts over two days for storm even and for one week later for understanding how snow effects traffic. The hypothesis is approved when traffic volume data is reduced in the number of trip and also the decreasing of the traffic speed because of the decreased friction on the road surface. Due to the assumption of this study the collecting data of traffic volume by UDOT's traffic count on I-15 in Utah between November and February 2007 are applied for calculating speed adjustment factors to delay cost in the winter condition. According to traffic count data, the average daily vehicle is calculated by using 3 traffic station counters on I-15 in Utah shown in Figure 7. The result in Table 2 shows the percentage of speed adjustment factors separate approximated centroid by county for applying to delay cost on network links in the winter condition.

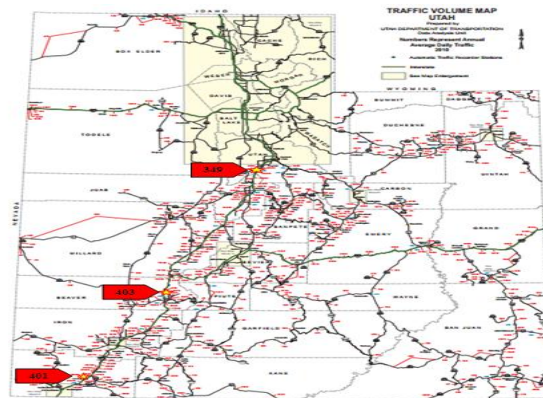


Figure 7 The traffic station counters which are chosen (source: UDOT)

Table 2 Speed adjustment factor

Station	Mileage Range		County Area		Speed Adjustment Factors (%)
	From	To	From	To	
401	0	42.170	Washington	Iron	12.72
403	42.171	242.460	Beaver	Juab	17.90
349	242.461	400.592	Utah	Box Elder	12.75

Truck speeds

To calculate delay time of each link, ATRI's average traffic speed is used for the input data. The speed capturing is recorded by the pavement traffic counters. Each station uses the Global Positioning System (GPS) equipments for tracking and reporting vehicle movements. ATRI coordinates working with the Federal Highway Administration (FHWA), the individual truck speed is recorded by three mile intervals every hour to capture direction and day of week for year 2009. The available average speeds compared with the speed limit by regulation are used to analyze traffic flow perspective and congestion. I-15 in Utah, the speed permit for trucking is 65 mph. in the cities and 75 mph. elsewhere areas. Only two zones of are considered rising permit to 80 mph. as a test and although still be posted as experimental. Functional Class (FClass) data is used to determine the speed limit area on each link; they also provide county route name, route number, total miles of route, type of area (Urban or Rural) and including a number of lane. There are only 2 types of FClass; FClass 1 for speed limit 65 mph. and FClass 11 for speed limit 75 on I-15.

3. Average freight price

The delay cost of truck is practiced analysis by freight price of UShip. Because it is the world's largest and most trusted transportation marketplace, primarily serving the freight, household goods and vehicle shipping markets. Consumers and business owners can compare and book upfront quotes by posting their name and own price or receive auction-style bids from 300,000 customer-reviewed transportation service providers. The auction system matches independent owner-operators with the largest freight carriers and brokers by ranking. Freight price used to practice in this study, full

Truck Load (FTL) and average weight 40,000 lb are defined on website to estimate price between 10 O-D pairs county by county and zip codes are used to define the position of county on I-15. Table 3 shows the average freight price and their distance provided from website.

Table 3 FTL average freight price and distance between 10 counties

County			Average Freight Price (U.S. dollars per truck trip)									
			1	2	3	4	5	6	7	8	9	10
			Washington	Iron	Beaver	Millard	Juab	Utah	Salt Lake	Davis	Weber	Box Elder
Average Distance (miles)	1	Washington		189	580	956	953	1,058	903	864	864	920
	2	Iron	64		232	841	836	777	1,003	920	920	877
	3	Beaver	116	52		463	566	751	851	971	855	957
	4	Millard	208	146	96		253	538	598	811	777	874
	5	Juab	230	167	118	49		197	395	606	588	645
	6	Utah	276	224	164	96	45		194	378	448	502
	7	Salt Lake	310	247	198	116	79	45		297	235	206
	8	Davis	344	293	229	160	110	76	38		186	420
	9	Weber	345	294	245	176	126	92	52	14		272
	10	Box Elder	371	307	259	190	140	106	69	31	29	

4. Empirical results

The result of annual average daily delay cost of truck compared with average speed from 221 links is shown in Figure 8-A and 8-B. The top 3 links which most costly delay cost are link number 186, 181 and 185 close to Salt Lake City. Their total length is only 0.87 mile but the amount of AADTT delay cost is 3.18 million of dollars. Compared FClass 11 speed allowed 65 mph. with average speed is only 0.5 mph. it can be shown the problem of the traffic congestion. Maps in Figure 8 identify the position of congestion area by map window GIS program.

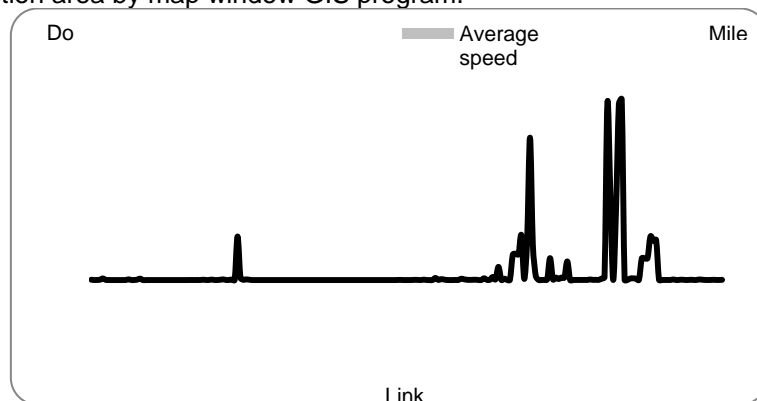


Figure 8-A Average speed and AADTT delay cost and FClass in each link

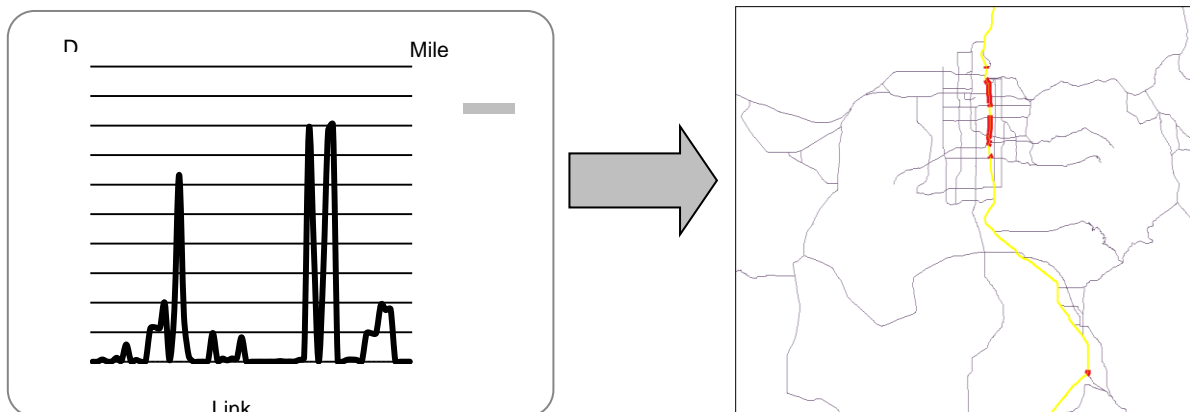


Figure 8-B Average speed and AADTT delay cost on I-15

Figure 9 shows the number of single and combination unit type of trucks from the percentage of truck trip allocation by our previous study. Because of top 5 commodities moved in Utah; coal, nonmetal mineral products, gravel, waste and scrap, and gasoline shown in Figure 10 using the majority combination unit type of truck transported within Utah. Consider with valuation of product based on their perishability potential and/or use (Small *et al.*, 1999), almost of all top ten commodities moved in Utah are the categories of moderately time sensitivities product except cereal and grains, and mixed freight categorized in a highly time sensitive. The moderately time sensitivity products are construction and energy product using bulk and liquid vehicles; coal, nonmetallic minerals, gravel, gasoline, fuel oils, crude petroleum and coal-not elsewhere classified. It can be seen that 9 by 10 commodities moved in Utah are time sensitive products and supported the assumption to adjust delay cost by seasonal adjustment factors under the weather condition.

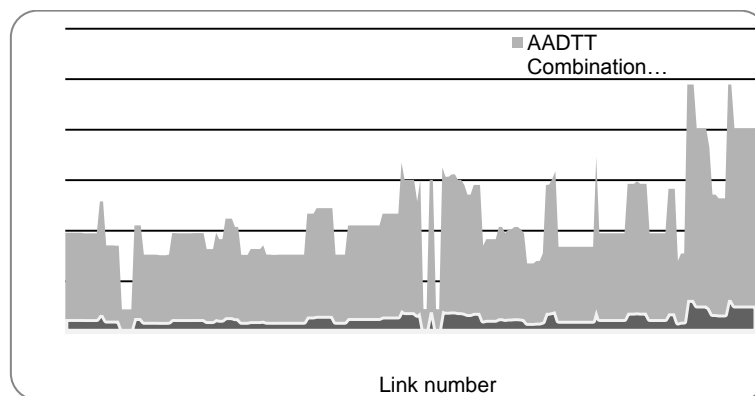


Figure 9 Single and combination unit type of trucks by FAF³ truck type allocation factors

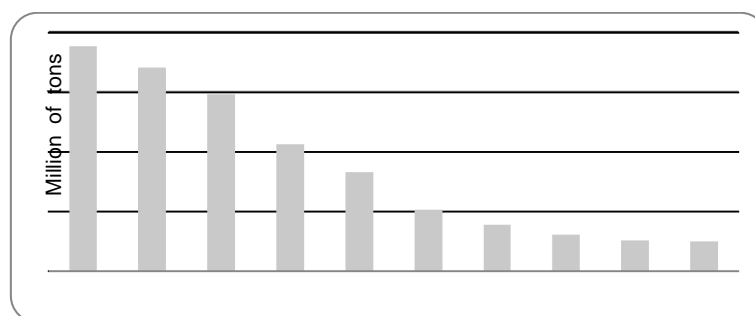


Figure 10 FAF³ top 10 Commodity flow survey by year 2007

Figure 11 shows top ten O-D route by freight price, freight cost is calculated by \$1.73 per mile according to ATRI cost estimation. It can be seen that a highest percentage markup is O-D Washington-Millard 208 mileages length accounted for 62.36% of markup. In contrast to O-D Washington-Box Elder 371 mileages length is the less markup accounted for 30.24%.

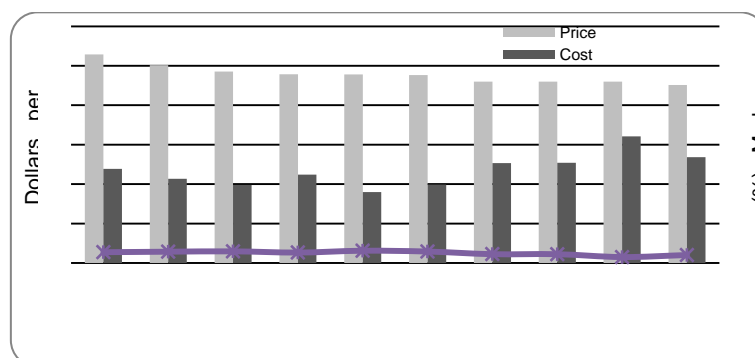


Figure 11 Top ten O-D routes by Uship freight price on I-15 in Utah

Continue with cost absorbed delay time in Figure 12, the result shows that cost in O-D Washington-Box Elder is the critical route to get loss. Because of that part is the longest distance of O-D route passed through the county close to mountain area along I-15 combining with the number of vehicle transported in Salt Lake City and also vehicle passed through Utah from other states, due to the raising of delay cost over freight price.

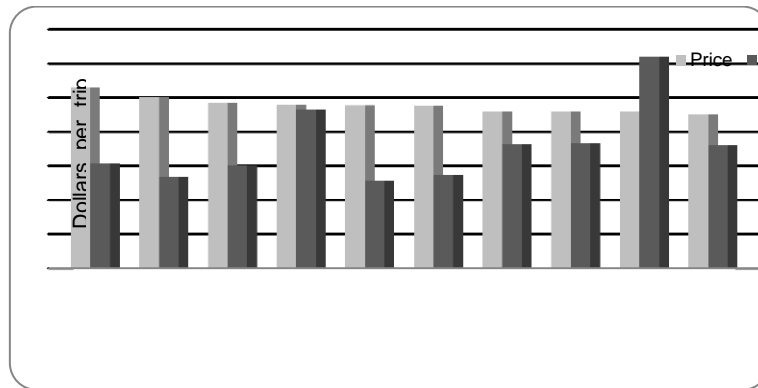


Figure 12 Comparative price and cost absorbed delay time

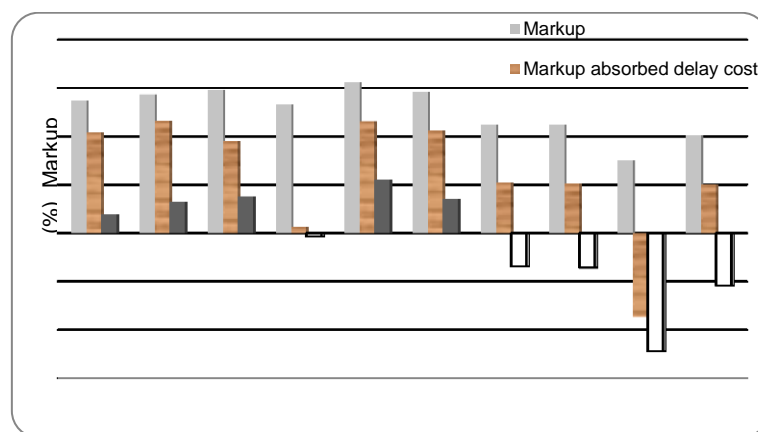


Figure 13 The percentage markup comparison

The result in Figure 13 shows the comparative percentage of markup pricing in 3 situations; regular cost, absorbed delay cost, and absorbed delay cost and a seasonal adjustment factor in winter condition. The delay time and seasonal factor effect to the reducing trend of markup all O-D route especially O-D route Washington-Box Elder, moreover O-D Washington-Salt Lake City, Iron-Weber and Iron-Davis get loss from the affect of seasonal adjustment factor.

5. Conclusions

Traffic congestion is recognized in transportation cost and significant factor in transport network system. Various methods are used to quantify congestion costs; consumers' willingness to pay, the marginal impacted vehicle entering the traffic on the road, the speed flow relationship of each road segment. The performance to evaluate and analyze delay cost is one method to quantify for congestion cost. The delay cost can be the guideline for applying this practice in transport planning decision and truck policy analysis; road capacity, pollution emissions and toll surcharge designed. Moreover, to quantify the full transportation cost of truck, the delay cost can be benefit for vehicle users and operators because it increases the vehicle cost, travel time and crash cost also the risk of customer satisfaction and opportunity cost. This study is a unique study area and provides cost explained economic evaluation techniques and how to apply them. The result represents delay cost all links on I-15 it can be seen the critical link on the roadway. To absorb the vehicle operating cost by delay and compared with freight pricing specific critical route, the markup pricing is derived. The

weather condition is also used to represent the interaction of traffic delay cost in this area. The decreased of markup pricing for trucks is affected by traffic volume on a transportation network and due to average speed and weather condition factors affected to the pavement. Identifying the type of truck-specific commodity and O-D routes markup pricing raises the awareness to construct the critical link. Although this study shows illustrative practice to calculate delay cost of truck and markup analysis specific area in Utah, the finding will be useful for applying in the state policy point of view. Moreover, it also points out the critical O-D link on I-15 which can be get loss in the difference of condition for providing a more accurate cost of annual truck congestion for commercial vehicle operators on the interstate highways.

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THE DEVELOPMENT OF REVERSE LOGISTICS PERFORMANCE ASSESSMENT TOOL

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Introduction

Reverse Logistics has gained more popularity due to its dual benefits. It is an environmental friendly activity that, by the same token, enhances company profitability (Autry et al., 2001). However, in order to achieve those ideal advantages, the firm must have managed the reverse logistics efficiently, starting with a deep understanding on which efficiency degree the company currently stays in terms of reverse logistics. According to the literature, one of the basic problems encountered in reverse logistics management is the lack of relevant performance measurement and assessment tool. A performance assessment is essential to any process improvement as it allows an organization to better understand the current level of its performance and capability, and to know where improvement efforts should be focused (Sharahi and Abedian, 2009). However, the existing performance assessment tools proposed in the literature are complicated and require a fair amount of time to construct as they require each decision maker to set up criteria, dimensions and weights. In addition, the results of these tools tend to vary with decision makers (Tonanont et al., 2008).

This research aims at developing a practical and pertinent key performance measurement in reverse logistics that can reflect the efficiency level of each business activity the firm engages. This set of measurement is constructed based on an assumption that a firm is able to develop and modify its current system if and only if it understands its current performance. In this research, intensive secondary data analysis on numerous past research papers was conducted to identify essential reverse logistics activities and associated key performance indicators (KPIs). A performance assessment framework was developed and evaluated by experts to enhance its correctness and completeness. Finally, the tool practicality was examined through a pilot test. The proposed performance assessment tool can measure the true capability of the company in reverse logistics management by taking into accounts both qualitative and quantitative attributes.

Background and Literature Review

The Process of Reverse Logistics Management

According to the literature, there are 4 main cycles in reverse logistics management, including collection, return handling, recovery and disposal (Fleischmann, 2000; Pohlen and Farris, 1992; Blackburn et al., 2004; Wen-Jie and Zhi-Geng, 2007). Collection is a process of taking goods from customers back into the reverse logistics system. Return handling is a process that follows the collection process. It starts with product inspection and ends when the products are held, waiting for the recovery step. Return handling involves: (1) inspection; (2) disassembly; (3) cleaning; (4) sorting for further treatment; and (5) storing for further process as sorted.

Recovery begins when products are transferred to the recovery center and finishes when the products are returned back to the customers. Direct recovery involves reuse, resale and return to the suppliers. Indirect recovery, referred to as Part/Product Recovery Management involves repairing, refurbishing, remanufacturing, cannibalizing and disassembling. Disposal represents the process of getting rid of goods or parts, which are no longer reusable. There are two main types of disposal, including landfill and incineration (De Brito, 2003; Thierry et al., 1995; Wen-Jie and Zhi-Geng, 2007; Dyckhoff et al., 2004; Rogers and Tibben-Lembke, 1998).

Barriers to Reverse Logistics Management

Various barriers to reverse logistics management were identified in the literature, including competitive and legal issues, financial constraints, and lack of several essential supporting elements such as information and technological systems, appropriate performance metrics, and management inattention (Ravi and Shankar, 2005; Tan and Hosie, 2010; Rogers and Tibben-Lembke, 1998). To clarify this, lack of information sharing among supply chain members makes it difficult to identify end customers' need, which might lead to inefficiency in reverse logistics management.

Failure in reverse logistics management within an organization could also be caused by a lack of strategic or long-term plan, leading to having an operation without clear objectives. Since reverse logistics typically generates small return relative to the amount of investment, it is perceived not attractive to business managers (Ravi and Shankar, 2005; Autry et al., 2001; Gonzalez-Torre et al., 2010). However, one of the main causes of the failure is a lack of reverse logistic performance assessment tool. Having a practical tool would enable an organization to have a clear view of the overall operation direction and business potential, which is essential to operational improvement (Ravi and Shankar, 2005).

Performance Assessment Tool for Reverse Logistics Management

Some examples of performance assessment tool for reverse logistics management are: 1) Balanced Scorecard (BSC), a tool that gives the overall picture of a business through 4 essential dimensions; 2) Analytic Hierarchy Process (AHP), a multiple criteria decision-making tool; 3) Data Envelopment Analysis (DEA), developed for evaluating efficiency of return channels or other decision making units (Tonanont et al., 2008). It should be noted that these tools can capture only non-financial dimensions. Furthermore, they require careful consideration on individuals or decision makers' personal opinion or any subjective judgment which could affect the reliability of the result. Since each decision maker has to set up his/her own criteria, dimensions and weights, the resulting assessment of these tools tend to vary with different decision makers.

Framework, Criteria and Method for Reverse Logistics Performance Assessment

Huscroft (2010) and Richey et al. (2005) expressed their similar opinions on reverse logistics performance assessment that the framework and the criteria being used in an assessment should take into account the relationships among reverse logistics, resources commitment, internal innovations and other relating factors. Daugherty et al. (2005) used the Resource Based View theory as a framework for considering individual's available resources, and determining which resource creates competitive advantage in reverse logistics. Moreover, Yuen (2006) proposed the performance measurement and management of third-party logistics providers (3PL) using an organizational theory approach to elaborate the relationship between 3PL quality, organizational effectiveness, and relationship management with service partners. This paper stated the criteria to be used in assessing service quality, organizational effectiveness and relationship management. Examples of such criteria are reliability, customer service or customer satisfaction, and reputation of an organization. Keebler and Plank (2009) used triangulation approach, which collects data through a Delphi study, personal interviews and a questionnaire to determine critical factors that directly influence logistics process.

Based on the literature, criteria and methods of a reverse logistics performance assessment; as well as an assessment result which is unavoidable are based significantly on a decision maker's perception and background knowledge, not a fact. In addition, an assessment method is not a quantitative analysis, which cannot provide a clear numerical result.

Research Methodology

The objective of this study is to develop a set of performance indicators to be used as a standard tool for reverse logistics performance assessment. The tool is expected to cover all reverse logistics activities in both financial and non-financial dimensions. This research started with reviewing literature to get insights of possible logistics issues that were of importance to a company's reverse logistics performance. The secondary data extracted from the literature were used for Content Analysis. Subsequently, the data were organized by Systematic Review method to set up the scope of the research, specify the framework of activities in reverse logistics process, identify key dimensions in both financial and non-financial aspects, and finally develop key performance indicators that reflect the performance of reverse logistic management for each activity.

After the reverse logistics performance indicators were obtained, the next step was to conduct an expert judgment by interviewing 5 academicians and practitioners on the comprehensiveness and accuracy of the underlying indicators as to whether they are consistent with the dimensions and the content of an associated activity. The assessment on appropriateness of the indicators was conducted in the form of survey. The result of the surveys was summarized and analyzed by Index of Objective Congruence (IOC). Finally, the responses from these 5 experts were used as a guideline for enriching the quality of proposed indicators in terms of accuracy and comprehensiveness. Five criteria were used in selecting the experts, including: 1) Having an evidence of expertise; 2) Good Reputation; 3)

Availability and Willingness; 4) Understanding on related materials; and 5) No financial gain or personal benefit from participation. The chosen experts were not only willing to participate in the survey but also gave additional feedbacks and useful comments during the interview.

The final step of the study is to assess practicality of the tool, which is essential in the tool development process. The practicality assessment was done by expert judgment through a survey on a group of experts. The content of the survey is associated with several practical features including ease of use, cost of data collection, and accessibility of information. Then, a series of pilot tests using volunteer sampling to examine the functionality and practicality of the tool were conducted with a company operating reverse logistics. This process also includes interviewing the users for difficulties in utilizing the tool. The responses from the interviews were analyzed to determine the level of practicality and user-friendliness of the tool.

Development of Framework, Dimensions and Performance Indicators

Reverse Logistics Activities

A framework of reverse logistics has to be practical to support the assessment of reverse logistics performance. Specifically, it needs to be at such a practicality level that an evaluator could correctly implement it. Moreover, it should be widely accepted by academicians and practitioners in logistics and related fields. Although there exists some gap between a framework of reverse logistics and that of logistic, building a reverse logistics system could rely on the same concept of logistics (Chaves and Alcântara, 2006). In this research, the logistics activity framework proposed by Grant et al. (2006) is proposed with some modifications to make it align with the nature of reverse logistics. The reverse logistics activities and their corresponding stages are summarized in table 1.

Reverse Logistics Activity	Collecting	Handling	Recovery	Disposal
Customer Service and Support	Before Collecting Goods	-	-	-
Demand Forecasting and Planning	Before Collecting Goods	-	-	-
Part/Product Acquisition	Collection Center	-	-	-
Inventory Management	Before Inspection	After Handling	-	-
Material Handling	Before Inspection at Warehouse	After Handling at Warehouse	-	-
Packaging	Transport to Inspection	-	Transport to Recovery	Transport to Disposal
Transportation	From Customers to Inspection Center	-	From Handling to Recovery	From Handling to Disposal
Facilities Site Selection, Warehousing and Storage	Before Inspection at Warehouse	After Handling at Warehouse	-	-
Part/Product Recovery	-	-	Reuse, Resale, Return to Supplier, Repair, Refurbishing, Remanufacturing, Cannibalization, Recycling, Reclaim	-
Disposal	-	-	-	Incineration and Landfill

Table 1: The scope of reverse logistics activities

Source: Authors

It should be noted that Return Goods Handling and Reverse Logistics were not considered in this research as it involves the whole process that of consideration in the context of this research. Order Processing and Logistics Communications process was also excluded because, in reverse logistics, these activities are considered part of Customer Service and Support. Procurement and Purchasing is

changed to Part/Product Acquisition. In addition, Material Handling is separate from Packaging activity as these two activities appear in different stages of reverse logistics. Finally, Recovery and Disposal were added as suggested by the literature.

Key Dimensions of Reverse Logistics Performance

To specify key dimensions of reverse logistics performance, all factors influencing reverse logistics performance in both financial and non-financial aspects as appeared in the literature were gathered and categorized into groups. From the literature review, economical dimension represents the key financial aspect while environmental and customer satisfaction are the key non-financial dimensions (Byrne and Deeb, 1993 cited in Autry et al., 2001; Carter and Ellram, 1998; Wu and Dunn, 1995; Giuntini and Andel, 1995; De Brito and Dekker, 2003; Rogers and Tibben-Lembke, 1998 cited in Yellepeddi, 2006; De Brito, 2003; Subramaniam et al., 2004; Sasikumar et al., 2010 etc.).

Economical dimension is a business philosophy whose goal is to maximize profits through cost reduction and increase in revenue. Recapturing the value of returned products is one way to increase profitability. Moreover, efficient reverse logistics management can reduce inventory-holding, transportation and product disposal costs. The reason why organizations are concerned about the environmental issue is twofold, regulations and pressure from consumers in terms of environmental friendliness (Wu and Dunn, 1995). Many companies are forced by the regulations to recall their products to the production process. Consumers' concern on global warming nowadays becomes one of the most critical environmental issues because it is perceived to cause many adverse changes to the earth. So the company is demanded to properly accountable for this phenomenon (Rosier and Janzen, 2008). The last dimension, Customer Satisfaction, reflects the service quality, which can be measured through responsiveness (Subramaniam, et al., 2004; McIntyre et al., 1998; Genchev, 2007 etc.)

Development of Performance Indicators

The main objective of indicator development is to warrant that each indicator is practical and consistent with the dimension, to which it belongs. For the Economical Dimension, related performance indicators are derived from the concepts given in www.benchmarkingsuccess.com since reverse logistics system could be designed using the same idea as proposed for the forward counterpart (Chaves and Alcântara, 2006). However, modifications were made to better fit it with the objectives of reverse logistics. In forward logistics, the performance indicator of economical dimension is the percentage of logistics cost per sale or per margin while, in reverse logistics, the denominator is replaced by the total cost of reverse logistics management, comprising 10 activities. The reason of the change on the denominator is to allow a company to precisely examine the contribution of the considered activity to the total reverse logistics since the use of sales or margins may lead to a low percentage of logistics cost, thus making the improvement of cost performance unrecognizable. However, the traditional formula, the one using sales or margins, can still be used if preferred because increased profit is also the main goal of reverse logistics management (Rupnow, 2011).

With respect to the second dimension, Environmental Dimension, the performance indicator is a carbon footprint or the amount of carbon dioxide emission in kilogram or ton unit. One of the environmental problems that are concerned the most is global warming (Panchaiyo et al., 2009). The carbon dioxide contributes over 60% of greenhouse gas, which is a major cause of global warming. Reverse logistics activities release carbon dioxide in different ways. Activities such as Service and Support, Demand Forecasting and Planning, Part/Product Acquisition, and Inventory Management entail a large amount of electricity to power electronic devices used for communication with the customers, for forecasting, for contacting with suppliers, and for inventory management, respectively (National Science and Technology Development Agency, 2009). Generating the electricity causes carbon dioxide emission. In inventory management activity, electricity is used to light up buildings and powers air conditioners or heaters to control the temperature inside the warehouse (McKinnon, 2010). Packaging also involves carbon dioxide emission in the production of packages (Wolfgarten, 2011). Transportation and Material Handling use vehicles that consume fuel such as gasoline to function the engine (McKinnon, 2010). For disposal, the amount of carbon dioxide emission from incineration or landfill can be computed by the carbon dioxide emission formula, but note that the transportation back to the center, a backhaul or empty haul, also needs to be taken into account. The process of recovery is different from company to company, and thus the amount of carbon dioxide emission should be calculated according to the actual activity. As for the last dimension, Customer Satisfaction Dimension,

the related performance indicator is Responsiveness, which can be measured by the amount of time spent on each activity.

Tool Testing by Expert Judgment

Tool Validation

Validity of the tool was examined through a survey on a group of experts to ensure that the framework, the key dimensions, and the resulting key performance indicators can comprehensively and accurately assess the performance of reverse logistics management in both financial and non-financial aspects. Index of Objective Congruence (IOC) was used as an indication as to whether such conditions are properly met. Experts' suggestions were considered in the enhancement process such that the comprehensiveness and appropriateness of the measurement tool is further improved. After an assessment, the value of the IOC indicated that all the required conditions were met except for the one stating that the recovery and disposal are composed of only two components, transportation and packaging. To cope with this concern, the scope of activity was thus expanded to include all other related activities into the recovery and disposal process. Other issues raised in the survey were also addressed. For example, ambiguous definitions and unclear scope of activity were properly revised according to the experts' recommendation.

Tool Practicality

Similar to validity assessment, practicality of the tool was evaluated by experts' opinion. The objective of the survey is to determine whether the tool is easy to use, does not require much time for worker training, and does not require many efforts to understand and follow the computation of performance indicators. Moreover, the tool must be economical and the information required by the measurement tool must be accessible (Characteristics of Good Measurement Instruments, online; Ruengtrakul, online). The result of IOC on the assessment of the tool practicality showed that all conditions met the required criteria. However, there were some feedbacks from the experts towards the computation of the electricity usage in each activity as some information necessary for the calculation may not be available. To handle this concern, the use of activity-based costing was recommended.

Pilot Test

A pilot test with S.K. food (Thailand), Ltd., a canned fish production company was conducted to examine whether the proposed tool can be practically implemented under the real-world situation. The result asserts the tool practicality as the company could use the tool with short worker training session (approximately 1 day) and little effort to understand and follow the computation of performance indicators. It was noted that cooperation in information sharing within an organization is required to get the required information to complete the assessment tool. From the test, it was also found that most of the required information was accessible although some information was available only in the form of total value. Under such circumstances, the total value should be decomposed to obtain the right value as required in the assessment form. In conclusion, the performance assessment tool is adequately practical but needs cooperation across departments within the company in order to get all necessary data to complete the assessment form.

The reverse logistics activities, key dimensions and performance indicators for reverse logistics management assessment are summarized in the following table.

Processes/ Activities	Economical Dimension	Responsiveness Dimension***	Environmental Dimension
Collection and/or Return Handling			
Customer Service and Support	$\frac{\text{Customer Service Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	Average Turn Around Time (TAT) or <i>The time from customer service request to problem resolution</i>	Amount of electricity unit used in an activity x coefficient of CO ₂ emission of a country
Demand Forecasting and Planning	$\frac{\text{Demand Forecasting Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	Average time spent on forecasting and planning	

Part/Product Acquisition	$\frac{\text{Part/Product Acquisition Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	Average time spent on collecting “materials” until the “materials” arrive at the collection center or inspection center (different from case to case)		
	$\frac{\text{Customer Service Cost} \times 100}{\text{Total Reverse Logistics Cost}}$			Average Inventory Days
Inventory Management	$\frac{\text{Material Handling Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	Average Material Handling Time		Quantity of fuel used for material handling x coefficient of CO ₂ emission of that fuel
Material Handling	$\frac{\text{Packaging Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	Average Packaging Time		Sum of the amount of materials used x coefficient of CO ₂ emission of that material
Packaging	$\frac{\text{Transportation Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	Average time spent on each transportation		Quantity of fuel used for transportation x coefficient of CO ₂ emission of that fuel
Transportation	$\frac{\text{Warehouse Management Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	Average Inventory Turns		Number of electricity unit used in warehouse x coefficient of CO ₂ emission of a country
Warehouse Management	Parts/Products Recovery			
Direct Options*				
Reuse	$\frac{\text{Reuse Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	The amount of time since inspection on whether to reuse resale or return a product to supplier until the product is delivered to the destination. For example, return to supplier is count since inspection started until a product is delivered to supplier.	Total amount of CO ₂ emission from fuel usage (the calculation is done according to transportation activity) and/or from electricity usage (refer to an activity with electricity for the calculation such as Warehouse Management)	
Resale	$\frac{\text{Resale Cost} \times 100}{\text{Total Reverse Logistics Cost}}$			
Return to supplier	$\frac{\text{Return – to – supplier Cost} \times 100}{\text{Total Reverse Logistics Cost}}$			
Recovery Options**				
Repair	$\frac{\text{Repair Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	The time that defects are detected until they are all completely removed. The unit of this value is day. The quality of a part or a product after correction can be either less or equal to that of a new product – depending on the level of fixing. (See more detail on each activity)	Recovery process is different from company to company, so a company should calculate the amount of CO ₂ emission according to their own process – thoroughly consider all possible CO ₂ emission that can incur during the recovery process.	
Refurbishing	$\frac{\text{Refurbishment Cost} \times 100}{\text{Total Reverse Logistics Cost}}$			
Remanufacturing	$\frac{\text{Remanufacturing Cost} \times 100}{\text{Total Reverse Logistics Cost}}$			
Cannibalization	$\frac{\text{Cannibalization Cost} \times 100}{\text{Total Reverse Logistics Cost}}$			
Recycling	$\frac{\text{Recycling Cost} \times 100}{\text{Total Reverse Logistics Cost}}$			
Reclaim	$\frac{\text{Reclaim Cost} \times 100}{\text{Total Reverse Logistics Cost}}$			

		production	
Disposal**			
Landfills	$\frac{\text{Landfill Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	The time since an inspection started and a product is decided to eliminate waste by landfill, take a product to the place where landfill is occurred until a product has been dropped at the landfill and the vehicle is back to the company.	Sum of (the amount of all different materials being buried(tons)x coefficient of CO ₂ emission of materials)
Incineration			
Open burning (Open air)			Quantity of materials burned(tons) x coefficient of CO ₂ emission from burning or
Incineration	$\frac{\text{Burning Cost} \times 100}{\text{Total Reverse Logistics Cost}}$	The time when an inspection is started, a product is decided to be burned, the product is dropped at the burning place, and finally the vehicle is back at the company.	Quantity of materials burned(tons) x coefficient of CO ₂ emission from generating electricity

Recommendation

Due to the limited time and information accessibility, the pilot test was conducted with only one company to assess the performance of the tool. Hence, the result may not be generalizable. Future research extension lies in having more interviews with both academicians and practitioners. Moreover, additional pilot tests with more companies in various industries should also be performed to increase the generalizability.

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THE IMPACT OF WEATHER CHANGES TO PEDESTRIAN RAIL COMMUTERS: AN OVERVIEW

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Abstract

Purpose - Residential site within 5 – 10 minutes walking distance from the rail station encourages higher pedestrian commuters to use the public transport. Studies have shown that the demand to use the rail system particularly for the rail pedestrian commuters were influenced not only by the physical environment of the walkways but also vulnerable to the changes in weather condition. The paper attempts to understand the impact of weather condition to the level of rail ridership. Secondly, the paper looks at the possible solutions to encourage rail pedestrian commuters to continue using the public transport even during high temperature and heavy rainfall.

Methodology - The paper analyses the previous literatures which emphasis on the weather elements that affect walking for transport.

Findings - Findings from the literature demonstrated mix results due to different topography and location where the study were being carried out. Daily temperature and unpredictable rainfall affect the pedestrian rail commuters on their travel decision.

Research Limitation - Literatures have shown that weather changes influenced the level of walking. Yet, there is still scarce of data that associates weather effects with the demand for walking to the rail system.

Practical implication - The paper facilitates the transport policy maker and planners in understanding how weather elements influenced pedestrian to access transit station and the effect to rail ridership and public transport modal share.

Originality - This paper addresses the problems on the affect of weather towards pedestrian rail commuter access public transport station experiencing hot and humid condition.

Keywords Weather, pedestrian rail commuter

Paper type Concept paper

Introduction

Rail transportation has been proven in its ability to transport passengers in high volume in one time. The efficiency of rail transport system is also able to overcome the current phenomenon of urban traffic problems and very effective to reduce the number of vehicles on the road especially during peak hours. The current trend in rail transportation is experiencing a decreasing in its modal share as the usage of private vehicles is increasing. The lack of public transport facilities, poor integration system, unpunctuality of services, and poor accessibility had hindered the public transport users and thus, motivates the usage of private transportations. Therefore, in an attempt to increase the modal share of rail based public transport, it is pertinent to increase the accessibility especially to the people who lives within 400 metres around the station.

It has been noted that the most practical mode to access transit station that involve short distance is by walking. Findings from previous study by Hamid (2009) in evaluating the park and ride system in Kuala Lumpur has demonstrated that more than 80 percent of the rail commuters walk to the train stations. Most journey to and from rail based public transport involve walking (Rietveld, 2000), but the importance of the mode of transport is always underestimated and seldom be planned pro actively (Semler and Hale, 2010). Findings from the literature reported that improvement in physical environment such as distance, sidewalk, street connectivity, station facilities and increase of safety will encourage users to walk from home to the transit station.

Nevertheless, the natural environmental factor – bad weather has been stated as one of factors that deterred rail transit ridership (Stover and McCormack, 2012). According to Hall *et al.* (2009) weather and season are factors that affect pedestrians in some level of degree.

Studies that investigate the effects of weather or climate change on rail transport and infrastructure are scarce. Research on the effect of weather on transit ridership is receiving more attention but there are still rare studies performed to discuss the effect of weather especially to the pedestrian rail commuters.

Measuring the impact of weather will allow planners and managers to consider the weather as a factor to lengthen the pedestrian transportation and take steps to encourage walking during bad weather (Hall *et al.*, 2009).

Tucker and Gilliland (2007), defined weather as refer to meteorological conditions, such as temperature, wind, clouds and precipitation. According to Nankervis (1997), weather is defined by rainfall and climate variable refers to temperature and precipitation.

Guo *et al.*, (2007) studied the impact of 5 weather elements – temperature, rain, snow, wind and fog on daily bus and train ridership. McGuinn *et al.* (2007) studies weather elements – temperatures, dew point, standard pressure, wind speed and precipitation.

Zhou (2011) on the other hand, has categorised cold days when the temperature is less than 60F and warm days if the temperature more than 60F. Whereas Cools *et al.* (2009) refer the temperature below 0°C or 32°F as cold and warm temperature is above 28°C or 82.4°F.

Methods

This study intends to adopt a fully quantitative approach with observations and dissemination of questionnaires. This paper reviews previous literatures and discuss the association of weather and transport. The literature has also been extended to identify the relationship of weather to the physical activity as it refers to walking activity. Research pertaining to weather and its effect to transit ridership has also been included in this paper.

Results

According to the literatures, studies in the transportation field have found contradictory results pertaining to the effect of weather to the level of physical activities (Tucker and Gilliland, 2007).

McGuinn *et al.* (2007), studied the relationship between transportation activity with the natural environment that consists of weather, hills and trees for shade and exhaust fumes may effects the physical activity. The study demonstrated those who perceived weather is a problem or a barrier, more like to engage in any transportation activity as compare to those who perceived weather was not a barrier to perform their physical activity. The study also revealed that there is no interaction between age factor and neighbourhood perception of weather as barrier to physical activity.

Hall *et al.* (2009) reported that weather such as cold temperature or precipitation consistently reduces aggregate level of walking by moderate amount (less 20%).

Guo *et al.* (2007) found that bad weather directly influenced the transit riders as well as the transit riders' behaviour. The study explained that more people use the rail system during good weather compare to when there was a bad weather day. As a result, bad weather can reduce the transit ridership.

Kalkstein *et al.* (2009) examined the air masses which include the elements of temperature, humidity, cloud cover and wind speed had significant impact on the transit ridership. The study found that precipitation, extreme cold and hot temperature discourage people to travel by public transport.

Zhou, (2011) mentioned when the temperature went up people tend to make few trips. Nevertheless if the temperature goes up more than 70F, people less likely to travel. In extreme cold days the study found that people are less likely to make trips as most of trips are for passenger pick up or dropped off or to change mode of transport.

Clifton and Livi, (2004) reported that the level of walking for both men and women will decrease slightly by 40% during bad weather and 12 – 15% will stopped walking in Maryland.

Alfonzo (2005) stated that people who live in a region with temperate climates are more motivated to walk compared to residents who live in a more frigid climate region. Tucker and Gilliland (2007) in the study in US focusing in Texas where the population experienced hot and humid temperature. It is reported that there is a decrease in physical activity during summer compared when there is winter. In developing countries, although weather is indicated as a barrier to walk, (Hook, 2003) but the study found that the average temperature in most Asian cities are about the same as summer in Europe, where walking and cycling are very popular at this time. Thus the streets in hot region need to be shaded and protected from the heat of the sun (Hook, 2003).

Stover and McCormack, (2012) found in their studies that adverse weather conditions have statistically significant effect on the transit ridership. The rainy weather in the local study area increase

discomfort to passenger especially if no shelter is provided. As bad weather will make travel unpleasant, thus people tend to switch to private automobile during rainy day. Khattak and De Palma (1997) reported that in Brussels, about half of the private transport commuters have switch their travel pattern as there is increase in transit ridership during adverse weather.

Most of the scholars in literatures have agreed that weather has been indicated to give influenced on the physical activity but some studies found conflicting results. Nankervis (1999) found that the inclement weather has low effect to the commuting trips. According to Aaheim and Karen (2005) ,bad weather is not generally an obstacle to travel. Studies on the Bergen in Norway demonstrated that weather relatively would not affect the travel pattern of the local people who switched from public to private transport. Badland *et al.* (2011) extents the study on the adults' overall physical activity in Perth where the weather condition were relatively constant across all seasons. In line with the previous findings, the report revealed that there is a non-significant or negative correlations existed for temperature and hours of sun- light with transport-related physical activity engagement.

Impact of weather to rail transportation

Evidence of the potential impacts of bad weather had been briefly discussed in the transportation literature. Sumalee *et al.* (2011) explained that extreme hot and wet day increase inconvenience to public transport users. Kalkstein *et al.* (2009) explained that weather condition have been recognised to affect people to travel in comfort, thus make travel by public transport less appealing. Bad weather may decrease the satisfaction level of travellers. In some places, the rain makes the transit station to be wet and slippery thus, increase discomfort in the waiting area.

The transit operator noted that bad weather might create disruptions on the rail service system (Koetse and Rietveld, 2009). In turn, reduce the quality of the overall rail services. Bad weather decrease in frequency and reliability in rail transport services due to flood. To the passengers, this situation might affect the travel decision and involves the need for rescheduling the travel time. Bad weather such as storm and lightning increase the possibility of infrastructure failure as there is possibility for the rail system delayed and stopped due to lack of power or electricity.

Bad weather such as heavy rain, extreme hot temperature and storm will make the passage to the transit station inaccessible. Pedestrian might experience difficulties in accessing the transit station as some of the walkways might be flooded due to heavy rain. On the other hand, high temperature might cause pedestrians to sweat more with unpleasant odours.

Conclusion

Understanding the impact of weather is essential to transport planners and engineers to incorporate possible solutions and improvement to ensure seamless travel experience and continuous support to public transportation. Upgrading the transport infrastructure such as covered pedestrian walkways, sheltered transit station and real time weather information will increase commuters' satisfaction level along their journey from home to their workplace.

As the literature on the effect of weather to transport and physical activity indicated mix results due to difference geographical climate, thus it is important to encompass this factor in physical activity related to research (Tucker & Gilliland, 2007).

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THE ROLE OF CAPABILITIES IN LOGISTICS SERVICE BUSINESS

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Introduction

The global competition of supply chains, market uncertainty and fluctuations in supply caused by tight economic condition and technological changes set continuously increasing requirements for logistics performance and logistics industry in general. The concept of logistics capability is broadly examined within logistics user companies, such as manufacturers and retailers. Nevertheless, there are no studies in earlier literature that would have considered the logistic service capability in itself (*i.e.*, excluding the other firm-specific capabilities) from the logistics service provider (LSP) viewpoint. Instead, their performance and competitiveness as a whole are widely examined. The topic of this paper is interesting and important because the significance of logistics is essential for competitiveness of user companies (*e.g.* Mentzer *et al.*, 2004) which are outsourcing their logistics functions more and more to LSPs. Furthermore, total freight volume is expected to increase globally but simultaneously transport routes are shifting according to the changing centers of economic gravity. This will cause increased competition among LSPs on the traditional routes between USA, Europe, and China. In fact, material flows on these conventional routes are not expected to decrease but their relative importance is anticipated to decline. (Christopher, 2011; Jeschke, 2011)

Superior performance in logistics service sector is largely based on knowledge, transformation of knowledge, and development of competencies both internally in companies as well as in cooperation between the logistics service provider and the logistics service user. Furthermore, the competitive advantage of logistics service provider is formed and re-formed from strategic logistic resources such as physical, human, information, knowledge, and relational resources, which are bundled together by service providers in order to create inimitable and firm-specific capabilities (Wong and Karia, 2010; Halldorsson *et al.*, 2007; Mentzer *et al.*, 2004). Therefore, theoretically this study is founded on the resource-based view of a firm (RBV). Logistics is a source of competitive advantage for manufacturers, assemblers, technology companies, and retailers (*e.g.* Mentzer *et al.*, 2004). Thus, tightened global competition in industries, uncertain business environment and technological developments have forced manufacturers and retailers searching for differentiation and competitive advantage from logistics function. This has set challenges for developing logistics capabilities of a firm and companies have begun to purchase logistics expertise by outsourcing logistics functions to LSPs. As benefits of logistics outsourcing have proved to be *e.g.* decreased logistics costs, decreased inventory levels, and improved customer satisfaction. However, sometimes the expected benefits, *e.g.* cost reductions, are not realized for some provider-based reasons, and thus, it is important to understand the operational logistics capabilities of service provider.

In the current study, we understand logistics more operational and tactical *action* than strategic supply chain *management* and we consider logistics as a part of a wider concept of supply chain. Respectively, Third Party Logistics (3PL) focus on the *logistics* activities that are needed for moving goods from A to B as well as to hold resources that are needed for these purposes. Fourth Party Logistics (4PL), in turn, act as logistics service integrator in *supply chain level* integrating, amongst others, the competencies of different 3PLs as a part of supply chain capability, creating value for customers. (Mentzer *et al.*, 2004; Win, 2008)

In earlier literature, logistics capabilities are comprehensively examined as a part of capability portfolio of manufacturers and analyzed as competencies through which companies can achieve competitive edge (*e.g.* Mentzer *et al.*, 2004; Zhao *et al.*, 2001; Lynch *et al.*, 2000 and; Morash *et al.*, 1996.)

The role of logistics service provider is to create value for customers in the form of more competitive logistics and to provide profit for its shareholders. In literature, the competitiveness of LSP is examined as a whole. It is obvious that the firm-specific capabilities, such as organizational strategy, structure, and organizational culture are vital for LSP's competitiveness but in this study they are excluded. For LSPs, logistics capabilities are core competencies and thus they are analyzed from strategic perspective in literature, *e.g.* Liu Wei-hua *et al.* (2012); Liu Xiaohong *et al.* (2010); Wong and Karia (2010) and; Lai (2004). This paper concerns logistics service capabilities of logistics service provider from both customer perspective and as LSP's internal capability profile. The idea is to address the

differences between 3PL and 4PL performance in providing logistics service-related tasks as well as to identify those capabilities a 3PL should develop in order to become a 4PL provider.

Literature review

According to RBV, competitive advantage is achieved through firm-specific resources and capabilities. Resources are heterogeneously distributed among companies and are imperfectly mobile (Barney, 1991) as in logistics field, resources are distributed across logistics service providers, forwarders, freight and fleet operators, and logistics users. In logistics sector knowledge has been cumulated over time and turned to tacit knowledge, which is impossible to transfer from one LSP to another. Capabilities “are complex bundles of individual skills, assets and accumulated knowledge exercised through organizational processes that enables firm to coordinate activities and make use of their resources” (Olavarrieta and Ellinger, 1997, p. 563). Logistics capabilities can be e.g. abilities to manage supplier relationships, customer service and order fulfillment. Capabilities are maintained and improved by using them; the more capability is used the more it is refined. (Wong and Karia, 2010; Olavarrieta and Ellinger, 1997)

Logistics outsourcing, characteristics of 3PL and 4PL

Manufacturers began to outsource transportation and warehousing at the early 1980s forced by tightened competition. Selviaridis and Spring (2007) have analyzed the benefits of logistics outsourcing, such as improved customer satisfaction, increasing flexibility to market requirements and reduction of total logistics costs. As main risks they recognized, e.g. the loss of control over the logistics function and customer contacts, expected cost reductions that are not realized due to LSP’s reason and inadequate provider expertise.

The characteristics and differences between 3PL and 4PL are presented in Table 1. Differences, according to Win (2008) are Asset basis, Accountability, Role in supply chain, Business impact, and Performance measurement. As 3PL deals with logistics activities, its function is operational and tactical whereas 4PL’s function is more strategic. Geographic coverage of 3PL is regional or national (Carbone and Stone, 2005) and 4PL function as one face to customer and it manages supply chain globally.

Characteristic	3PL	4PL
Function	Operational, tactical	Strategic
Main assets	Transportation fleet, warehouses, logistics IT-systems	Sophisticated IT-systems, knowledge, networks
Role and task	Transportation, warehousing, freight forwarding	Logistics-, supply- and demand chain integration: Identifies, integrates, controls and manages
Geographic coverage	Regional, national	Global
Capability	Operational logistics capability	Strategic supply chain capability
Accountability	Partial: internal resources and/or 3PL as subcontractor	Total singular accountability
Business impact	Influences time and place utilities	Controls time and place utilities
Measurement	Costs	Value creation within customer organization

Table 10: Characteristics and differences between 3PL and 4PL. Adapted from Win (2008).

Logistics capability

Logistics capabilities have mainly been explored as in-house logistics functions of manufacturer companies and retailers (i.e. logistics users) and reported as one source of competitive advantage. In earlier literature logistics capabilities have been classified e.g. as follows: Demand-oriented capabilities, Supply-oriented capabilities, Process capabilities, Information capabilities and Coordination capabilities (E.g. Mentzer *et al.*, 2004; Zhao *et al.*, 2001; Lynch *et al.*, 2000 and; Fawcett *et al.*, 1997; Morash *et al.*, 1996). Afterwards, when logistics service users started to outsource their logistics functions to service providers over 30 years ago, success factors of logistics service providers have been of interest of both logistics researchers and managers (e.g. Liu Wei-hua *et al.*, 2012; Liu Xiaohong *et al.*, 2010; and Wong and Karia, 2010). However, researches have focused mainly on

LSPs' competitiveness and capability to success on the market as a whole rather than on LSPs' logistics service capability in itself.

For our empirical study we reviewed some other relating literature. According to Dyllick and Hockerts (2002, p. 131), corporate sustainability is defined as "meeting the needs of a firm's direct and indirect stakeholders' without compromising its ability to meet the needs of future stakeholders as well". They state that in order to achieve long-term sustainable competitiveness, a firm needs to satisfy all the three dimensions of sustainability called triple bottom line, namely economic, social, and environmental dimension. Because our study is about logistics, the perspective of this paper is in environmental sustainability. Environmental sustainability can be affected by logistics choices, especially by transportation through reducing the carbon footprint. Evangelista *et al.* (2013) highlight the role of logistics buyers in promoting greener logistics. According to Dey *et al.* (2011), logistics companies can differentiate themselves from competitors by sustainability initiatives. However, the investigation of van Hoek and Johnson (2009) revealed that due to changing price of energy and fuel, decision-making still remains economic performance-driven rather than environmental or social performance-driven.

Another issue from literature that has impact on logistics process is the knowledge of local market and conditions in specific context. This comes out for example in cross-border settings between two countries, especially if they differ from each other economically, socially, politically, legally, or business culturally. The lack of knowledge of local market and formalities is one factor causing significant time and cost inefficiencies as well as delays in border crossing points. (Carbone and Stone, 2005). As material flows and risks are worldwide, LSP companies can benefit from horizontal cooperation *e.g.* through accessing into local market knowledge (Verstrepen *et al.*, 2009).

In our empirical study we form a logistics capability profile of LSP company adopting approaches of Mentzer *et al.* (2004); Zhao *et al.* (2001); Lynch *et al.* (2000); Fawcett *et al.* (1997) and Morash *et al.* (1996) as described above in this section. Moreover, we utilize and combine to the framework earlier researches on LSP companies as well as other related literature.

Empirical case study

AHP application

We have applied Analytical Hierarchy Process (AHP) for studying the logistics capabilities in a case environment. AHP is an expert method that allows structuring and decomposing a decision problem into a hierarchy of parts. According to Saaty (1999), it is possible to form a complete picture of the whole system through structuring a system into clusters and subdividing clusters into smaller pieces. In AHP, the criteria at each level of hierarchy are then weighted against other criteria that give the relative global (G) and local (L) weights to the criteria attributes. The mathematical foundations of AHP applications are presented, for example, in Saaty (1999). In this study, the AHP is used in the first stage of the empirical part for structuring the logistics service capabilities into hierarchy. In the second stage, we assign weights for the criteria (service capabilities) by using the expert input. A pair-wise comparison weighting method is used which implies that the relative importance of each capability is assessed against other capabilities inside each capability category by using a scale of 1 to 9. This gives the capability priority weight in a local (item) level of the model. In the final stage, we then compare the performance of two alternative business models against capabilities. AHP has been used in the recent logistics literature, for example in the assessing an organization's logistics strategy (Meadea and Sarkis, 1998), the benchmarking of the logistics performance (Chan *et al.*, 2006), and the evaluation of logistics providers (Perçin, 2009). Thus, an AHP method seems to provide a useful tool for evaluating logistics capabilities and performance.

The case company

The case company is a medium size leader logistics service provider, which has operated in international logistics business for decades. The company owns warehouses, transportation fleets, and facilities not only in Finland but also in its strategic locations in some other countries. In addition, it cooperates with several companies horizontally and has a few partners through which it has access to extra capacity in its strategically important countries. As informants in expert evaluation and comparison process of this empiric study were the experienced director of this leader logistics company and an expert who has a long operative managerial experience from both the leader logistics company and a governmental logistics organization.

The framework

In this framework the components of logistics service capability are grouped to Demand-Oriented Logistics Capabilities, Supply-Oriented Logistics Capabilities, Process Capabilities, Information Management Capabilities and Coordination Capabilities. The capabilities and components are described next below.

1. Demand-Oriented Service Capabilities consists of *Delivery reliability* and *Delivery speed* (e.g. Morash et al., 1996); *Logistics quality*, (e.g. Mentzer et al., 2004); *Customer Service* and *Responsiveness to target market* (e.g. Morash et al., 1996); *Ability to introduce new services* and *Ability to provide solutions to customer-specific needs* (e.g. Lynch et al., 2000).
2. Supply-Oriented Service Capabilities includes *Widespread distribution coverage*; *Selective distribution coverage* and *Low total cost distribution* (e.g. Mentzer et al., 2004); *Environmental sustainability* (e.g. Evangelista et al., 2013); *Local market knowledge* (e.g. Carbone and Stone, 2005).
3. Process Capabilities involve *Ability to attain the lowest total cost logistics*; *Ability to seek solutions to logistics problems before they occur*; *Ability to differentiate logistics service offering*; *Ability to simplify the overall logistics process*; *Ability to provide uniform quality*; *Ability to innovate* (e.g. Lynch et al., 2000); *Ability to assess overall logistics performance* (e.g. Fawcett et al. 1997).
4. Information-management capabilities are formed of *IT-technology*; *Information sharing*; *Connectivity* (e.g. Zhao et al., 2001) and; *Ability to acquire, analyze, store and utilize relevant information* (e.g. Mentzer et al., 2004).
5. Coordination capabilities consist of *Ability to integrate / cooperate with external partners*; *Verstrepen et al., 2009*); *Ability to cooperate with external stakeholders*; *Ability to coordinate internal functions*; *Ability to monitor internal and external functions* (e.g. Mentzer et al., 2004).

This framework, formed on logistics service related to factors from literature, is next approved in expert evaluation through AHP model.

AHP hierarchy for Logistics service capability

Table 2 illustrates the AHP comparison and results based on the expert evaluation. Both local and global values are presented in the Table 2. Local value means the relative importance of the alternatives on the same hierarchical level under one category. Global value means the relative importance of the factor in terms of the primary goal, which is to evaluate the capabilities of logistics service provider. In the AHP, the sum weights of attributes in the same hierarchy level equals to 1. The higher the relative weight of the attribute in the model, the more important is its role in the model. The first level capability categories (Demand, Supply, Process, Logistics information management, and Coordination) are set equal (0.2) in the model.

The following individual capabilities (components) are seen as the most important in the overall assessment: Ability to provide solutions to customer-specific needs, Responsiveness to target market, Low total cost distribution, Local market knowledge, Ability to asses / evaluate overall logistics performance, Ability to acquire, analyze, store and utilize relevant information, and Ability to integrate / cooperate with external partners.

1..	Demand-oriented capabilities (L: ,200 G: ,200)
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1.7. Delivery reliability (L: ,106 G: ,021)

1.2. Delivery speed (L: ,021 G: ,004)

1.3. Logistics quality (L: ,021 G: ,004)

1.4. Customer service (L: ,106 G: ,021)

1.5. Responsiveness to target market (L: ,319 G: ,064)

1.6. Ability to introduce new services (L: ,106 G: ,021)

1.7. Ability to provide solutions to customer-specific needs (L: ,319 G: ,064)

3. Process Capabilities (L: ,200 G: ,200)

3.1. Ability to attain the lowest total cost logistics (L: ,024 G: ,005)

3.2. Ability to seek solutions to logistics problems before they occur (L: ,122 G: ,024)

3.3. Ability to differentiate logistics service offering (L: ,122 G: ,024)

3.4. Ability to simplify the overall logistics process (standardize) (L: ,122 G: ,024)

3.5. Ability to provide uniform quality (a consistent approach...) (L: ,122 G: ,024)

3.6. Ability to asses / evaluate overall logistics performance (L: ,366 G: ,073)

3.7. Ability to innovate (L: ,122 G: ,024)

2. Supply-oriented capabilities (L: ,200 G: ,200)

- 2.1. Widespread distribution coverage (availability) (L: ,030 G: ,006)
- 2.2. Selective distribution coverage (L: ,148 G: ,030)
- 2.3. Low total cost distribution (L: ,443 G: ,089)
- 2.4. Sustainability (L: ,063 G: ,013)
- 2.5. Local market knowledge (L: ,316 G: ,063)

4. Logistics information-management Capabilities (L: ,200 G: ,200)

- 4.1. IT-technology (hard- and software, network) (L: ,045 G: ,009)
- 4.2. Willingness to share information (L: ,136 G: ,027)
- 4.3. Connectivity (L: ,136 G: ,027)
- 4.4. Ability to acquire, analyze, store and utilize relevant information (L: ,682 G: ,136)

5. Coordination capability (L: ,200 G: ,200)

- 5.1. Ability to integrate / cooperate with external partners (L: ,682 G: ,136)
- 5.2. Ability to integrate / cooperate with external stakeholders (L: ,136 G: ,027)
- 5.3. Ability to coordinate internal functions (L: ,136 G: ,027)
- 5.4. Ability to monitor internal and external functions (L: ,045 G: ,009)

Table 11: AHP hierarchy and relative weights for logistics service capabilities

In the second stage of the AHP assessment, two alternative logistics service models (3PL and 4 PL) are compared in terms of capability fit. In other words, we pairwise compare how well each business model capability performs against alternative concepts. Figure 1 shows the performance sensitivity of alternative business models when capabilities are evaluated against alternative business models. It illustrates that 3PL performs better in Demand and Process capability groups. On the other hand, 4PL performs better in Information and Coordination capability groups. Overall evaluation shows that both models perform rather equally, which implies that both models can provide advantages for customers.

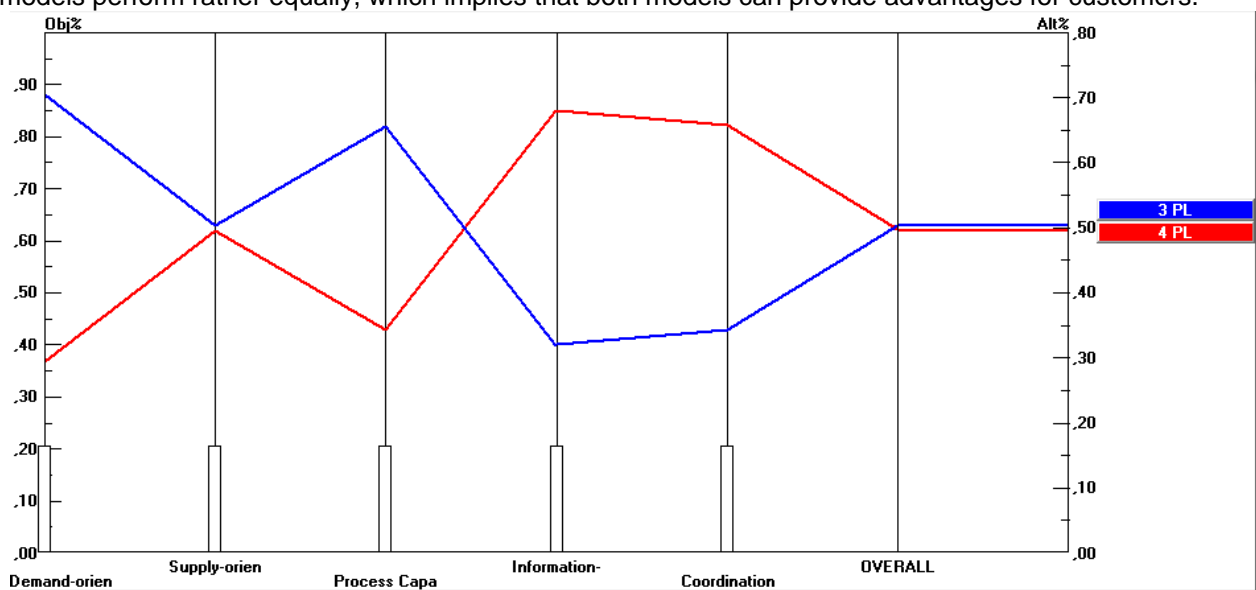


Figure 6: Performance sensitivity of alternative business models

This preliminary test of the AHP logistics capability framework provides interesting opportunities for both service providers and service customers. Service provider is able to develop its logistics service offer based on the identified capability gaps. Service provider is able to create a capability profile, which assures the competitive position in the markets. The customer sets priorities on the capabilities and selects a provider which capability profile fits for the customer preferences. Thus, the customer is able to evaluate alternative service providers based on their capability profile. From managerial perspective, the results indicate that 3PL should develop its information management capabilities as well as the capabilities to coordinate partners, stakeholders and internal functions in order to grow into a 4PL provider. In addition, one more capability that is worth to maintain and develop is the Knowledge of local market and conditions which has an important role and impact on global supply chain context that often covers several border crossings from a supplier of raw material to the end user.

Conclusions

In this study we have discussed logistics service capabilities that contribute directly for LSP's performance, *i.e.* its ability to provide logistics services and solutions, such as storing and moving goods, value-added services as well as related information flows. We developed a framework for logistics service capability of logistics service provider, structured a model on AHP method, and applied the model in the contexts of 3PL and 4PL providers. In this study we categorized logistics service capabilities to five different groups, which are Demand-Oriented Service Capabilities, Supply-Oriented Service Capabilities, Process Capabilities, Information-Management Capabilities and Coordination Capabilities. When the applicability of the individual service capabilities (components) were evaluated and compared between 3PL and 4PL service providers' business models, the results showed that the overall performance is somewhat equal. However, 3PL seems to perform better in Demand and Process capability groups, whereas 4PL performs better in Information and Coordination capability groups. In Supply capability group, 3PL proved to be only slightly better than 4PL. Consequently, in order to become 4PL provider, 3PL should develop its Information management capabilities and Coordination capabilities. In this study, the other firm-specific capabilities affecting on a firm's performance were excluded. Also, reverse logistics capability was excluded as this study concerned only forward logistics and supply chain issues. In future, this topic can be examined more detailed *e.g.* with multiple case studies involving some logistics users and some LSP companies also from other European countries for getting wider overview of logistics service capability of LSP company.

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THE ROLE OF RESPONSIBLE BUYING PRACTICES IN SUPPLY RISK MANAGEMENT

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Introduction

Global organizations have recognized sustainability as an increasingly important strategic goal (Closs et al., 2011) as the general awareness about responsibility and sustainability has significantly grown. Hoejmose and Adrien-Kirby (2012) have stated that sustainability and responsibility in purchasing and supply management is a vital topic driven by globalization, fragmented supply chain and stakeholder pressure. Firms are required to show more and more transparency in their business and their supply chains. In today's conscious business world each organization can be viewed only as sustainable as its entire supply chain or network. The purchasing and supply management of a firm has one of the most critical roles when sustainability and responsibility need to be concretized. The supply management is responsible for the management of the firm's supply network and external resources. Thus, it has a key role in defining the origin of its raw materials and products. According to Schneider and Wallenburg (2012), the implementation of corporate responsibility relies strongly on the firm's supply function implementing sustainable supply.

Several risks are arising from the supply base and thus, the significance of risk management in purchasing and supply is constantly growing. Risks violating the image and brand of the company are increasingly arising from the supply base. These risks can include the supplier's use of toxicant materials and fabrics in end-products, the use of child labor, sub-standard working conditions in a low-cost country or other similar issues. Thus, the different principles and practices related to sustainability and responsibility of purchasing are highly critical and firms should have principles and codes of conduct on how to act in different situations. Literature review shows that risk management has rarely been connected to the studies of responsibility, and empirical evidence on the topic is still lacking. As the clear connection between risk management and responsibility can be shown, this paper focuses on the discussion of the role of responsible buying practices in supply risk management.

The role of responsible buying practices in supply risk management is examined by utilizing a quantitative survey data collected from Finnish firms in 2013. The questionnaire was addressed to large Finnish companies and the emphasis was on the fields that were engaged in project business. The included fields were manufacture of machinery and equipment, building of ships and boats, repair and installation of machinery and equipment, construction of buildings, and civil engineering. This study is a part of a large research project started in June 2012 in Finland. The project is launched and financed by TEKES - the Finnish Funding Agency for Technology and Innovation. The research project focuses on project business in global context. The objective is to examine the risk management in the purchasing decision-making in global project business and increase understanding about the critical supply network risks. From the managerial point of view the objective is to develop project managers' ability to evaluate proactively economic and financial effects of supply network risks. The aim of this paper is to provide new empirical evidence and insights concerning both the risk management and sustainability in purchasing and supply management by discussing the role of responsible buying practices in supply risk management.

Supply risk management

Risk management in supply chains is widely studied issue among the logistics and supply chain scholars. Complexity of supply networks, long geographical distances and uncertainty of political and economic circumstances around the world are serious concerns in companies. Several risk management strategies are proposed to mitigate these risks and decrease risk occurrences in a supply chain (Manuj and Mentzer, 2008). The risk management process is a combination of risk identification, risk analysis and risk evaluation. Lee and Whang (2005) approach supply risk

management from the security point of view and suggest that Six Sigma (generally known as a quality management tool) cycle is relevant approach to risk management in supply chains because it covers all the risk management phases from identification to the elimination of root causes of the risks.

Management of supply risks requires categorizing of the risks accordance the strategy of the company. Companies must identify the risk elements and the causality, what are the antecedents of the risks and what is the probability of the risk occurrence. For example, according to Zsidisin (2003) supply risks must be divided to the sources of the risks and to the outcomes following the risk incidents. According to Zsidisin (2003, p. 222), "Supply risk is defined as the probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety". The outcome of a supply risk embodies directly through the product attributes – value for buyer, quality, price and performance (Chen and Chang, 2012), but also indirectly such as a loss of image, decrease of brand value and violations of property rights. Moreover, Cavinato (2004) presents that supply chains are constructed from physical, financial, informational, relational and innovational elements and supply risks must be identified in every of these elements.

Moreover, business and production can incur sustainability risks (Shrivastava, 1995). It is stated that serious ecological risks in business are arising because of the production of wealth. Irresponsible production and "ecologically unsustainable consumption of natural resources are the root sources of modern risks" (Shrivastava, 1995, p. 120). Hence, companies should strive for ecological business to gain profit, and thus, fulfill the economic responsibility to their shareholders. This responsibility of companies is strongly linked to supply risks (Christopher et al., 2011). Especially, sustainability and social problems of global sourcing and outsourcing can be sources of serious supply risks (Lonsdale, 1999; Manuj and Mentzer, 2008; Reuter et al., 2010). Therefore, companies need to act proactively and utilize purchasing practices that help minimize sustainability risks.

Responsible buying

The terms responsibility, sustainability, and green are used interchangeably in many studies of focusing responsibility issues in supply chains. Based on Carroll's (1979) original work of corporate social responsibility (CSR) several authors and institutions have presented their interpretation of the responsibility of a firm. The predominant view is that the responsibility is consisted of three different elements, being social, ecological and financial responsibility (Montiel, 2008). Consequently, responsible buying includes purchasing practices that take account the social, ecological and financial impacts of the purchases in the country of origin or location where the goods or services are acquired and in a buyer's company, and further in the usage of final customer. Hence, in this study the focus is environmental issues related to whole supply network management including ethical awareness concerning to the origin of the goods and services and the surrounding environment where they are produced.

Previously, Walker and Brammer (2012) have studied the research stream of sustainable procurement in public sector. Giunipero et al. (2012) have examined the drivers and barriers of sustainability in purchasing and supply management. The main drivers of responsible buying are the company's commitment, supplier assessment, and supplier collaboration (Bowen et al., 2001; Large and Gimenez Thomsen, 2011). Furthermore, responsible buying (environmental purchasing more precisely) has been shown to have influence on firm performance (Carter et al., 2000). In addition, responsible buying has been connected to the studies of value nets, customer value and shared value (Porter and Kramer, 2011).

Responsible buying includes several practices and tasks. Purchasers need to follow company's CSR policy and promote transparency and traceability in the whole supply chain. Adopting international standards, ISO14000, SA8000, for example, is a way to demonstrate responsibility in purchasing decisions. Furthermore, company's responsibility must be extended over the supply network (Vachon and Klassen, 2006). Therefore, information regarding company's CSR requirements need to be delivered to suppliers and include to supplier selection, auditing and control actions.

Methodology and analysis

A survey was conducted to examine the risk management and responsible buying practices in Finnish companies. The sample was limited to companies situating in Finland having more than 50 employees and with a turnover at least 1 million euros. The emphasis was on the fields that were engaged in

project business. The included fields were manufacture of machinery and equipment, building of ships and boats, repair and installation of machinery and equipment, construction of buildings, and civil engineering. (NACE codes 28, 301, 33, 41 and 42). A total of 347 companies were identified in the selected industries drawn from the commercial Amadeus database. All 347 companies were contacted by phone in the first phase. The purpose of the phone call was to identify a suitable key informant and to give potential respondents some advance information about the survey, and to increase the response rate. From these companies 260 agreed to answer. Some companies offered multiple respondents, and therefore, a total 265 web links to the questionnaire were sent. Finally, 99 answers were received yielding a satisfactory response rate of 37% per cent (99/265).

Several descriptive and background factors were included in the questionnaire to be able to categorize the responses. The financial figures were generated from Amadeus database showing financial data based on last available financial statement and two preceding years of the respondent companies. Table 1 summarizes the descriptive statistics of the respondents.

Descriptive Statistics*	N	Min	Max	Mean	Std. Dev.
Turnover (th€)	99	-675	2 586 814	202 358	478 551
Employees	99	40	8180	561	1095
Net Income (th€)	99	-39 013	691 369	9 122	69 791
Profit margin %	98	-16	51	4	9
ROCE	82	-170	312	21	58

*last available year from Amadeus database, 12.4.2013

Table 1: Summary of the descriptive statistics of the respondents

The respondents paid attention very much or extremely much to delivery risk (74 %) and to the business relationship risks (50 %) and risks related to third party (44 %). Of the respondents 34 % rated the risks related CSR to be under concern very much or extremely much. Because over 70 per cent of the respondents are engaged in project business it is logical that delivery risk and risk of business relationships were the most critical. Interestingly, country risk was not at all or was very little under concern in these companies. Figure 1 shows how much attention Finnish project business companies pay on business risks.

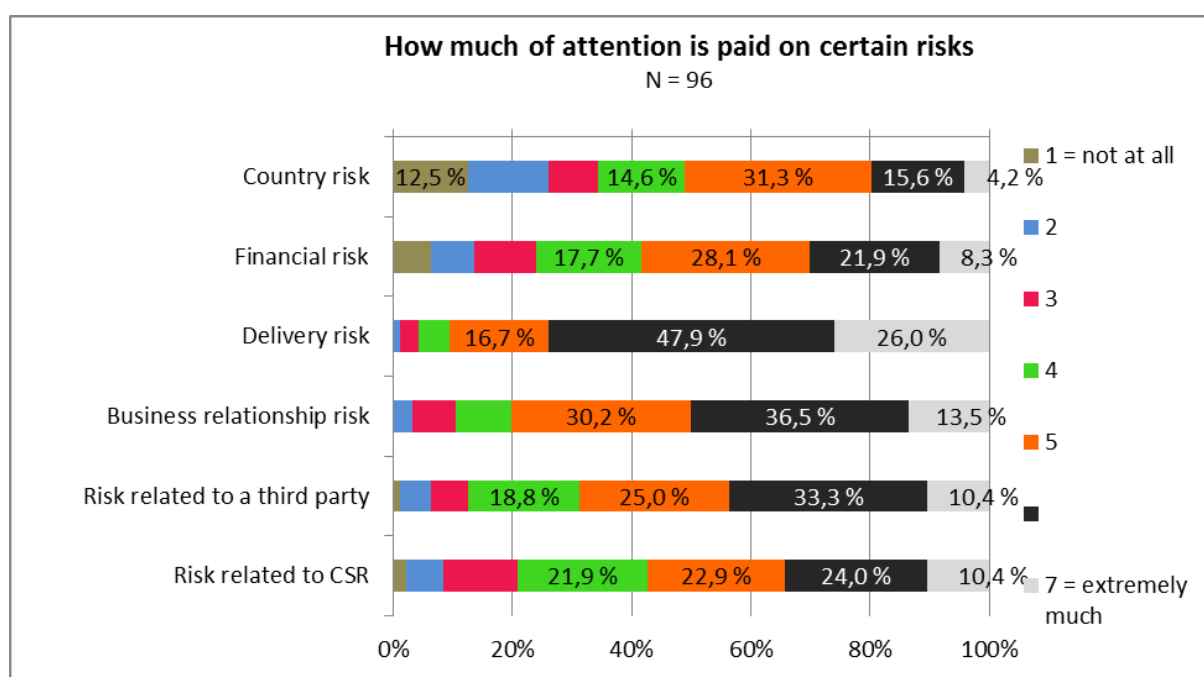


Figure 1: Risks in respondent companies

Because of the small sample size ($N=99$) the original five industries were summed up to three main groups being 1) Machinery and mechanical engineering ($n= 50$), 2) Marine and MRO ($n=11$), and 3) Construction and civil engineering ($n=38$). Based on the ANOVA test it was found that there was no significant differences between the groups in terms on size, age and financial stance. However, it was found that there were significant differences between some of the industry groups of how much they pay attention to business risks. The Marine and MRO industries pay more attention to country risks than construction and civil engineering (mean difference 1.574, $p<0.01$). This is logical as in the construction and civil engineering the work sites usually are located geographically close or in the same country whereas maintenance and repair projects and ship building can be globally dispersed. Furthermore, it was found that construction and civil engineering pay attention more on risks related to third-party related risks than machinery and mechanical engineering (mean difference 0.668, $p<0.005$). Moreover, risks related to CSR were more under concern in construction and civil engineering than in machinery and mechanical engineering (mean difference 1.016, $p<0.01$). Hence, it can be concluded that risks vary accordance the industry and nature of the business. Table 2 shows the means of the risks across the industry groups.

Business risks	1 (N=50)	2 (N = 10)	3 (N =38)	All Groups	ANOVA F	Sig.
Country risk	4.2	5.1	3.53	4.03	3.93	0.023
Financial risk	4.5	5.2	4.42	4.54	0.963	0.386
Delivery risk	5.78	6.2	5.87	5.86	0.685	0.507
Business relationship risk	5.14	5.4	5.47	5.3	0.857	0.428
Risk related to third-party	4.7	5.5	5.37	5.04	3.477	0.035
Risk related to CSR	4.3	4.5	5.32	4.71	3.477	0.004

Table 2: Means and standard deviations of risks across the industry groups

As Table 3 indicates, in the respondent companies the means of following responsible buying practices were quite high. The biggest variation was in following international CSR standards (Standard Deviation 1.93). However, the practices across the industry groups did not vary significantly. Table 3 shows the means and standard deviations of practices among all the respondents.

Responsible buying practices (N=95-97)	Mean	Std. Dev.
The principles of responsible buying are followed	5.92	1.22
The supply chain is transparent up to the end-customer	5.00	1.43
The management of the product life cycle is important to us	5.00	1.52
The traceability of the product is important to us	5.53	1.31
International standards are followed in supply management (ISO14000, ISO26000, SA8000 etc.)	4.93	1.93
We pay attention to ethics and environmental values within our supply management	4.59	1.77
When auditing and selecting suppliers we make sure that the supplier follows ethical guidelines and environmental values	4.80	1.70
We aim to find the principal causes and respond quickly in case there are CSR problems in our supply network	4.99	1.65

Table 3: Responsible buying practices in Finnish project business companies

To examine if responsible buying practices are incorporated to risk management of a firm a correlation analysis was performed. The means of responsible practices statements were summated to one variable (mean 5.10, Cronbach's Alpha 0.889). Table 4 shows the means and standard deviations of the variables and Table 5 indicates the results of the correlation analysis. As Table 5 shows, it was found that responsible buying practices correlate positively with all the business risks. The highest correlation was by definition between risks related to CSR and responsible buying practices. Delivery risk and risk related to third-party had also high correlations with the responsible buying practices. The lowest correlation between responsible buying and risks was surprisingly country risk. Furthermore, it was found that country risk do not correlate with CSR risk and third-party risk.

Variables	Mean	Std. Dev.
Responsible buying practices	5.10	1.204
Country risk	4.03	1.744
Financial risk	4.54	1.606
Delivery risk	5.86	1.035
Business relationship risk	5.30	1.212
Risk related to third party	5.04	1.346
Risk related to CSR	4.71	1.471

Table 4: The means and standard deviations of the variables

Variables	1	2	3	4	5	6	7
Responsible buying practices	1						
Country risk	0,270**	1					
Financial risk	0,408**	0,623**	1				
Delivery risk	0,545**	0,339**	0,394**	1			
Business relationship risk	0,405**	0,230*	0,282**	0,478**	1		
Risk related to third party	0,556**	0,193	0,280**	0,537**	0,448**	1	
Risk related to CSR	0,652**	0,196	0,315**	0,514**	0,516**	0,620**	1

*p<0.05; **p<0.01

Table 5: Correlations analysis

Conclusions

Due to the constantly growing importance of sustainability and responsibility, the transparency in business and in supplier networks is highly required. Each firm can be viewed only as sustainable as its entire supply network and thus, the practices and principles related to the purchasing and supply are becoming more and more important. Different risks are arising from the supply base and therefore, the significance of risk management in purchasing and supply is constantly growing which moreover, highlights the importance of defined principles and practices related to sustainability and responsibility of purchasing. It can be stated that companies need to act proactively and utilize purchasing practices that help minimize sustainability risks. Thus, the aim of this paper was to discuss the role of responsible buying practices in supply risk management by utilizing a survey data collected from Finnish companies.

The results of the study show significant differences between the industry groups of how much the attention is paid on the business risks. According to the survey results, the marine and MRO industries in Finland pay more attention to country risks than construction and civil engineering. This is logical as in the construction and civil engineering the work sites usually are located geographically close or in the same country whereas maintenance and repair projects and ship building can be globally dispersed. Furthermore, the results show that construction and civil engineering pay attention more on risks related to third-party related risks than machinery and mechanical engineering. Moreover, risks related to corporate social responsibility were more under concern in construction and civil engineering than in machinery and mechanical engineering. Hence, it can be concluded that risks vary accordance the industry and nature of the business.

The results of the study also show that responsible buying practices correlate positively with all the business risks. The highest correlation was by definition between risks related to CSR and responsible buying practices. Delivery risk and risk related to third-party had also high correlations with the

responsible buying practices. The lowest correlation between responsible buying and risks was surprisingly country risk. Furthermore, it was found that country risk do not correlate with CSR risk and third-party risk.

It can be concluded that active responsible buying practices correlate positively with supply risk management. However, differences in terms of risk type were found. The results of this study will help firm managers to understand the connection between responsible buying and risk management. It is important to recognize that the supply management function is responsible for the management of the firm's supply network and external resources, and thus, it has a key role in defining the origin of its raw materials and products. Good business relationships and thorough knowledge of supply market help supply managers to deliver company's CSR policy over the supply chain. Consequently, risks can be mitigated and the probability of the risk occurrence may decrease. Hence, there is a need to find innovative and proactive suppliers who are able to deliver green and sustainable solutions with a high orientation towards responsible business. The results also highlight the significance of determined buying practices and the compliance of those.

In the future it would be interesting in to examine what is the role of responsible buying in companies' risk management strategies and how it is incorporated into these strategies. Furthermore, because this study was limited only to Finnish companies and project business it is highly recommended to expand examination of the connections of responsible buying and business risk management to other countries and industries.

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USING ONLINE GEOCODING AND DIRECTIONS MAP SERVICES TO ENHANCE THE CAPABILITY OF ROUTE PLANNING AND MANAGEMENT SYSTEMS

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Abstract

Route planning for providing optimal transportation between offices and employees' residences for large organizations is a complex and challenging logistics problem when there are complex conditions and constraints involved. Effective route planning and management can help reducing operating costs. Typically, employees' address information, in most databases, is stored in the form of text. Route planning associated with geographical location data is; therefore, difficult to manage in such cases, plus it is difficult to generate clear, understandable results. If such text address data is converted into latitude-longitude coordinate data, the problem involving extensively uses of location data will be much more effective in finding and displaying results. Nowadays, there are various publicly available online map services that can be accessed via application programming interfaces from web applications. This paper is focused on developing a web application for route planning and management that accesses publicly available online map services in order to study efficiency and limitations of such online map services in the processes of geocoding and displaying the results on the maps; to be applied in a route planning system used by employees across nine provinces in the central region of Thailand.

Keywords

Route planning, route management, geographic information systems, online map services, geocoding

Introduction

Within an intensely competitive business environment, increasing revenues is difficult, and as a result, cost reduction becomes a key requirement of many business operations. Apart from production, there are other operations that affect overall costs, such as logistics. Effectively planning of employee transportations can help reduce logistics costs. The aim of this study was to design an effective employee transportation route planning system, while meeting required conditions. The factors that needed to be factored into the design included the duration of the longest trip made within the company, the number of vehicles and the distance from employees' homes to their destinations. It could be seen quite clearly that these journeys involve many coordinates, and so designing an application able to display geographical data would help improve information management, as well as the company's understanding of such information.

This paper describes the development of a web application, to be used to display spatial data for employee transportation route planning purposes. The development comprised three main steps, as shown in Figure 1. Step (1) involved converting employees' address information from the employee database, that stored in the form of text, into a latitude-longitude format, so as to be able to use such data as inputs for the route planning algorithms in subsequent step. The conversion of text addresses into latitude-longitude coordinates can be carried out by employing the geocoding technique. Nowadays, numerous online geocoding services are widely available, such as Google geocoding service, which was used in this case study. Step (2) used the latitude-longitude employee address coordinates and company locations to solve route planning problems, as the Vehicle Routing Problem (VRP), one designed to minimize the duration of journeys, from their starting points - taking into account stops - and on to the final destination. Details of the solution developed for this step are shown in (Jintawiwat, 2010). The results of the routing exercise were then stored in the database, to be used as part of a map display in step (3). During this step, Google Maps APIs (Google, 2012a) were used in order to enhance the effectiveness of the map displays and route information given.

This paper will discuss the details of the first and third steps shown in Figure 1, in which the first step involved converting the text addresses into latitude-longitude coordinates making use of the geocoding service, and the third step involved using online map services to display data within a web application. The details of step (2) are presented in (Jintawiwat, 2010).

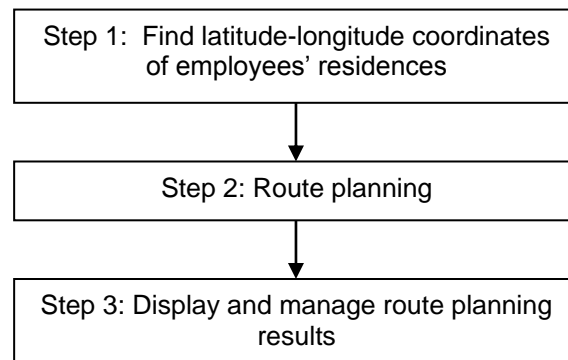


Figure 1: Main operating structure of the employee transportation route searching system

Geocoding

Geocoding involves converting geographical location data from text into latitude-longitude coordinates, and the effectiveness and accuracy of a geocoding service depends upon: (1) the completeness of the text address information to be used as an input, and (2) the size of the database of mapping data between the text addresses and latitude-longitude coordinates offered by a service provider. Currently, geocoding services are available in following three forms; (1) online geocoding services available for access via Application Programming Interfaces (APIs), such as Google Geocoding API, Microsoft's Bing Maps Geocode API, and MapQuest Geocoding API (Google, 2012b; Microsoft, 2012; MapQuest, 2012), (2) online geocoding services available for online access but not via API, and (3) stand-alone software package (Texas A&M University, 2012).

This case study employed the Google Maps API services, which feature a large amount of global address information which is updated regularly and consistently, resulting in high levels of accuracy, as well as good service reliability and stability. Also, API services are easy-to-use, high standard, with a wide variety of options. In addition, Google Maps API services are offered free of charge, assuming a maximum number of services are requested within a day, and the address information in a text string and latitude-longitude coordinates are returned in JavaScript Object Notation (JSON) form, or XML.

One advantage of employing the geocoding method to obtain latitude-longitude coordinates is its speed and its suitability for use with large data set, while obtaining coordinate information using other methods is difficult and costly. The usefulness of the coordinates data obtained by geocoding depends upon: (1) the completeness of the text address delivered to the geocoding service and its level of accuracy - which depends upon the level of completeness of the text address information, which should include the city, the postal code, the street, and the address point, and the last element is considered the most accurate result, and (2) the size of the mapping database held by the service provider containing the text address information and latitude-longitude coordinates, as the amount of data may vary in accordance with the density of a given community in a particular location (Roongpiboonsopita, 2010).

One disadvantage of geocoding is that errors may be produced due to a lack of mapping data – either text addresses and/or latitude-longitude coordinates in an area, or the density of mapping data is not high enough, which results in errors when converting the information into coordinates. For instance, if there is insufficient street information, a geocoding service will return the results as street centroids, or, in some cases, as city centroids (Roongpiboonsopita, 2010; Cayo, 2003)

Due to the high quantity of information used in this case study, the geocoding technique was seen as a suitable approach to use to obtain the required coordinates. The process for this step is shown in Figure 2, during which a web application retrieved the text address from the database, called the Google Maps API geocoding service, and received the results in the form of latitude-longitude coordinates, which were then stored in the database, to be employed by the company.

	A	C	D	E	F	G
1	033110	65 ม.6 ต.บางเจ้าฉ่า		โพธิ์ทอง	อ่างทอง	14120
2	057464	พหลก สดาร์เพลส ต.เชิงกรานน้อย		มาบะปิ่น	พระนครศรีอยุธยา	13180
3	070389	33 ม.10 ต.ต.ดงศรีน้อย		เกษตรวิสัย	ร้อยเอ็ด	45150
4	072183	5 ม.1 บ.หัวหนองแวง ต.หนองแวง		เกษตรวิสัย	ร้อยเอ็ด	45150
5	072539	97 ม.3 บ.หนองแวง ต.เกษตรวิสัย		เกษตรวิสัย	ร้อยเอ็ด	45150
6	106505	221/1 ม.2 ต.คลองจิก		มาบะปิ่น	พระนครศรีอยุธยา	13160
7	110664	218 ม. 15 ต.เหล่าหลวง		เกษตรวิสัย	ร้อยเอ็ด	45150
8	112595	173 ม.3 ต.ทุ่งทอง		เกษตรวิสัย	ร้อยเอ็ด	45150
9	113083	128/82 ต.บ้านเลน		มาบะปิ่น	พระนครศรีอยุธยา	13160

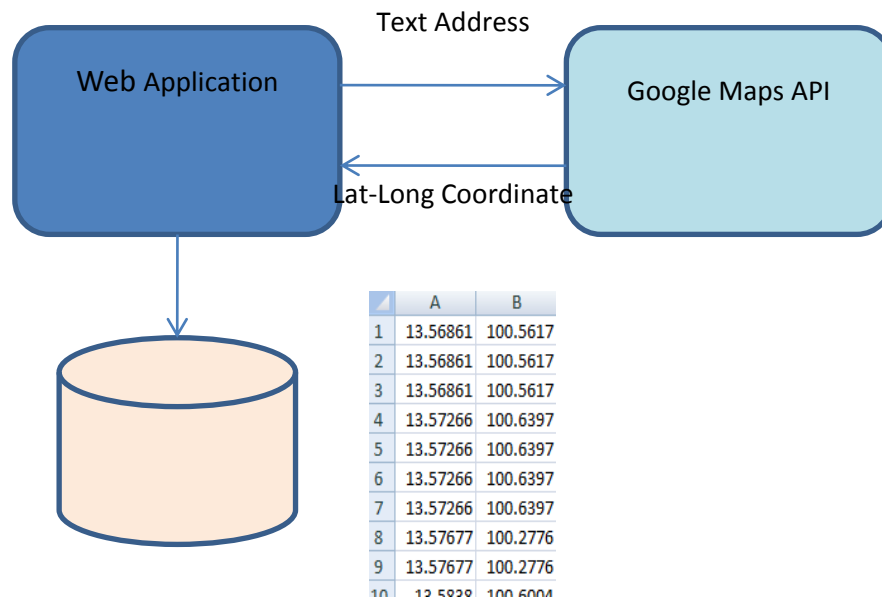


Figure 2: Use of the geocoding service to convert the text address information into latitude-longitude coordinates

Errors in geocoding process

As discussed, the results of geocoding may contain errors in terms of the latitude-longitude coordinates returned, depending upon the density of mapping and text data available for a given location in the database. Normally, the density of mapping data obtained from big cities is higher than from smaller cities and towns, leading to street centroids being returned as the geocoding results.

For the Thai data used in this study, in the Bangkok urban area the average error ranges between 10 and 30 meters - with a maximum error of approximately 200 meters. In the districts of other provinces, the average error lies between 100 and 200 meters - with a maximum error of approximately 500 meters, and in rural areas, the average error ranges from 200 to 500 meters - with a maximum error of approximately 800 meters

In rural areas, the high error level is due to low amounts of information and a low density of mapping data available in terms of both the text addresses and latitude-longitude coordinates. One solution that may be used to reduce the amount of error is to manually adjust the latitude-longitude coordinates one at a time, as shown in Figure 3. This method; however, is time consuming and so unsuitable when one has a large amount of information, and for users who are not familiar with the mapping data – a problem found in the case study company where many employees had difficulty understanding the information on the map.

Another method which might generate a higher level of accuracy would be to interpolate addresses from surrounding locations with more complete information using a keyword in the existing text address to search for a nearby location that contains more complete data.

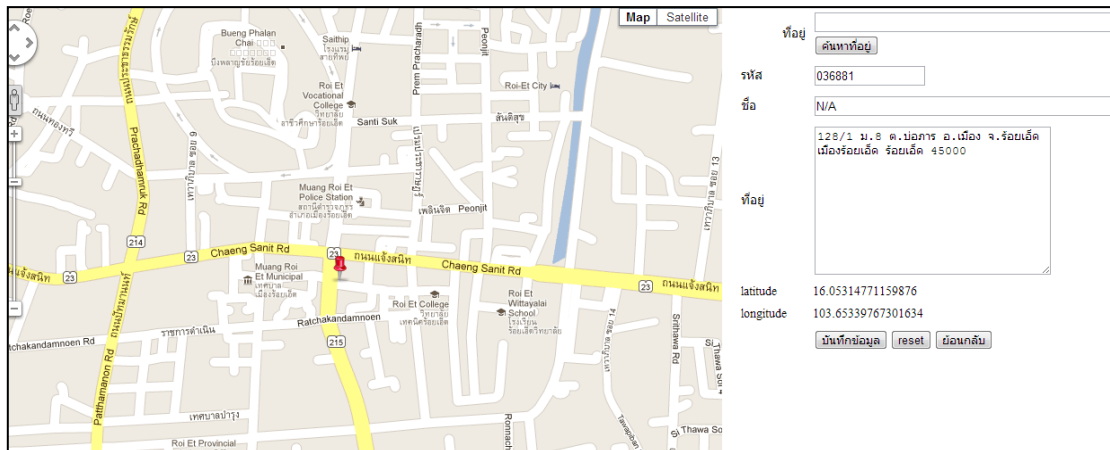


Figure 3 Adjustment of a location obtained by geocoding the text address to the right

Data employed in the case study

The data used in this study was the address information of 20,095 workers across 9 Thai provinces, these being: Phra Nakhon Si Ayutthaya, Bangkok, Pathum Thani, Nonthaburi, Saraburi, Nakhon Nayok, Ang Thong, Lopburi and Singburi. The case study company is located in Bang Pa-In district, Phra Nakhon Si Ayutthaya, as designated by the ⊗ symbol in Figures 4 to 6.

The distribution of the information used in the study was divided into the Bangkok area (21%), urban areas (65%) and rural areas in other provinces (14%), with an average error of approximately 100 meters, an error margin which allowed for primary routing.

After converting text address information into latitude-longitude coordinates, Google Maps API was then requested to display geographical data, as shown in Figure 4, which shows the location and density of employee address coordinates. This map helped to establish a better understanding of the dataset's dispersion.

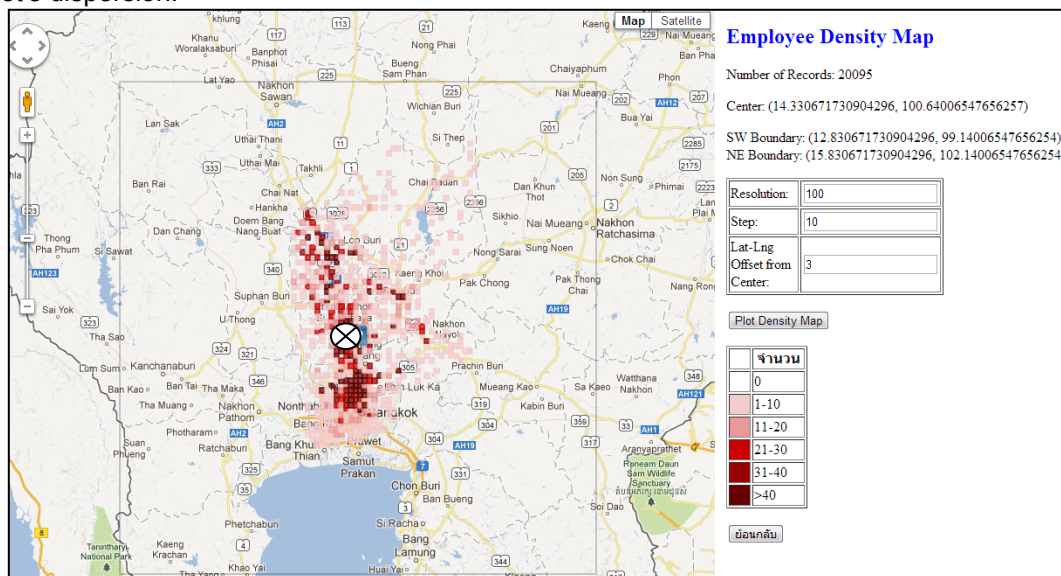


Figure 4: Location/density of employee address coordinates

The latitude-longitude coordinates of the employees' addresses and the company location could thus be used as inputs – to solve the routing problems; which consisted of two parts. The first part was used to carry out employee address clustering, so as to generate the stopping points, including the number of stops, the maximum distance from a residential address to a stop, and the average distance from a residential address to a stop. After the optimal stops were obtained, they were then used as inputs. The second part involved incorporating these stops into the routing planning system, based on the required conditions, these being the number of routes, the number of vehicles, and the maximum distance or duration of each route. The results of the route planning exercise were stored in the database, to be used for the display and management of the geographical information. There are three additional important database entities from the results in this step, these being the routes, the stops, and vehicles.

Figure 5 shows the results the routing results with the help of Google Maps API in displaying on the map. Within the system, the connections between stops along each route are estimated using a straight line - for ease and speed of display of the overall features such as stops, connecting lines between stops, and the farthest stop on each route. Figure 5 only shows stops along the route and the connecting lines between stops, while Figure 6 demonstrates the stops and a map of the results extracted from the clustering step - to find the optimal stops to use. When details of a route are required, users can click on a route and the appropriate details will appear, as shown in Figure 7.

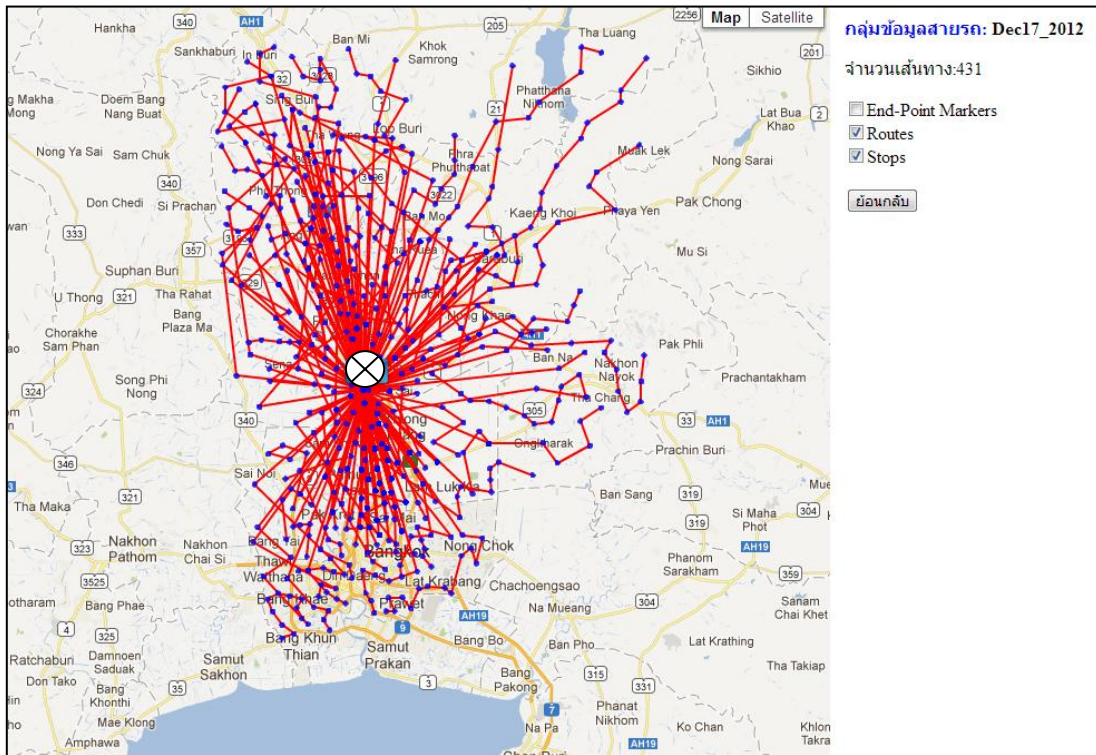


Figure 5: Geographical routing results displaying only the stops and connecting lines along the routes

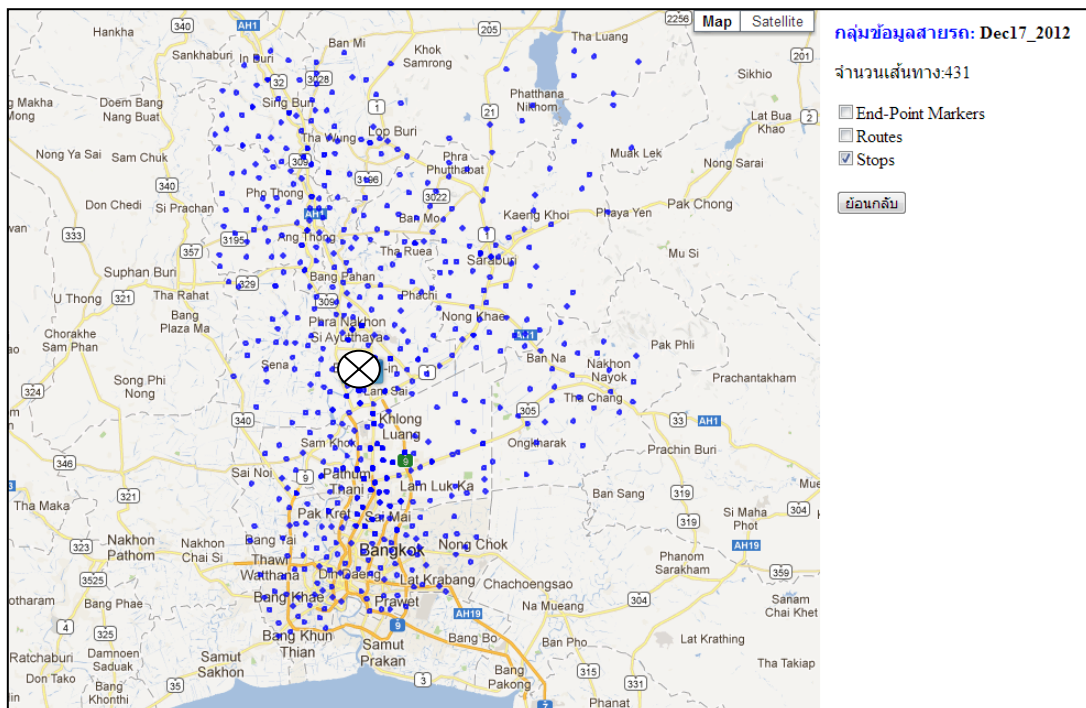


Figure 6: Geographical routing results displaying only the stops

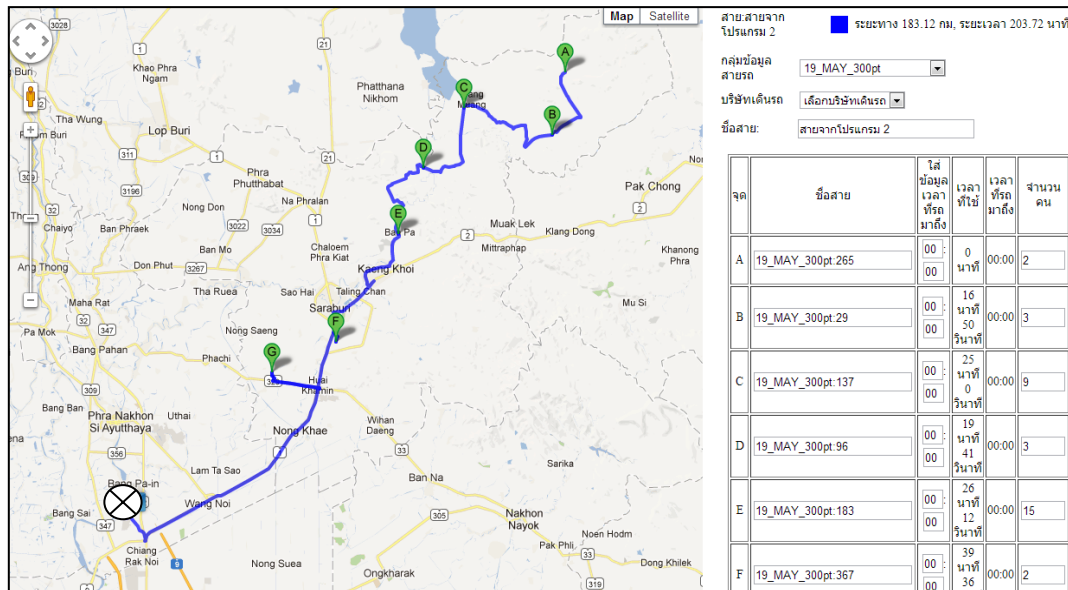


Figure 7: Sample transportation details for one route

Figure 7 shows the details of a specific route by making use of the directions service contained within the Google Maps API services, displaying the route that passes a specific set of stops along the chosen route. The directions service provides the distance between consecutive stops, and the time it takes to reach these stops, which is calculated by Google Maps API. The figures obtained can be used to estimate the time of arrival at each stop, assuming the departure time is set. Furthermore, the routes and stops can be adjusted and the directions service then re-calculates the new routes, and provides new distances and times. The results obtained can then be updated in the system, to allow the web application to schedule the optimum stops and routes. The distance of each route obtained from the directions service, incorporating the requirements to pass specific points, can be used to ascertain other information, such as the total distance of each route and the total fuel costs. The duration between stops along a route can also be used for timetable planning purposes, and to enhance the utilization of each vehicle.

It can be seen that the geographical data display will not only help improve the company's level of understanding of the routes used and help it to deal with route adjustments, but may also be used to generate other useful geographical information. For example, users may want to find the nearest stop along a route, or when to leave in order to reach a particular destination at a given time. It can therefore be seen that to search for information based on data held in the form of text, numbers and tables might prove difficult. In contrast, if such data is held on an appropriate map display system, as shown in Figure 8 (which demonstrates the nearest five stops), and used together with the Google Maps API directions service, users should be able to access information on the nearest stops, distances and estimated traveling times, including the arrival times of the next vehicle, along a given route. As can be seen, the map display, working in tandem with Google Maps API, can be used for a variety of tasks, and will result in higher route planning efficiency.

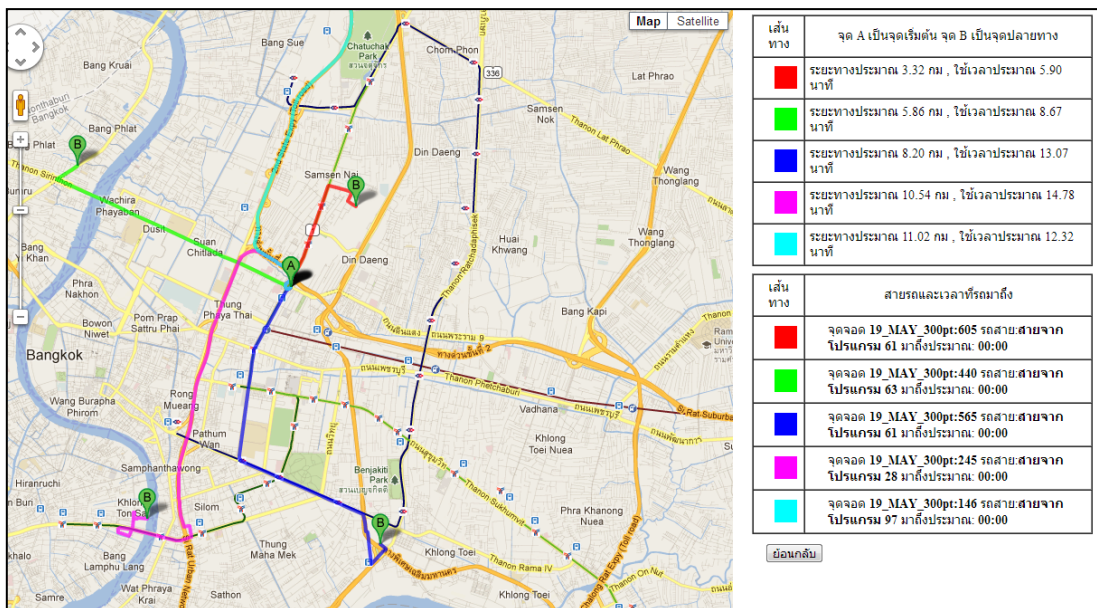


Figure 8: Search functions for the nearest stops along a route

Conclusions

This paper has given details of a solution developed in order for the study company to carry out more efficient employee route planning activities. The solution uses a web application connected to online map API services, and uses a geocoding service to convert text address information into latitude-longitude coordinates. The system also provides directions – to find what routes pass certain stopping points, and uses a map APIs to construct geographical data, so enhancing the efficiency of the mapping display and the management of information. Even though location information obtained from the use of geocoding services still contains errors, this paper illustrates the usefulness of an application used to resolve geographical problems making use of a publicly available online map services, one which can be employed easily and quickly, and still provide good results in terms of displaying mapping information, and that may be used as the framework for a primary solution to be developed, in this case by the study company.

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VULNERABILITY IN SUPPLY CHAIN RISK MANAGEMENT

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Introduction

Transportation and supply chains have become the focal point of many firms trying to improve competitiveness in an increasingly global marketplace. Global supply chains are comprised of a multitude of companies acting as part of a long and complex, logistics system that is increasingly vulnerable to various disturbances (Wagner and Neshat, 2010; Vilko, 2012). The length and complexity of supply chains derive from the many parallel physical and information flows in place to ensure that products are delivered in the right quantities, to the right place, in a cost-effective manner (Jüttner, 2005). The increased length and complexity of transportation chains is attributable to globalization, the development of communications and other technologies, e-business, complex international networks of industrial partners, unpredictable demand, cost pressures, outsourcing, reliance on suppliers, international governmental intervention and more lean and agile logistics; such complexity, in turn, drives supply chain vulnerability (Waters 2007; Craighead et al., 2007; Harland et al., 2003; Hult, 2004; Mason-Jones et al., 2000; Narasimhan and Talluri, 2009; Thun and Hoenig, 2009, 2011; Brindley, 2004).

Transport logistics have become increasingly significant in an era of international trade (Beresford et al. 2011). Although logistics were previously considered to be purely operational by nature, nowadays it can be considered a strategic issue for many organizations (Gattorna, 1998; Frankel et al., 2008). There are currently more than two billion containers delivering cargo globally, and this choice of transport mode, or combination of modes, may have a direct impact on the efficiency of a supply chain (Hu, 2011; Beresford et al., 2011). In order to be competitive companies are leaning towards complex logistic networks that act more as an extension of the core competitive advantage. In doing this, supply chains are becoming more agile with a view of getting products to customer more quickly and at a minimum total cost (Gunasekaran et al., 2006). Thus, it becomes clear that the level of logistics service provision can determine how competitive an organization is and whether it will retain its customers or attract new ones (Oflac et al., 2012).

The transportation system has increased inter-organizational dependency and inter-organizational relationships have become increasingly important (Soosay et al., 2008). Integrated and seamless logistics can play a crucial role in facilitating global transportation processes (Banomyong, 2005). Yet, in practice, greater integration increases dependency between companies, which can have the undesirable effect of increasing vulnerability. Organisations, therefore, need to understand and analyze the causalities of network processes in order to ensure that the goals of the supply chain fit with their own organizational strategy. It is essential that actors collaborate and share information in their network in order to avoid interruptions in logistic flows (Edwards et al., 2001; Svensson, 2001).

It is clear from the above example that logistics is undergoing continuous, considerable and rapid changes with a primary focus on supply chain vulnerability (Frankel et al., 2008). For the past decade, scientific discussion has focused on supply chain risk management, and while some scholars (e.g. Peck, 2005; Sheffi, 2005) have contributed on the issue of vulnerability, in the context of supply chains, it has received only limited attention. Therefore this paper aims to give light to the supply chain vulnerability by illustrating the factor when using discrete-event-based simulation as an analysis method. The paper continues by presenting the relevant theoretical concepts. Thereafter, different focuses for using simulation in supply chain vulnerability are introduced and then followed by the simulation analysis. Finally, concluding discussion is presented.

Theory

This section of the paper presents the main concepts, namely: supply chain, vulnerability and risk and supply chain risk management and analysis in terms of transport logistics.

Supply chain, vulnerability and risk

A supply chain is defined as a system of suppliers, manufacturers, distributors, retailers and customers in which material, financial and information flows connect participants in both directions (Fiala, 2005). According to Lambert et al. (1998), supply chains consist of networks of structures, processes and management components that provide the linkages between supply and demand. Meanwhile, Waters (2007) describes a supply chain as consisting of a series of activities and organizations through which material moves on its journey from initial suppliers to final customers. Material can include everything that an organization moves—both tangible and intangible.

To define supply chain vulnerability it is essential to first examine the characteristics of risk. Risks can be defined in a multitude of ways, as found in literature. Waters (2007) defines risks as a threat that something might happen to disrupt normal activities, which stop things happening as planned. Finance-related literature views risks in terms of probabilities of expected outcomes (Beaver, 1966). This point of a view is probably the oldest one known, as it was used for insuring merchant ships hundreds of years ago. In strategy literature, risk is used to adjust rates of capital return of investment (Christensen and Montgomery, 1981), variability of expected and actual returns (Bettis, 1981), risk of strategic actions and relational risks (opportunism, cheating, stealing from customers, etc.) (Baird and Thomas, 1985; Bettis and Mahajan 1985; Manuj and Mentzer, 2008). Marketing literature views risks as concerned with the nature and importance of buying goals and failure of meeting psychological or performance goals (Cox, 1967; Manuj and Mentzer, 2008).

Other literature defines risk as purely negative and sees it leading to undesired results or consequences (Harland et al., 2003; Manuj and Mentzer, 2008). A standard formula for the quantitative definition of supply chain risk is:

$$\text{Risk} = P \times I \quad (1)$$

where P is probability of risk event and I is impact of the risk event (Mitchell, 1995).

Hetland (2003) and Diekmann et al. (1989) view risk as an implication of the phenomena of being uncertain. The difference, however, is explained by Waters (2007), who states that “the key difference is that risk has some quantifiable measure for future events, uncertainty does not”. Trkman and McCormack (2009) classify uncertainty into two categories: endogenous and exogenous, whether they are deriving from within or outside the supply chain. The supply chain risk can be considered as originating from any unwanted event that concerns the material, information or cash flow from the initial supplier to the end customer. Risks can arise from organizations, from supply chain partners, or from the external environment (Waters, 2007). How sensitive a supply chain is to these disturbances is measured by its vulnerability.

According to Wagner and Bode (2006, p. 304), “supply chain vulnerability is a function of certain supply chain characteristics, and the loss a firm incurs is a result of its supply chain vulnerability to a given supply chain disruption”. Asbjørnslett (2008) defines vulnerability as “the properties of a supply chain system; its premises, facilities and equipment, including human resources, human organization and all its software, hardware, net-ware that may weaken or limit its ability to endure threats and survive accidental events that originate both within and outside system boundaries.” Previous definitions have differed somewhat from this. For example, Peck (2005) describes vulnerability as an “exposure to serious disturbance, arising from risks within the supply chain as well as risks external to the supply chain.” Furthermore, according to Waters (2007), “supply chain vulnerability reflects the susceptibility of a supply chain to disruption and is a consequence of the risks to the chain”. Jüttner et al. (2003) describes supply chain vulnerability as the propensity of risk sources and risk drivers to outweigh risk-mitigating strategies, thus causing adverse supply chain consequences and jeopardizing the supply chain’s ability to effectively serve the end customer market. Synthesising from the previous definitions found in the literature, we define supply chain vulnerability as the supply chain system’s exposure to unwanted and unexpected risk events that originate both within and outside the supply chain system.

According to Asbjørnslett (2008) the difference between vulnerability analysis and risk analysis comes from the focus of the analysis. While vulnerability analysis focuses on the more holistic supply chain perspective in terms of system mission and security of supply, risk analysis focuses more on the impacts of individual events. When examined from a quantitative perspective, the difference between

risk and vulnerability comes from the exposure-element; here we define the supply chain vulnerability formula as follows:

$$\text{Vulnerability} = P \times I \times E \quad (2)$$

where P is probability of a risk event, I is the impact of the risk event and E is the exposure to the risk.

In reality, when considering supply chain vulnerability, the actors can better affect the probability of a risk event when they have control over the operations (risk coming inside the supply chain) or affecting the exposure to the risk events (risk that comes from outside the supply chain). Thus, when analyzing the proper responses to supply chain vulnerability, the origin of the risk event needs to be taken into account.

Using simulation as a method for vulnerability analysis

Complete understanding of the consequences of a risk is impossible to analyze. Basically we are always acting with limited and uncertain data that offers only a limited view of the vulnerabilities facing a complex supply chain system. In many cases, supply chain information sharing is limited, which can hinder visibility of the vulnerabilities and processes in the supply chain. In these cases, the focus of the analysis method (in here simulation) has to be carefully selected in order to obtain relevant results. By selecting proper focus for analysis, the accuracy of the assessment can be improved, yet on the other hand, when trying to optimize the system where not enough information is available of a complex supply chain system, the results cannot be considered reliable. Thus, an organization can waste resources by trying to get too rigorous results.

There are several factors contributing to the success of vulnerability analysis, such as the personal skills of the logistics managers and the availability of software. However, essentially the accuracy of the analysis is based on the data, namely the amount (and availability) of it and the quality of. In terms analysing and managing supply chain vulnerability, supply complexity defines the focus of the simulation. Thus, these categories are used to illustrate the simulation focus in Table 1.

The available information is divided into two categories: High amount of data with low uncertainty and to the low amount of data with high uncertainty. The left column of the Table illustrates the level of complexity inherent to the supply chain system. It is divided into two categories, namely high and low.

	High amount of data with low uncertainty	Low amount of data with high uncertainty
Low complexity of the supply chain	Optimization	Estimation
High complexity of the supply chain	Structures	Causalities

Table 1: Simulation focus in supply chain risk management

Illustrative example

In this section we present a simulation study where simulation is used to give some estimations about the performance of a potential supply chain. The case consists of off-shore supply with a long lead-time (30 days) to a central warehouse, which in turn feeds five local warehouses. The supply chains has been illustrated in **Figure 1**. However, it is not well known what kind of delays might exist from the off-shore supplier. As such, the supply chain is simulated with predefined operation policies but the potential disruption are given different likelihoods, as well as, lengths.

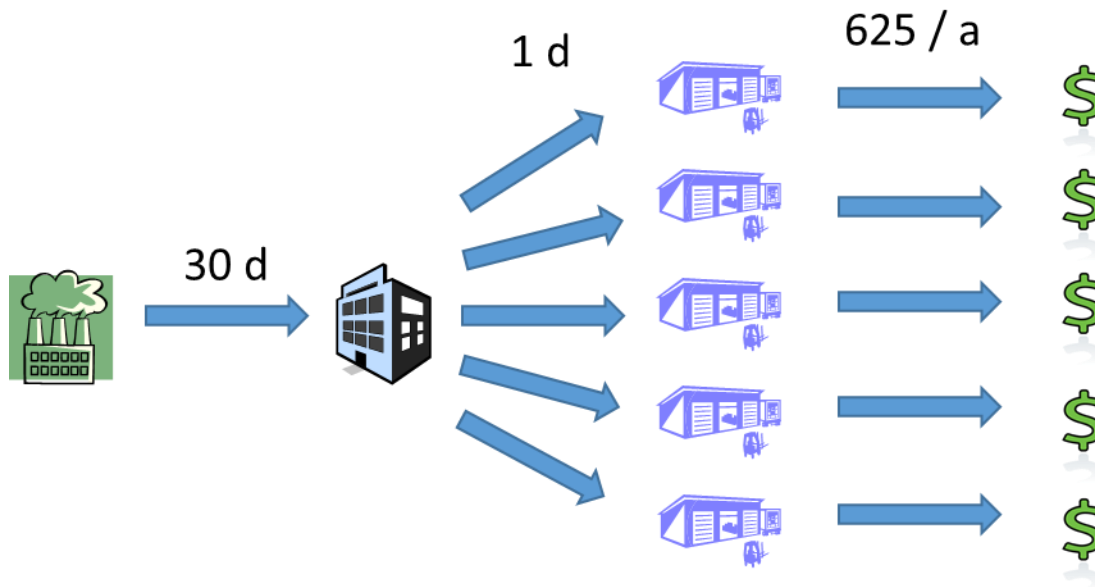


Figure 7: The analyzed supply chain.

The central warehouse has a maximum stock of 1000 units and will order in lots of 250 units from the supplier. The local distributors, on the other hand, have a maximum stock of 65 units and orders with a lot size of 50 units. The delay from the off-shore supplier is 30 days to the central warehouse while the delivery delay to the local distributors is only one day. The demand for the local distributors is stochastic following a basic poisson process with an annual demand of 625 units.

The disruptions occur between the off-shore supplier and the central warehouse. Each time a delivery is made from the supplier to the warehouse, the system randomizes whether a disruption occurs. If the disruption occurs, the delivery is delayed by a fixed amount. With the simulation model we use different chances for the delay and different lengths for the disruptions.

The simulation model was constructed using Anylogic. The basic connections are presented in **Figure 8**. The stock of the central warehouse contains all of the goods in the warehouse. Whenever a sale is made at a distributor, it will send this information to the central warehouse. The warehouse then releases a unit for the specific distributor and moves them into batching operation, where the unit waits until a full lot is ready. After this the goods are delivered to the distributor. A similar connection exists between the central warehouse and the off-shore supplier.

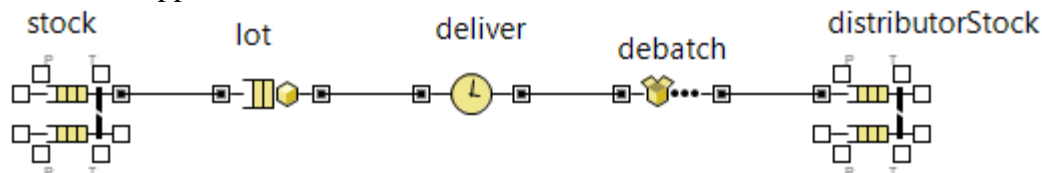


Figure 8: Basic connections in the simulation model.

The simulation model will calculate the total costs of the system. These include the total warehousing costs, total delivery costs, as well as the cost of lost sales. These values will depend on different parameters and they are presented in Table 2.

Variable	Value
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Warehousing cost	\$ 200 / year per unit (25% warehousing cost)
Cost of lost sales	\$ 1000
Fixed ordering cost for distributor	\$ 500
Fixed ordering cost for central warehouse	\$ 4000

Table 2: Simulation parameters

Results of the model

The supply chain was analysed with 10 different likelihoods of disruptions and 8 different lengths for the disruptions. The model had a warm up period of 1000 weeks and the simulation period was 520 weeks. A long simulation period was used to smooth out the disruptions in the results of the simulation model. We finally divided the total costs with 10 to come up with a yearly cost for the whole supply chain. Overall all different options were run for 100 times and the average values are used. Final results of the model are presented in Figure 3.

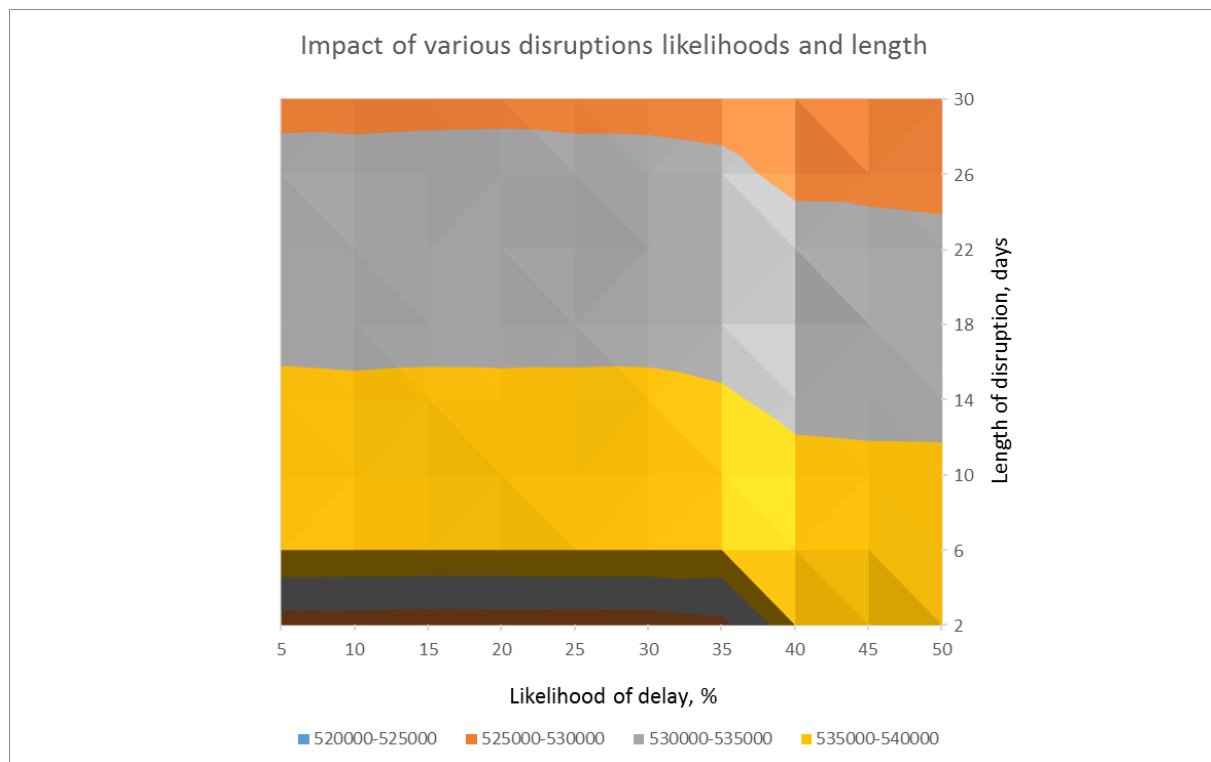


Figure 9: Basic connections in the simulation model.

The performance of the supply chain clearly depends on these disruptions. With the current ordering policy, the likelihood of the disruption has an impact if the disruption likelihood goes over 35 percent. Anything between 5 and 35 % has similar results. On the other hand, if the length of the disruptions are long (30 days), the costs of the supply chain are lower than with a disruption with a length of 6 days. This indicates that the chosen ordering policy leads to too high warehouses and the organization should lower them. The exposure to the risks is possibly too low and it leads to excessively high costs in most cases.

The same simulation model could be used later to optimize the performance of the supply chain when more information becomes available. If the likelihood of the disruptions would be

known, as well as the length of the delay, the organization could use the simulation model to optimize the performance of supply chain. However, in the current state this would not be possible as the disruptions most likely have a bigger impact on the results when the lot sizes would be decreased.

Concluding discussion

Supply chains have become increasingly important to the global economy. Numerous trends have affected the development of complex logistic systems during the last decade, and many of those trends have also exposed the supply chains to various risks, making them more vulnerable than ever before (Wagner and Nethat, 2011). In many ways, coping with this vulnerability is still in its infancy. Assessing the vulnerability of an international supply chain has proven difficult. In order for decision makers to properly make these assessments, managers need to have a proper meta-level understanding of the problem domain.

This paper aims to increase the understanding of the current level of knowledge over vulnerability analysis by a twofold contribution: firstly, we improve the clarity of the current academic discussion of the topic of vulnerabilities in supply chain risk management by taking into account both the risk and exposure elements and by illustrating the impact of those in a simulation. Secondly, we put forward a managerial framework for choosing proper vulnerability analysis methods using available data.

The understanding of the causalities at the theoretical and practical levels is essential in order to properly analyze vulnerabilities. As a part of supply chain risk management, the conceptual maturity of supply chain vulnerability is still very much developing. Our scientific contribution is drawn from synthesizing previous literature (e.g. Asbjørnslett, 2008; Peck, 2005; Waters, 2007; Wagner and Bode, 2006) and building our own definition of supply chain vulnerability. In doing this, we aim to improve the conceptual clarity by using a differentiating element - exposure - in supply chain vulnerability.

In order to analyse the supply chain vulnerabilities properly the supply chain's operations and risks need to be identified by the actors involved. The importance of a comprehensive view is vital especially in the case of long and complex supply chains where there are several different modes of transportation in different environments that reflect the variation in vulnerability with different exposure to some risks and different probability of other events occurring. In order to attain a comprehensive view of the supply chain, extensive knowledge about the different phases of operations is required. In this study we utilized a simulation model as they can grasp dynamic and stochastic behavior, as well as provide confidence intervals about the performance of the whole supply chain, not only individual parts of the complex supply chain system.

Simulation is a multipurpose tool and is suitable in order to analyze complex supply chains. The more complex the supply chain, the more difficult it is to optimize all parts of the supply chain. However, simulation can be used to look for optimal structures, e.g. a supply chain design which should fit well with environment and products involved. Even in cases with a small amount of unreliable information, simulation can provide insights into the causalities which exist between different parts of the supply chain. In this study we presented how simulation can be used to gain some estimates about the performance of a hypothetical supply chain even with a limited amount of information. Choosing the correct method to utilize simulation should help managers make more informed decisions regarding supply chain risk management.

In reality it is virtually impossible to list every conceivable risk, and identification gives a list of the most significant risks that have an effect on the supply chain. Inter-organizational employees typically have the most intimate knowledge of the organization and its conditions, but not necessarily the capability to identify risks (Waters, 2007). This illustrates the benefits of having a holistic perspective, which is also essential for supply chain vulnerability analysis. By understanding the importance of using the appropriate focus with the information organizations are able to more efficiently benefit from the risk management practice. Thus, organizations can achieve a competitive advantage from engaging in effective risk management, especially when acting in high-risk environments, by appropriately focusing their risk management efforts according to relevant vulnerabilities.

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Course Requirements >>>

Core Courses

3 Courses (9 Credits)

- DB 801 Advanced Statistical Analysis (3 Credits)
- DB 802 Advanced Economics (3 Credits)
- DB 803 Econometrics I (3 Credits)

Major Course: Accounting Series

4 Major Courses (12 Credits)

- DB 811 Research Methodology (3 Credits)
- DB 812 Empirical Capital Market Based Research in Accounting (3 Credits)
- DB 813 Judgment and Decision Making Research in Accounting (3 Credits)
- DB 814 Archival and Survey Research in Accounting (3 Credits)

2 Elective Courses (6 Credits)

Selected from the other courses in Accounting Series and/or courses approved by the Ph.D. Executive Committee

Major Course: Finance Series

4 Major Courses (12 Credits)

- DB 821 Econometrics II (3 Credits)
- DB 822 Financial Economics (3 Credits)
- DB 823 Financial Theory (3 Credits)
- DB 824 Corporate Finance (3 Credits)

2 Elective Courses (6 Credits)

Selected from the other courses in Finance Series and/or courses approved by the Ph.D. Executive Committee

Major Course: Marketing Series

4 Major Courses (12 Credits)

- DB 811 Research Methodology (3 Credits)
- DB 831 Marketing Theory and Practice (3 Credits)
- DB 832 Advanced Consumer Behavior (3 Credits)
- DB 833 Marketing Decisions Modeling (3 Credits)

2 Elective Courses (6 Credits)

Selected from the other courses in Marketing Series and/or courses approved by the Ph.D. Executive Committee

Admission Information >>>

Admission Criteria

Admission to the program will be based on the Admission Committee's careful evaluation of the applicant's qualifications.

Master's degree requirement

Applicant must hold a Master's degree in related field.

Interview

Applicant must show strong commitment, strong research capability, and ability to communicate in English.

Research Proposal

Only an applicant enrolling for plan I has to submit a research proposal in area of interest and the Ph.D. executive committee will consider and suggest the dissertation advisor who might be interested in the proposal.

Admission Requirements

- 1) A TU-GET score of 550 or TOEFL score of 550 (paper based), 213 (computer based), 79 (Internet Based) or IELTS score of 6.0 taken within 2 years on the application date.
- 2) A GMAT score of 550 or GRE score of 1100 (verbal and quantitative parts) or SMART II score of 600 (minimum of 250 for each part) or satisfactory level score of Graduate Program Admission Test taken within 5 years on the application date.
- 3) Three letters of recommendation
- 4) A statement of intent to pursue a Ph.D. degree
- 5) The Research Proposal (for application to Plan I)

Tuition Fees and Expenses

Tuition and general fees are approximately 230,000 Baht per annum.

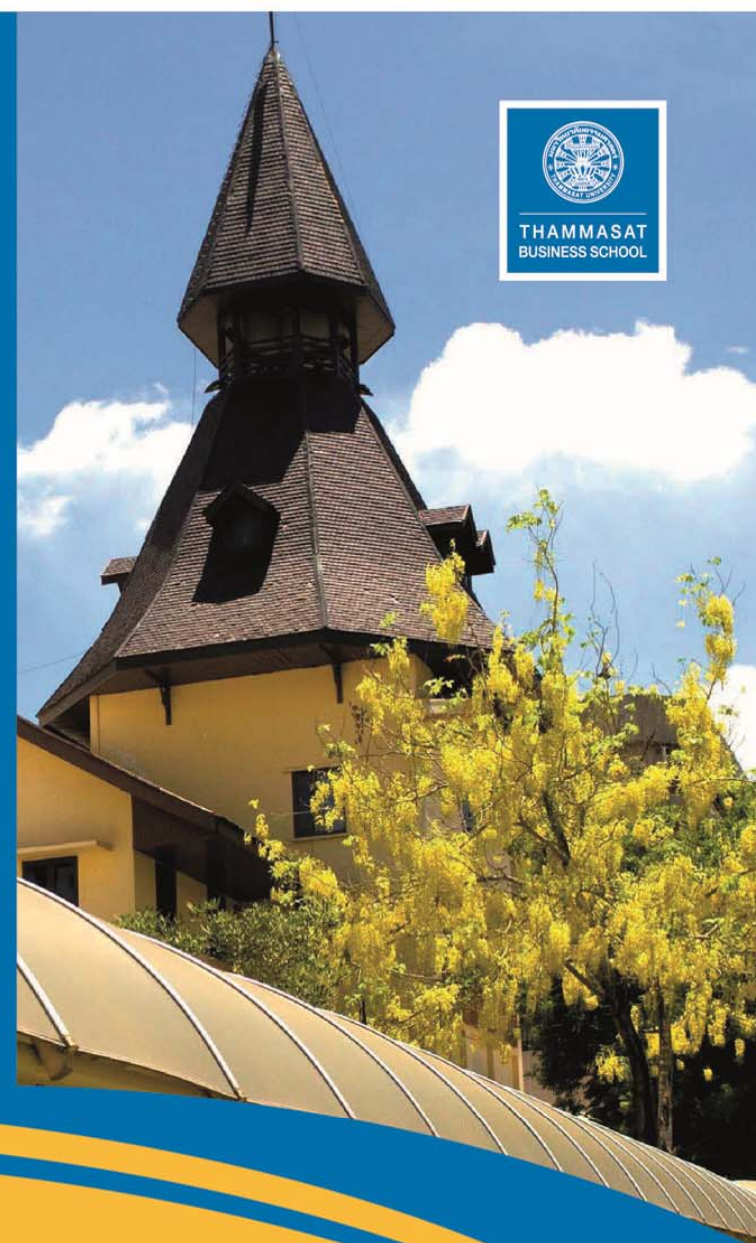
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PhD

DOCTOR OF PHILOSOPHY PROGRAM
IN BUSINESS ADMINISTRATION



Master of Engineering (M.Eng.)
Logistics Engineering and Supply Chain Management
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(หลักสูตรสอนภาษา)

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Faculty of Engineering
Chiang Mai University

Duration:

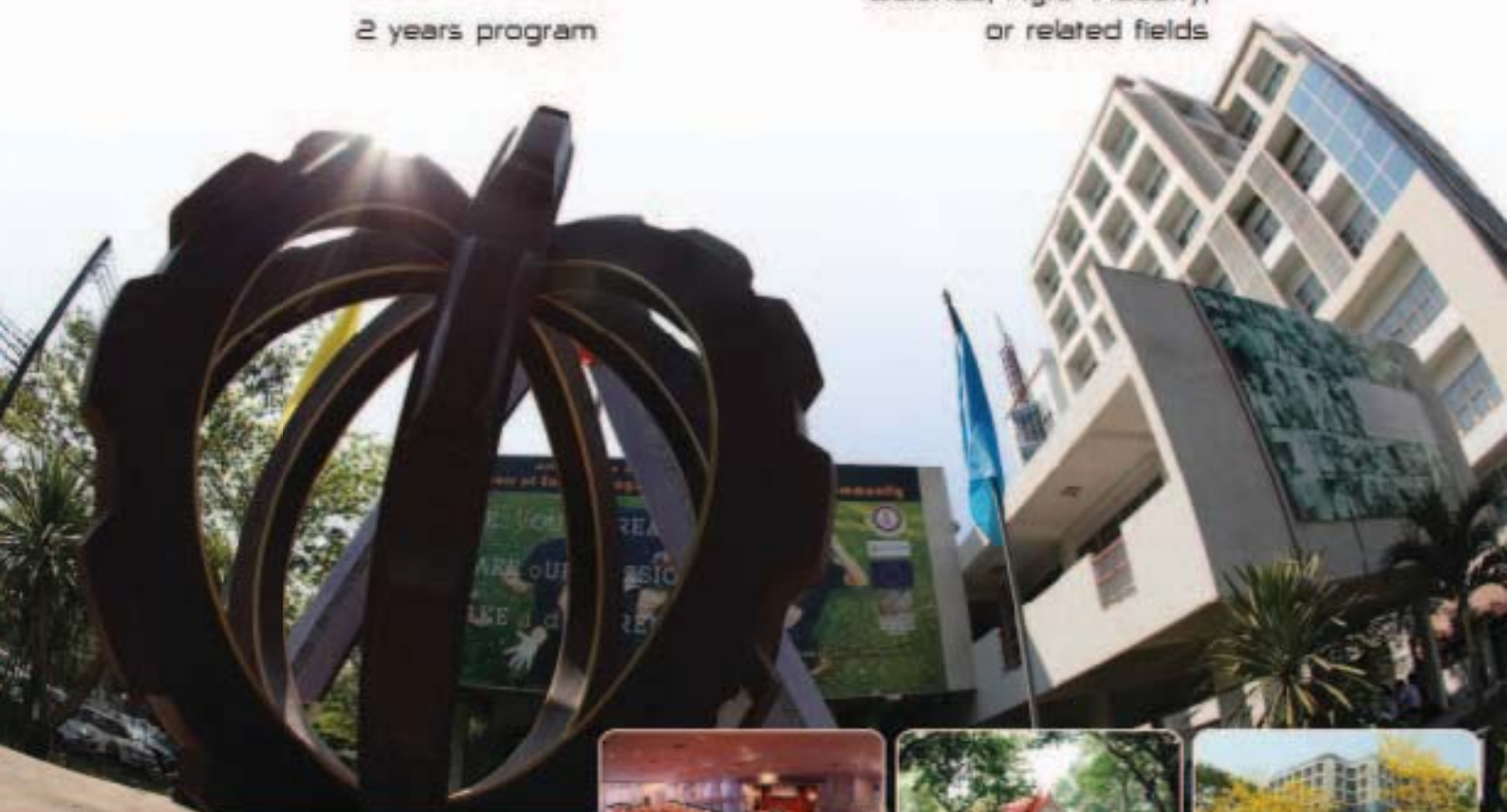
2 years program

Language:

Bi-Lingual (Thai and English)

Qualifications:

Bachelor Degree in Engineering,
Science, Agro-industry,
or related fields



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For more information:

Contact K.Sudarath Kaewsangjal
Industrial Engineering Department Faculty
of Engineering Chiang Mai University
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