NORTHEAST ASIAN CONTAINERISED MARITIME LOGISTICS: SUPPLY CHAIN COLLABORATION, COLLABORATIVE ADVANTAGE AND PERFORMANCE

by

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ABSTRACT

This thesis aims to develop and validate the dimensions of supply chain collaboration and collaborative advantage in the containerised maritime industry and explores the impact of supply chain collaboration on collaborative advantage and port performance. Additionally, this thesis tests a mediation effect of collaborative advantage on the relationship between supply chain collaboration and port performance.

This thesis employs a quantitative method. A theoretical model is built based on thorough literature reviews of supply chain management and maritime studies, in-depth discussions with experts, item review and Q-sorting techniques to signify ambiguity or misunderstanding with the scales and to suggest modifications. The proposed model is empirically tested with survey data using 178 responses from terminal operators, shipping lines, inland transport companies, freight forwarders, ship management companies and third-party logistics providers involved in maritime logistics in the major containers ports of Busan, Gwangyang and Incheon for a comprehensive and balanced view by using structural equation modelling.

With regard to the findings of the empirical research, three main constructs were successfully validated as multi-dimensional constructs. The structural paths support hypotheses that supply chain collaboration has a positive influence on collaborative advantage, and collaborative advantage has a strong contribution to port performance. However, the direct impact of supply chain collaboration on port performance is insignificant. A hierarchical approach of the mediation test and bootstrapping test found that the association between supply chain collaboration and port performance is fully mediated by collaborative advantage. In other words, the greater degree of supply chain collaboration between the port and port user enables them to gain a higher degree of collaborative advantage, and, in turn, this collaborative advantage can contribute to augmenting port performance.

This thesis synthesises transaction cost theory, resource based theory and a relational view to explain how supply chain collaboration influences collaborative advantage and port performance. Its theoretical contribution expands the concept of supply chain collaboration and collaborative advantage into containerised maritime contexts, capturing the perspective of the ports and port users. Further, despite numerous maritime studies which extol the importance of collaboration between the ports and port users, no systematic approach has previously developed and validated those constructs and relationships.

The various maritime logistics organisations would benefit from applying the results of this study to their supply chain collaboration practices when seeking greater collaborative advantage. The results heed practitioners in containerised maritime logistics organisations to focus on balancing the facets of supply chain collaboration to transport flows of containers seamlessly and efficiently from door-to-door, as supply chain management philosophy drives the maritime logistics industry to become more integrated into shippers' supply chains.

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LIST OF ABBREVIATIONS

Abbreviations	Full words
3PL	Third-Party Logistics provider
ADF	Asymptotic Distribution-Free
AGFI	Adjusted Goodness-of Fit Index
AHP	Analytical Hierarchy Process
AMOS	Analysis of Moment Structures
APEC	Asia Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
AVE	Average Variance Extracted
BS	Business Synergy
CA	Collaborative Advantage
CC	Collaborative Communication
CE	Cost Efficiency
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CPFR	Collaborative Planning Forecasting and Replenishment
CPU	Convenience of Port User
CR	Continuous Replenishment
CR	Composite Reliability
CTM	Collaborative Transportation Management
CV	Connectivity
DH	Decision Harmonisation
ECR	Efficient Consumer Response
EDI	Electronic Data Interchange

EFA	Exploratory Factor Analysis
EO	Efficient Operation
EU	European Union
FEU	Forty-foot Equivalent Unit
FF	Freight Forwarder
FL	Flexibility
GATT	General Agreement on Tariffs and Trade
GFI	Goodness-of-Fit Index
GS	Goal Similarity
ICT	Information and Communication Technology
IMO	International Maritime Organization
IN	Innovation
IS	Information Sharing
IT	Information Technology
ITC	Inland Transport Company
JIT	Just-In-Time
JPM	Joint supply chain Performance Measurement
KC	Knowledge Creation
KIFFA	Korea International Freight Forwarders Association
KMO	Kaiser-Meyer-Olkin
KPLA	Korean Port Logistics Association
KSA	Korea Shipowners' Association
M&A	Mergers and Acquisitions
MAUT	Multi-Attribute Utility Technique
MERCOSUR	MERcado COmún del SUR (Southern Common Market)
ML	Maximum Likelihood

MLO	Maritime Logistics Organisation
NFI	Normed Fit Index
NAFTA	North American Free Trade Agreement
OEM	Original Equipment Manufacturer
PNFI	Parsimony Normed Fit Index
PP	Port Performance
QL	Quality
R&D	Research and Development
RBT	Resource Based Theory
RL	Reliability
RMR	Root Mean square Residual
RMSEA	Root Mean Square Error of Approximation
RV	Relational View
RNI	Relative Non-centrality Index
SCC	Supply Chain Collaboration
SCM	Supply Chain Management
SCOR	Supply-Chain Operations Reference
SEM	Structural Equation Modelling
SL	Shipping Line
SMC	Ship Management Company
SRMR	Standardised Root Mean Residual
SS	Safety and Security
T Coefficient	Target Coefficient
TCT	Transaction Cost Theory
TESCI	seaport Terminal Supply Chain Integration
TEU	Twenty-foot Equivalent Unit

TLI	Tucker Lewis Index
TO	Terminal Operator
VAS	Value-Added Service
VICS	Voluntary Inter-industry Commerce Standards
VMI	Vendor Managed Inventory
WTO	World Trade Organisation

AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

Papers have been published and presented by the author including:

Publications-Journal Papers

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2. Young-Joon Seo, John Dinwoodie, and Michael Roe, "Measures of supply chain collaboration for container logistics", ***Maritime Economics and Logistics*** (Forthcoming, Accepted).
3. Hee-Yong Lee, Young-Joon Seo, and John Dinwoodie, "Does supply chain dynamism moderate the association between supply chain integration and supply chain performance?", ***Supply Chain Management: An International Journal*** (Under review).
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Chapter 1. Introduction

The primary objective of this chapter is to introduce the research background and shape the research objective in order to provide an overview. In addition, the research methodology the study adopted is briefly introduced. The final section shows the research structure to outline the whole steps of this study.

1.1 Research background

Globalisation, increased international trade and shorter life cycles of products and technologies have redefined maritime logistics. Developments in logistics and supply chain management (SCM) have induced global outsourcing, which has stimulated relocation of production facilities offshore to economies with low labour costs. Global outsourcing has stimulated increased movements of cargo, international procurement and new distribution strategies in multi-national companies. A preference for door-to-door services has prompted maritime logistics organisations (MLOs) including shipping lines and third-party logistics providers to accept responsibility for transporting container cargoes door-to-door and to assume increased SCM functions. In ports, terminal operators play an important role in integrating global supply chain systems (Song and Panayides, 2008). Given the complexities of maritime logistics, supply chain collaboration (SCC) now underpins smooth cargo movements in supply chains. However, ports exhibit differing levels of SCC, and offer shippers varying levels of supply chain performance. In many port supply chains, an enhanced capability to practice SCC could also enhance their competitiveness.

Although SCC underpins effective SCM, it is insufficiently developed both academically and practically. Firms tend to rely on SCC to develop and augment their supply chain capabilities and operational performance by adopting goals often centred on supply chain efficiency (Min *et al.*, 2005). When manufacturers adopt new practices, maritime logistics providers must in turn reconsider their practices and adapt their business activities to satisfy manufactures as their main and final consumers. The logistics provider should not only concern itself with its transport operations at low cost, but also optimise the value of the supply process as a whole, not just transport within the SCM context (Mason *et al.*, 2007). Recent philosophical developments in SCM have reshaped transport and logistics chains, engendering closer collaborative management between ports and port users in which transportation and logistics is a key component (UNCTAD, 2004).

SCC engages both MLOs and final customers, but current measures fail to measure either its entirety or its multi-faceted nature. Despite the fact that developing measurement of the construct is at the heart of theory building and of paramount importance (Venkatraman, 1989, DeVellis, 1991), they have been often been lacking in maritime studies (Woo *et al.*, 2011b). MLOs have only recently adopted SCC concepts, seeking to generate synergies by converging their interests to augment reliability, services and productivity in their port supply chain (Carbone and Gouvernal, 2007). Measures of SCC in maritime logistics are urgently required to offer organisations a self-diagnostic tool to assess proactively in cases where they need to undertake SCC practices or they seek operational and strategic movements involving SCC. Despite numerous studies which have stressed the importance of collaboration between port supply chain members (Frankel, 1999, Carbone and De Martino, 2003, Paixão and Marlow, 2003, Bichou and Gray, 2004, UNCTAD, 2004, Paixão and Marlow, 2005, Carbone and Gouvernal, 2007, Panayides and Song, 2008, Song and Panayides, 2008, Panayides and Song, 2009, Heaver, 2011, Heaver, 2014), no systematic approach to develop and validate SCC scales in containerised maritime sectors has been presented. From the maritime academics' perspective, SCC measurements are required to expand theory.

From the perspective of strategic management, firms have focused only on competition and competitive advantage to achieve their own profits. The important fact that a firm is connected to other firms to interact with has been largely overlooked in the business world (Dyer, 2000). In order to achieve competitive advantage with partners, which is called collaborative advantage (CA), organisations have started adopting and implementing SCC philosophy over the last two decades. SCC is defined as *"two or more independent firms jointly working to align their supply chain processes so as to create value to end customers and stakeholders with greater success than acting alone*" (Simatupang *et al.*, 2004, p. 57). CA is defined as joint competitive advantage and concentrates on creating joint value between different organisations (Cao and Zhang, 2011). These collaborative paradigms would support many organisations for new and shared opportunities to achieve CA and better performance through SCC.

A port is a complicated reality engaged in a series of supply chains, each of which is an independent unit aiming at its own profits (De Martino and Morvillo, 2008). In this regard, Mason and Nair (2013) posited that the container liner shipping sector is considered as a complex system composed of diverse MLOs combined with the behaviour of the providers of container transport services.

SCC between ports and port users may make it possible to satisfy customers' need for seamless movement of cargo and information. Nonetheless, limited studies on SCC paradigms have been conducted in the maritime industry. Hence, this study firstly examines the impact of SCC on CA and port performance (PP) in the context of the containerised maritime industry. In particular, this theme or qualitative methodologies applied to that industry in South Korea has yet to be thoroughly examined.

As for the maritime industry, mergers and acquisitions (M&A) and strategic alliances amongst major shipping lines have led to changes of structure in the port industry. This gives shipping lines much larger bargaining power against other MLOs, causing asymmetry with them such as container terminal operators, port authorities and inland transport companies in terms of market power. Moreover, competition amongst container terminal operators is getting fierce, whilst competition between ports also becomes severe. The rising trend of door-to-door from production to consumption site forces traditional maritime transport to adopt a SCM philosophy. Also, the phenomenon of horizontal and vertical integration amongst MLOs has gradually been prevalent, which might be derived from the aspect of SCM (Heaver *et al.*, 2001). Nevertheless, the proliferation of vertical integration through ownership appears to have disadvantages compared to SCC. Effective collaboration can be possible for tasks through vertical integration, whilst it is difficult to gain specialisation and share knowledge (Dyer, 2000). Furthermore, this vertical integration, which is almost dominated by shipping lines, would not only limit the choices of shippers, but also reduce competition (Frémont, 2009). It also costs a large amount of money rather than strategic partnerships or collaboration (Verma, 2004).

Beyond integration strategies, both horizontal and vertical collaboration strategies are pursued by each maritime actor (Carbone and Gouvernal, 2007). In this dramatically changing environment, to survive and coexist together, MLOs require a new strategy, as the aspect of port competition is fast shifting from competition between ports to competition between transport chains (Ducruet and Van Der Horst, 2009). Therefore, SCC could be an effective strategy to gain competitive advantage together and satisfy the demand of shippers. This study focuses on SCC, CA and PP in the containerised maritime industry within a collaborative paradigm.

1.2 Research objective

Given the research background presented above, this thesis aims to develop and validate adequate SCC scales in the containerised maritime context, and evaluate the relationships between SCC, CA and PP from the standpoint of containerised MLOs in South Korea. Therefore, research questions are as follows.

Research Question 1. What are the major activities and dimensions of supply chain collaboration in the containerised maritime context?

Research Question 2. What are the dimensions of collaborative advantage and port performance in the containerised maritime context?

Research Question 3. How and to what extent does supply chain collaboration influence collaborative advantage in the containerised maritime context?

Research Question 4. How and to what extent does collaborative advantage influence port performance in the containerised maritime context?

Research Question 5. How and to what extent does supply chain collaboration influence port performance in the containerised maritime context?

A comprehensive understanding of SCC and CA that is related PP in the containerised maritime context will provide containerised MLOs with guidance on what the attributes and dimensions of SCC practices are, what the benefits of SCC and CA are, and how SCC, CA and PP are related to each other.

1.3 Research methodology

The research aims to develop and validate the multi-dimensional SCC and CA constructs in the containerised maritime logistics context and examine whether SCC has an impact on CA and PP or not. To achieve these goals, this study utilised quantitative methods. Observed variables derived from latent variables are explored and chosen based on rigorous literature review, in-depth discussions, item review and sorting as well as the Q-sorting technique with experts to signify ambiguity or misunderstandings with the instruments and to suggest modifications.

Survey based data were obtained from organisations engaged in container maritime logistics in South Korea, an economy which handled the fourth largest global maritime container port throughput of approximate 20M TEU in 2011 and owned the fifth largest fleet in terms of deadweight tonnage with leading container shipping lines such as Hanjin shipping and Hyundai Merchant Marine as well as the second largest shipbuilding industry in the world (UNCTAD, 2013). Regarding sampling design, no single representative directory lists all containerised MLOs in South Korea. Rather, potential respondent mailing lists from the Korean Port Logistics Association (KPLA), Korea Shipowners' Association (KSA), Korea International Freight Forwarders Association (KIFFA), and Maritime and Logistics Information Directory (MLID) in the Korean shipping gazette were compiled by cross-checking entries in the four directories. Terminal operators, shipping lines, inland transport companies, freight forwarders, ship management companies and third-party logistics providers that are involved in containerised maritime logistics were selected to obtain a comprehensive and balanced view on SCC (Nam and Song, 2011). All were located in the major container ports of Busan, Gwangyang and Incheon adjacent to major shipping routes close to major markets in the hinterland and would tend to adopt SCM and provide more integrated logistics activities (Ferrari *et al.*, 2006).

Online links to a web-based survey were emailed to 643 potential respondents. This method of collecting data is inexpensive to create and maintain, eliminates the risk of missing data, and facilitates accurate assembly of a complete dataset (Froehle and Roth, 2004). To increase response rates, respondents were promised to be offered anonymity and an executive summary of findings. Questionnaires were distributed from April to August 2013, followed by two email reminders and one phone call generating 178 responses, a 27.68% response rate. The covariance structure preferred for subsequent analysis assumes no missing values in the data set (Anderson and Gerbing, 1988), a condition guaranteed by the design of the web-based questionnaire.

An exploratory factor analysis (EFA) is utilised to explore the key dimensions of SCC, CA and PP. In this stage, SPSS software (version 21.00) was used to reduce unnecessary variables and gain appropriate levels of unidimensionality, reliability and validity. Subsequently, a structural equation modelling (SEM) approach is employed to test research hypotheses. This approach can deal with a large number of both endogenous and exogenous variables as well as latent variables. SEM was carried out to verify the relationships between them using Analysis of Moment Structures (AMOS) statistical packages (version 21.00), since this technique is very strong at analysing multiple relationships simultaneously. This step focuses on examining the coefficients of the paths between above three constructs. A two-step approach proposed by Anderson and Gerbing (1988) is used to undertake SEM. Confirmatory factor analysis (CFA) is firstly carried out to assess the unidimensionality, reliability and validity of the constructs in the research model. Then, the structural model from the latent variables is estimated.

1.4 Structure of the thesis

The structure of this thesis comprises eight chapters as shown in Figure 1.1 to accomplish the research objectives.

In chapter 1, the research background, objective, methodology and structure of this thesis are introduced.

Chapter 2 outlines the extant literature in regard to the changing environment of the maritime industries and supply chains in order to provide detailed knowledge regarding world trade, demand for container port facilities and various changes in the maritime industries. Then, the role of maritime transport and logistics in global supply chains is explored.

Chapter 3 starts with three theories involving transaction cost theory (TCT), resource based theory (RBT) and a relational view (RV) as foundations for further understanding of role of SCC and CA. In addition, this chapter explicates an exhaustive literature review regarding SCC, CA and PP to identify their characteristics. The review includes both maritime and SCM studies to appropriately conceptualise them.

Chapter 4 demonstrates a conceptual model by developing hypotheses. In addition, the scales for each construct are conceptualised and operationalised to underpin questionnaires deployed in this study.

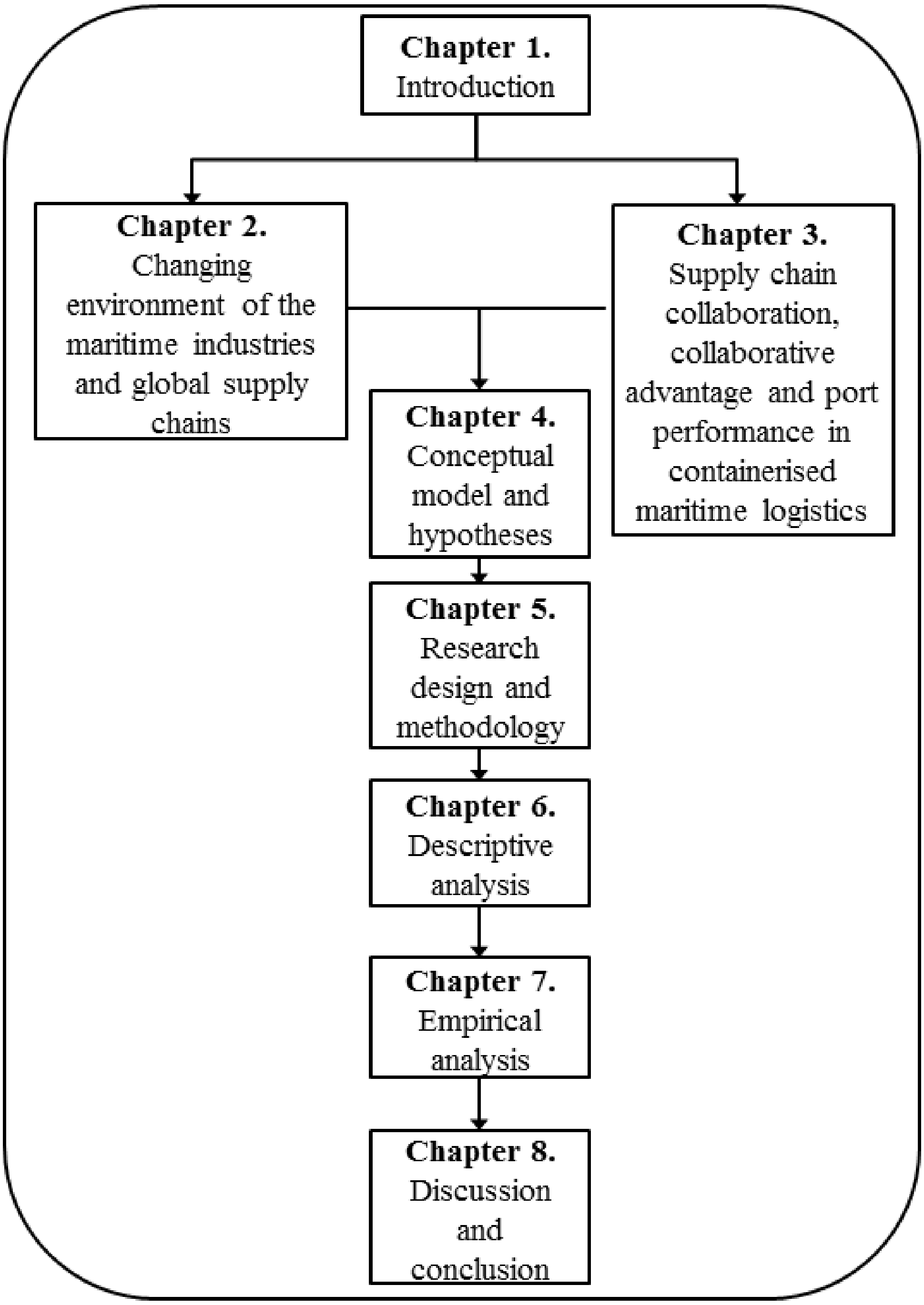
In chapter 5, research design and methodology including research design process, data collection method, questionnaire design and sampling design are presented. Subsequently, validity and reliability of the measurements as well as the main data analysis techniques are discussed.

Chapter 6 displays the descriptive analysis based on an online survey to provide a general picture of the respondents' profile and their perceptions of survey questions. It also incorporates consideration of non-response bias and common method variance. In order to recognise the differences between ports and port users in terms of their perceptions of critical research questions, comparisons between their responses are analysed.

Chapter 7 debates the results of empirical analysis. It begins with EFA to ensure reliability, validity and unidimensionality. Then, the measurement models are tested using confirmatory factor analysis (CFA). Subsequently, the structural models between the constructs are evaluated using SEM. For more detailed understanding, this study tested further various structural models with first- and second-order constructs. Finally, it focuses on examining a mediation effect of CA on the association of SCC and PP with a hierarchical approach.

Chapter 8 summarises the empirical findings and considers their contributions to theory. The theoretical and managerial implications are also presented for academics and practitioners in the maritime industry. Finally, this chapter details the limitations, recommendations and directions for future studies.

Figure 1.1 The structure of this thesis



1.5 Summary

This chapter provided an overview of the contents of this thesis by including research background, research objective, research methodology and the structure of the thesis. The next chapter presents the literature review on changing environment of maritime industries and global supply chains. Then, the literature review on three main constructs of this thesis, SCC, CA and PP is discussed in chapter 3.

Chapter 2. Changing environment of maritime industries and global supply chains

Both chapter 2 and chapter 3 are concerned with literature review. Chapter 2 focuses on discussing the changing environment of the maritime industries and supply chains including world trade, demand for container port facilities and various changes in the maritime industries. Subsequently, the role of maritime transport and logistics in global supply chains are outlined. Chapter 3 is dedicated to explore main constructs of this study.

2.1 Growth in world trade

This section outlines the globalisation that results in the growth of world trade. Then, it reviews the recent developments in containerisation in response to the rapid growth of world trade.

2.1.1 Globalisation

Globalisation, along with international trade and shorter life cycles of products and technologies have guided maritime transport through a rapid and complicated development. Since the world economy has become more integrated via globalisation of activities of enterprises such as production, consumption and services, the scope of markets has dramatically changed from local markets to one international single market (UNCTAD, 2004). The emergence of China, where a great number of manufactures exist, and the accession of China to World Trade Organisation (WTO) in 2002 may hugely affect the growth of container cargoes in trade (Hayuth, 2007). Moreover, economic trading blocs such as the EU, NAFTA, ASEAN, MERCOSUR, GATT and APEC lead to globalisation by blending several countries into single areas. In this changing environment, globalisation is considered as the management of supply chains on a world scale, accompanying cooperation, integration and information (King, 1997).

The concepts of logistics and SCM have encouraged global outsourcing, which favours relocation of production facilities from origin countries to other countries with low labour costs. This relocation implies increased movements of cargoes, changed procurement and new distribution strategies for multi-national companies. For this reason, conventional transport companies encountered opportunities and threats through demands for diversification, driven by global manufacturers, in order to both improve the quality of services and reduce their costs.

Shipping is viewed not only as a core constituent of a number of supply chains in global distribution, but also as a context for the globalisation of business (King, 1997). Recently, globalisation has caused global competition and has had a huge influence on the way firms operate in the maritime industries (Yang *et al.*, 2009). It appears that shipping companies and international logistics companies have adapted to globalisation, whilst the port industry has recently started to expand its business globally in this environment. Both the globalisation of international trade and SCM has affected the emergence of global terminal operators (Hayuth, 2007).

2.1.2 Recent developments in containerisation

During the twentieth century, one of the remarkable inventions was containerisation (Ng, 2012). Since the mid-1950s, containerised cargo has grown significantly. Ports have also struggled to adopt new equipment to meet demand for an increased container movement, which was prompted by the pursuit of economies of scale by shipping liners (Ferrari and Benacchio, 2002). Traditional cargo handling techniques required a long time to load and unload non-containerised cargo due to a high level of reliance on dockworkers. Following containerisation, vessel-time in port significantly reduced as new operating processes facilitated a faster flow of container cargoes for loading and unloading from vessels to land and *vice versa*. It could be said that this containerisation revolution increases total vessel capacity since vessels are able to earn revenues during only the transportation of cargoes from a departure port to a destination port on a sea route. In terms of expense, in the early phase, containerisation unavoidably costs a huge amount of money through investment in container vessels for shipping lines and container handling equipment for container ports respectively. In turn, it has significantly reduced transportation costs overall, culminating in further industrial globalisation and changes in manufacturing supply chains because regardless of where finished goods are produced they can be exported at low cost and raw materials can be sourced from any geographic location at low cost (Ng, 2012).

Containerisation also affects trade patterns, ship design, ship routes, ship deployments, port operation, custom processes, cargo security, and communication systems. Thus, it has induced an organisational structure and inter-organisational relationships amongst organisations in a port, which draws them closer together (Martin and Thomas, 2001). An another important motivation for containerisation was to achieve door-to-door services (Frémont, 2009). Containerisation has facilitated the entire transportation system for door-to-door services and just-in-time production. To satisfy this demand, maritime transport companies have strived to transform themselves into total logistics companies dealing with entire logistics chains for door-to-door services by engaging in all logistics activities, not just mere maritime transport (Notteboom and Winkelmans, 2001). Further, the advent of containerisation enlarged the geographical market of ports, so that ports are no longer regarded as a captive hinterland (Haezendonck and Notteboom, 2002). Containerisation may intensify port competition compared to traditional port systems since container cargoes are readily loaded or unloaded without requiring excessive labour times, permitting containers to be easily transferred from maritime transport to another transport mode for final destinations. This phenomenon would broaden shipping lines' choice amongst various ports in the proximity because cargoes can be unloaded at any port and transported by using inland transport as long as there is no congestion from the port to final destinations. As a result, competition between ports occurs.

Containerisation has contributed to both economies of scale and scope for shipper, standardising containers into categories such as Twenty-foot Equivalent Unit (TEU) and Forty-foot Equivalent Unit (FEU). Significant changes in relationships amongst MLOs were affected by this phenomenon.

2.2 Demands for container port facilities

The upward growth of international trade substantially increases the demand for container port facilities (De Souza *et al.*, 2003). In particular, the growth of trade from China, Russia, India and Brazil is a main driving force of increased demand for container port facilities. Ports have been pressured to expand their capacity, since container cargo traffic in the world doubles each decade (Baird, 2007). In addition, the largest vessels of more than 18,000 TEU capacity in Maersk have provoked larger container terminal investment. In order to accommodate such large vessels some critical issues such as ship-to-shore operations, inappropriate inland transport infrastructure and commitment to safety and security must be dealt with (Hayuth, 2007). If these factors cause congestion in a port, overall flows of cargo in entire supply chains are no longer seamless. This might not only result in customers' dissatisfaction with their cargo movements, but also delay container ships, causing a financial loss for shipping lines. Therefore, the issues of congestion are a critical challenge for the port industry.

2.2.1 Increasing global demand for container ports

The rapid escalation of container cargo traffic has caused continuing demands for extra container port capacity (Baird, 2007). A lack of port capacity may affect not only a port itself, but also regional developments and economic centres in the area the port belongs to because the port is still playing an important role in importing and exporting most cargoes as a gateway (Song, 2003). Further, the rapid diffusion of port deregulation and privatisation in the last three decades has triggered new developments of ports. The demand for container port capacity has seemed increased ever since international trade started. Containerisation forced ports to invest a large amount of money on infrastructure to accommodate container ships. Ports take a high risk when investing a great amount of money on constructing terminal sites, dredging channels, and installing larger gantry cranes even if there is no certainty that container cargo throughputs will grow or that shipping lines deploy larger vessels on their routes (Slack, 1993).

Especially, a significant economic growth of ASEAN and China as a global manufacturer has created unprecedented maritime container cargoes, causing an imbalance of trade between Asia and both the EU and USA. Due to this, UNESCAP (2007) expected that more than 1,000 new container berths would need to be built in East Asia and the Pacific region so that ever increasing container throughputs could be efficiently handled without the envisioned congestion in ports. This requires expensive investment in new berths.

2.2.2 Demand for container ports in South Korea

The Northeast Asia region has become the world's manufacturing centre as multinational corporations have expanded due to cost advantages. The ports in South Korea have both benefited and suffered from such changes (Lee and Kim, 2009). Busan port is considered as a major transhipment hub port in Northeast Asia, dealing with a significant number of transhipment cargoes to and from China. This caused severe congestion in local container terminals, prompting the South Korean government decided to develop Busan Newport, which accommodates super post-Panamax ships with a total of 30 berths for 8 million TEU in pursuit of a seamless cargo movement and value-added service (Anderson *et al.*, 2008).

The growing concern for congestion in Busan port drove the South Korean government to initiate developing Gwangyang port as an international two-hub port strategy so as to balance regional development, improve port capacity and encourage collaboration between those ports in response to the competition from Japanese and Chinese ports (Lee and Kim, 2009).

2.3 Changes in the maritime industry

The maritime industry refers to international transport of goods by ocean, which is a still significant transport mode, accounting for about 90 per cent of international logistics. Historically, the role of seaborne trade has been important in developing an economy. Technological advances over the last half century have had an enormous influence on port operation and management. They transformed the organisational and institutional relationships between members in the container terminal community (Martin and Thomas, 2001). In this study the term *container port industry* limits its boundary to shipping lines, container terminal operators and other related service providers such as inland transport companies, freight forwarders, third-party logistics providers, and ship management companies. This section illustrates the changes in the container port industry.

2.3.1 Changes in liner shipping structure

By and large, competition becomes fiercer in a particular industry, if the difference between depression and prosperity in the industry is significant. The dramatic fluctuation of market cycles permeates the shipping industry (Stopford, 2009), since shipping liner services are seriously affected by trade volumes, costs, political situation and regulations in a certain area (UNESCAP, 2005). Shipping lines' revenues hugely depend on freight rates. Although a number of forecasts of the shipping cycle have been undertaken, predictions in the volatile maritime sector are accompanied by uncertainties (Van de Voorde, 2005). As a result, competition in the shipping industry has been more intense than other industries. Severe competition forces shipping lines to cooperate and make partnerships through strategic alliances, joint ventures and mergers in order to attain both financial and operational advantages. This cooperation not only has a significant impact on routes on which vessels are operating to move international goods to more cover geographical maritime networks, but also compels container terminal operators to invest in port capacity (Heaver *et al.*, 2001).

A number of shipping lines who have traditionally offered mere sea transport have turned their eyes on comprehensive logistics services, including warehousing, information process and inland transport. These shipping lines are regarded as a logistics provider. Based on the interests of shippers to outsource logistics services with fewer suppliers, most shipping lines have been introducing diverse logistics services. Moreover, their actions impact operating terminals and warehousing as a service provider (UNCTAD, 2004). This trend, especially as shipping lines become interested in the hinterland connection, might be interpreted as saying that shipping lines are changing their roles in an effort to become a partner of manufacturers in attempting to offer seamless cargo movements (Notteboom and Winkelmans, 2001). For example, some shipping lines have launched inland container terminals in order to optimise their flows of both empty and full containers. The fact that economies of scales from maritime transport are no longer available due to advanced technology for ship size is one reason. Besides, profits from logistics services are frequently higher than from maritime transport, which can be additional incomes (Slack, 2007). This also coincided with shipping lines' intentions to control the entire transport chain from sea to land by offering a door-to-door service (Heaver *et al.*, 2000). For instance, the biggest shipping line, Maersk Sea-Land has tried to expand its business towards terminal operations as well as transportation in the hinterland (Haezendonck and Notteboom, 2002), whilst global container terminal operators, who have expertise in technologies of terminal operations, attempt to expand their business towards other companies in operating terminals and in integrating with inland transport companies (Heaver *et al.*, 2001). Despite the advantages of involving other transport modes such as inland transport from a shipping line's view, this phenomenon might reduce in a competitive environment in which inland transport companies used to compete with each other.

This diversification of strategies can give shipping lines new strengths to make them less vulnerable in shipping economic cycles (Van de Voorde, 2005). Thus, shipping lines have attempted to invest in ports to operate their own terminals to increase the efficiency of their cargo and vessel movements, if port authorities are willing to lease land for shipping lines to own and operate terminals as dedicated operations.

Recently, most liner shipping companies have adopted slow steaming as an operating strategy in order to downsize their operating capacity, utilise the idle capacity, and reduce operating costs and the amount of CO_2 emissions under the condition of high-fuel prices and low-freight rate (Woo and Moon, 2014). In the Asia-Europe route, the average voyage speed was decreased to 15-18 knots in 2011. As the International Maritime Organisation (IMO) has planned to lessen the amount of CO_2 emissions from existing vessels by 20 to 50 percent by 2050 (IMO, 2009), it is expected that slow steaming is not temporary phenomenon in the liner shipping industry.

2.3.2 Changes in the port industry

Due to the advent of improved shipbuilding technology, the size of container ships has increased to achieve economies of scale, to the extent that calling at a large number of ports with a large ship is no longer possible. This increased ship size generates a significantly larger number of containers for both loading and unloading in a port, which implies that large vessels spend a relatively longer time in the port. To keep pace with developments in vessels, the ports strive to meet shipping lines’ demand for efficient and quick handling of containers because a shorter time in port allows shipping lines to attain greater profits derived from efficient utilisation of their vessels. Table 2.1 shows increased port time due to larger vessels.

Table 2.1 Increased port time for bigger vessels

Vessel size (TEUs)	Speed	Moves	Time spent in ports (days)	Voyage
2,500	20/21	6,600	6.0	11%
4,000	21/22	13,300	9.7	17%
6,500	23/25	22,600	11.9	21%
8,000	22/24	24,500	13.2	24%

Sources: Midoro *et al.* (2005, p. 98)

In reality, not many ports are able to accommodate large vessels owing to an insufficient water depth and lack of terminal equipment, meaning that the transhipment volume from hub ports to feeder ports and *vice versa* has dramatically grown over the last decade. Also, strategic alliances amongst shipping lines may have an influence on port selection that leads to concentration of container cargoes in a few ports (Musso *et al.*, 2000). Moreover, inter-modality has affected the degree of hub and spoke systems that were connected to inland transportation networks (Frémont, 2009). From the ports' stance, they have coped with shipping lines' demands for costly equipment such as faster and larger gantry cranes. These demands may jeopardise the whole stevedore industry by reducing profits, but global terminal operators which possess extensive capital may survive because they benefit from economies of scale gained by operating globally in such terminals (Musso *et al.*, 2000). The new maritime transportation pattern related to transhipment, network and hub and spoke system has changed the traditional scope of competition and competitors, since ports could compete for broad cargoes with far-distant competitors (UNCTAD, 2004).

The introduction of this system whereby shipping liners participated in owning and operating a terminal for their own interests, created *dedicated terminals*, whereby a port authority allows a shipping line to gain either an exclusive concession or a joint concession with a terminal operator (Van de Voorde, 2005). This is regarded as a vertical agreement between a port and a particular shipping line which creates discrimination between users of the port, and results from shippers seeking to manage their supply chains (Musso *et al.*, 2000). Through dedicated terminals, shipping lines can adjust terminal operations in line with the optimisation of ship movements to achieve economies of scale for ships. The focus on ship optimisation such as exact arrival and time reduction, results in increased productivity as an integrated player (Ferrari and Benacchio, 2002). Haralambides *et al.* (2002) claimed that dedicated terminals give shipping lines a power to manipulate their operations, which is seen as a supply chain activity beyond the simple seaborne from a strategic perspective. They also argued that it provides a number of benefits for shipping lines: (1) reduced time for arrival and departure of vessels, (2) reorganised service time in accordance with a free disposability of the terminal, (3) encourages standardisation and faster processing because of common characteristics of the ships. However, taking over a dedicated terminal entails high initial investment, and shipping lines must ensure that there is sufficient container throughput to fully exploit their dedicated terminals. From the port's stance, by engaging shipping lines in an agreement, footloose container throughputs can be reduced through long-term leases and sharing of capital costs. As for port authorities, they are able to develop integrated services and tie shipping lines to their ports (Heaver *et al.*, 2001).

Another important change in the port industry is that global terminal operators in the era of deregulation and port privatisation have attempted to penetrate overseas regions over the last decade. Indeed, privatisation has led foreign terminal operators to invest in other countries' terminals. They have aggressively undertaken a geographical expansion of their business through horizontal integration, M&A and leasing terminals far beyond their local countries (Jacobs and Hall, 2007). Although they are regarded as a key player in the maritime industry their market power rarely dominates against the shipping lines. The advent of global terminal operators represents an effort to gain more power to control others by creating networks amongst ports all over the world (Bichou and Gray, 2004). Their main aim is to gain high profits and to hedge the risks through their expertise in operating terminals, because their national markets are too limited to expand their activities (Slack, 2007).

The fact that a few global terminal operators dominate most markets seems to be similar to a trend towards concentration in the shipping industry. Musso *et al.* (2000) explained that the international penetration of terminal operators is the only way for them to keep growing, and it allows them to overcome reliance on a single port in terms of performance and profits. For instance, during recession in the EU, their profitability could be offset by increased outputs in Asia. HPH, DP World, PSA, APM Terminals, Eurogate and HHLA are examples of major leading global terminal operators. According to Hayuth (2007) global terminal operators can be categorised into three types: global stevedoring companies, global carriers and global hybrid. The global stevedoring companies focus on only port operations all over the world. Secondly, the global carriers refer to the shipping lines, whose main activity is to transport maritime cargoes, but they are involved in terminal operations by efficiently managing terminals for their container cargoes. The shipping lines such as Evergreen, Cosco, Maersk-Sea Land, Hanjin, Hyundai Merchant and APL are typical examples. This movement can be regarded as vertical integration along the transport chains. Thirdly, the global hybrid usually acts as an individual shipping line, whilst operating its terminals as an independent business for other shipping lines.

It is well known that the demand for ports is considered as double derived demand. Therefore, ports always strive to satisfy their customer' needs and closely observe a changing environment.

2.3.3 Port coopetition

The rapidly changing environment has led to a new strategy for every organisation in the maritime industries. Especially, from the ports' and terminal operators' perspectives, it is difficult to sustain profits, using only competition strategies such as price differentiation. Therefore, ports have started to seek new business strategies to survive and avoid destructive competition.

The term *port coopetition* was firstly applied to the port industry in the region between Hong Kong and South China in order for ports to increase market power as a global business strategy towards ever larger bargaining power of shipping lines (Song, 2003). It was a case study showing the situation in which container terminal operators in Hong Kong and South China (Shenzen) compete and cooperate at the same time, utilising a number of coopetitive activities such as joint ventures. Balancing between competition and cooperation is an important aspect for the success of terminal operators (Song, 2004).

In addition, Brooks *et al.* (2009) examined horizontal cooperation relationships between seaports as well as vertical coordination relationships between supply chain operators in ports, and investigated the motives for cooperation and existing cooperation activities in ports in peripheral locations in Canada. Nevertheless, this study has a limitation as it focuses mostly upon peripheral ports, which have a narrow local market and poor centrality, because these results might be difficult to apply to major ports, which have a large amount of cargo throughput.

Because few studies have examined port coopetition, it would be appropriate to review the literature on port cooperation and port competition to gain insights into port coopetition paradigms.

2.3.3.1 Port cooperation

Approximately two decades ago, Driel (1992, p. 530) elucidated *"The fact that stevedores, unlike shipowners, originally were of rather low social origin did not favour the development of a co-operation-friendly culture. Stevedores were more street fighters than gentlemen*". This may imply that competition between container terminal operators better characterises stevedore industries rather than cooperation.

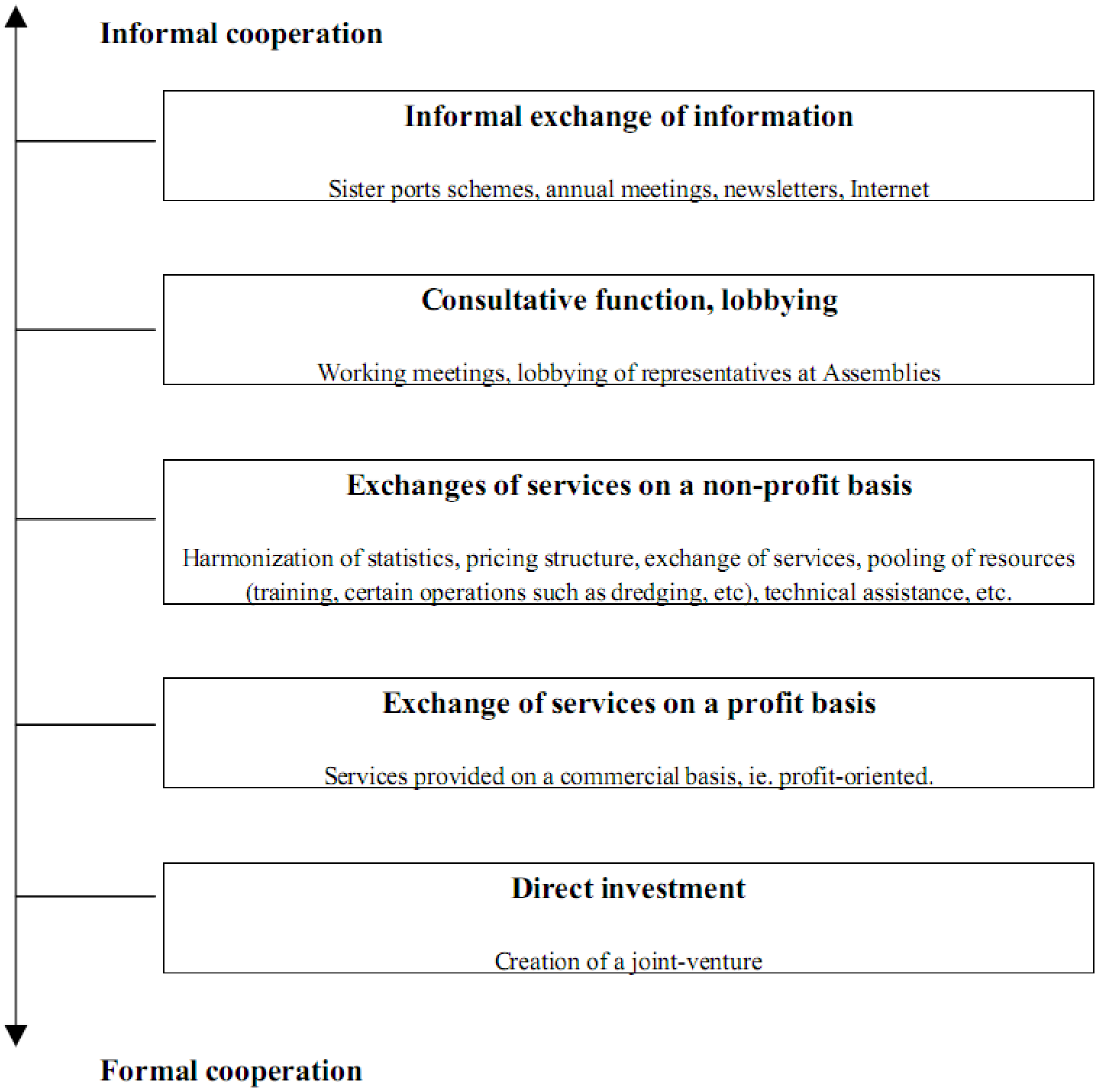
However, a variety of cooperation forms are interrelated in the advancement of global supply chains, showing that integration has recently become an important ideology in the maritime literature (Panayides, 2006). In the shipping industry, horizontal cooperation between shipping lines has been common through the form of strategic alliances. However, horizontal port cooperation and mergers between terminal operators within the same port or different ports in proximity have grown in scope recently (UNCTAD, 2004). Similarly, Marlow and Paixão (2003) proposed that ports can initiate partnerships or strategic alliances by adopting new working philosophies so that ports are able to provide innovative services, resulting in increased performance. They also claimed that if multiple ports cultivate collaborative attitudes in sharing information and gaining a high degree of customer service, they become more efficient as a lean port network rather than mere lean ports. As an example of sharing resources, a terminal operator Noord Natie in Antwerp, sometimes shares cranes with Hessenatie at peak times as one cooperation activity (Ferrari and Benacchio, 2002).

Cooperation between container terminal operators may be necessary in the port supply chain for the whole information network (UNESCAP, 2005). An information gap at one point in a port has a negative impact on a whole port system and each port supply chain member. Each member should ensure that all information flows smoothly. The necessity for information networks generates the motivation for cooperation in a port. For example, port authorities and terminal operators are likely to cooperate by sharing information on hazardous cargoes, departure times of ships and cargo reports. Another possible form of cooperation is the use of a shared training centre for staff at terminal operators to share costs (UNESCAP, 2005). On top of that, several terminals in the same port could share the costs of promotional actions such as co-marketing, which leads to competitive advantages for both of them (Heaver, 1995).

The container terminal operators might waste resources through excessive investment on additional facilities within their ports, causing overcapacity and duplication of terminals, in the optimism of becoming a hub port or a transhipment port. If a number of ports simultaneously believe in the optimism, it could cause destructive competition, which is harmful to each terminal operator, port and even national economy (UNESCAP, 2005). Therefore, cooperation activities such as sharing future plans for development between adjacent terminal operators and a port should be undertaken to reduce destructive competition.

UNCTAD (1996) stated that the term *cooperation* generally refers to joint activities implemented by more than two parties who are reciprocally committed whilst *port cooperation* is a term to define cooperation among all parties engaged in port activities, resulting in a 'win-win' strategy for all of them. Each port can share resources such as know-how, time, financial resources and managerial capabilities to achieve advantages such as financial savings, service quality and market share. Three categories of port cooperation can be defined: *institutional cooperation*, *industrial cooperation* and *commercial cooperation*, and proposed that the equilibrium between cooperation and competition should be harmonised to secure the interests of port operators and port users and to improve flexibility of distribution pattern. The crucial features of cooperation embrace degree of autonomy, responsibility for initiating cooperation and the intensity of commitment. From informal to formal cooperation, generic activities of port cooperation can be shown in Figure 2.1.

Figure 2.1 Generic activities of port cooperation



Source: UNCTAD (1996, p. 16)

Interestingly, UNCTAD (1996, p. 9-12) indicated influential factors of port cooperation as below.

- *Globalisation in trade and transport*
- *Consolidation in cargo handling activities*
- *Redefinition of the role of the public sector*
- *Uncertain international business environment*
- *Barriers to entry to new market*

- *Importance of cooperation specifically in the services industry*
- *Sustainable development*

Approximately three decades ago, UNCTAD (1985) first proposed the possibility of cooperation between ports. It suggested possible activities for port cooperation as follows (UNCTAD, 1985, p. 1).

- *Harmonisation of port statistics*
- *Harmonisation of port tariffs*
- *Joint dredging*
- *Technical and marine salvage operations*
- *Expertise exchange*
- *Training*

However areas were focused only on developing countries, particularly in small ports in the Mediterranean, and some plans were infeasible due to a different structure of governance within different countries. Nonetheless, these attempts contributed towards proposing potential cooperation practices between ports, and predicted current port competition that resulted from over investment without inter-governmental plans within adjacent ports.

Avery (2000) proposed that strategic alliances between adjacent ports are necessary as a coping strategy against the shipping lines' rising bargaining power. Similarly, Notteboom and Winkelmans (2001) developed a new concept of port networking with overseas, neighbouring and inland ports as a strategy of port authorities. The aim of this strategy is to make a policy together and share resources. As viable activities such as traffic management, management of efficient hinterland connections, environmental issues, co-marketing with ports in proximity, information exchange with ports abroad and research and development (R&D) within the network of different port authorities were suggested. The forms of port networking might vary from simple informal cooperation to partnerships such as alliances, joint venture and M&A. They contended that port networking might reduce inter-port competition, resulting in saving resources, and facilitating hinterland connection and inter-modalism. Further, from the viewpoint of land side operators, cooperation within a proximate port might lead to more effective bundling of container cargo volumes for the hinterland connections. They revealed many viable strategies for cooperation. Notwithstanding their contributions to new port strategies, this study was confined to only European regions, and these strategies seem to be difficult to implement owing to differences of governance amongst port authorities. Nonetheless they contributed to identifying two key aspects to garner the competitive advantage of ports: (1) flexibility to be proactive to a changing environment and (2) an integral perspective in contexts of whole transport chains through core competencies such as inimitability and durability (Notteboom and Winkelmans, 2001, Haezendonck and Notteboom, 2002).

According to UNESCAP (2005), *cooperation* is defined as a generic term portraying joint activities performed by several parties for win-win deals. As examples of cooperation, there may be resource sharing such as know-how, financial information causing financial profits, service quality improvement and larger market share. The terms *partnership*, *alliance* and *strategic alliance* are sometimes used to represent the nature of cooperation more accurately.

Donselaar and Kolkman (2010) examined how cooperation amongst port authorities affects societal welfare and how the government is involved in supporting this activity, showing examples of cooperation amongst Dutch ports at both a national and international level. They underlined the role of port authorities to enhance their competitive position by increasing the efficiency of logistical chains since a port is a critical link in the whole logistical chain. However, in most cases, an important decision is made by commercial organisations, not port authorities, i.e. the choices of how to deploy vessels or trucks, where to locate a business and transport choice. Therefore, port authorities and the government only have limited impact on the above issues. Nonetheless, they should strive to achieve public interests and avoid abuse of market power.

Brooks *et al.* (2009) discussed cooperation between ports on the periphery, primarily concentrating on Atlantic Canada's ports. They identified core reasons and benefits of port cooperation, and they divided port cooperation activities into whether formal or informal activities. They argued that there may be two main reasons why ports cooperate. Firstly, destructive competition results from considerable redundancy in the port services. Secondly, shippers for whom port cooperation may be beneficial perceived gaps between ports in terms of abilities and services. Moreover, they suggested different perspectives of meaning for port cooperation. The following activities are examples of cooperation between ports (Brooks *et al.*, 2009, p. 10).

- *Marketing and business development: joint advertising and promotional activities, establishing a joint marketing agency, seeking joint clients, exchange of experts, promote the use of each other's facilities*
- *Operations: common training agreements, joint application of new communications technologies, port development planning, partnerships with other actors, joint development of similar operating practices, information*

exchange on terminal management, sharing information on port development, exchange of experts, joint studies

- *Administrative: port representatives participating in other ports, joint investments in hinterland infrastructure, joint management of port expansion, formation of international/national cooperative organisations, technical assistance in port management, common positions at an international forum*
- *Regulatory: joint environmental protection initiatives, coordinated investment in safety and security, information sharing on environmental programs*

Ports in proximity have made some agreements for cooperation with other adjacent ports in implementing joint ventures, collective marketing and lobbying for common interests. Cooperation between port authorities in proximity may be the key solution to irrational demands arising from the larger bargaining power of shipping alliances (Heaver *et al.*, 2001). Even though ports are vying to accommodate shipping lines by satisfying them with reduced tariffs, value-added services and well-organised inter-modalism, it is likely that they should be involved in cooperative actions to expand infrastructure together for overall container throughput as a consequence of trade in their regions.

2.3.3.2 Port competition

Today, port competition occurs across the world, not just between adjacent ports. The increasing cases of strategic alliances, M&A and consortia provide shipping liners with more bargaining power, impacting on globalisation in the container liner industry (Heaver *et al.*, 2000). In addition, larger sized vessels and inter-modality have re-shaped the level of port competition (Song, 2003). In fact, shipping lines sometimes attempt to deliberately induce a certain degree of terminal and port competition by changing their calling at different terminals expecting better services in European ports (Ferrari and Benacchio, 2002).

Although ports themselves are major players in international logistics, ports relatively may not be a global player, but a local player following local politics excepting ports such as Dubai or Singapore (Jacobs and Hall, 2007), whilst shipping lines whose roles are international in scale have a power to choose ports and affect the flows of container traffic (Slack, 1993). The important aspect pertaining to port competition is that because no ports provide identical services and prices, competition between ports is not only dependent on prices, but also a number of other aspects such as services, infrastructure, hinterland connections, and efficient inter-modal transport.

Notteboom and Winkelmans (2001) contended that destructive competition between ports sometimes causes under-utilisation of facilities and reduction of port tariffs as well as container handling fees. Additionally, shipping lines with larger bargaining power overwhelmingly demand lowering port tariffs. As a result, a number of port authorities had to provide significant rebates on port tariffs for shipping liners, and financial incentives in return for extra inland transport costs. These factors have a negative influence on the profitability of terminals as superfluous investments on port infrastructure are irremediable.

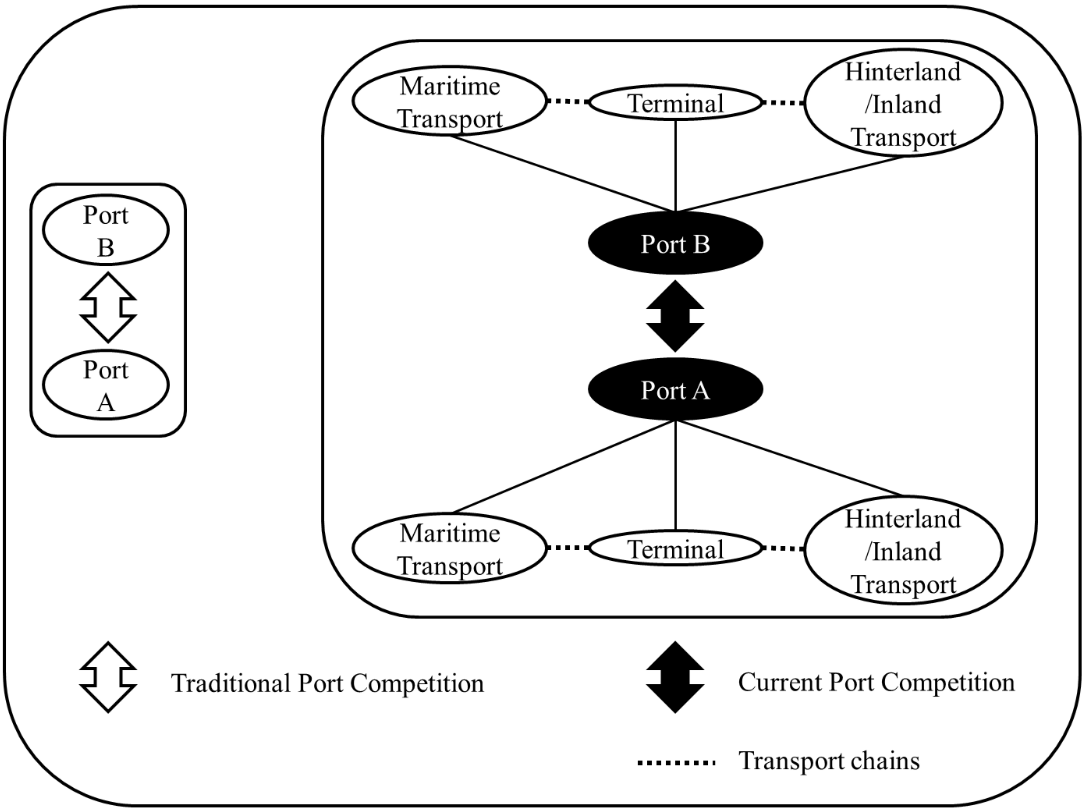
Van de Voorde and Winkelmans (2002, p. 11) pointed out that previous definitions of port competition have limitations, not showing the comprehensive meaning of port and competition or focusing only a partial aspect of port, and re-defined as following:

"Seaport competition refers to competition between port undertakings, or as the case may be terminal operators in relation to specific transactions. Each operator is driven by the objective to achieve maximum growth in relation to goods handling, in terms of value added or otherwise. Port competition is

influenced by (1) specific demand from consumers, (2) specific factors of production, (3) supporting industries connected with each operator, and (4) the specific competencies of each operator and their rivals. Finally, port competition is also affected by port authorities and other public bodies"

Ports generally compete with other ports in proximity to satisfy the needs of their customers such as shippers and shipping liners from the hinterland to the foreland where there might be an overlapping region between ports (Brooks *et al.*, 2009). Traditionally ports have only one strategy of reducing tariffs as ships are able to transfer their routes without sunk costs (Heaver *et al.*, 2000), but in these days numerous terminal operating companies have expanded their investments from their domestic market towards an international terminal network structure. The facet of port competition is rapidly changing from competition between ports to competition between transport chains (Ducruet and Van Der Horst, 2009). As a consequence, a large number of ports are struggling to develop new strategies in the changing competitive environment. Furthermore, ports are willing to improve hinterland connections for whole transport chains. Figure 2.2 shows the comparison between traditional and current port competition.

Figure 2.2 Traditional versus current port competition



Source: Seo *et al.* (2013, p. 12)

It is worthwhile examining types of port competition since the ranges and features of port competition are diverse.

The World-Bank (2007, p. 5-6), which published a Port Reform Toolkit, suggested three different types of port competition.

- *inter-port competition arises when two or more ports or their terminals are competing for the same trades*
- *intra-port competition refers to a situation where two or more different terminal operators within the same port are vying for the same markets*
- *intra-terminal competition refers to companies competing to provide the same services within the same terminal*

In addition, Van de Voorde and Winkelmans (2002, p. 11-12) concluded that port competition occurred at three levels after the rigorous literature review.

- *Intra-port competition at operator level: competition between operators – with regard to a specific traffic category and within a given port (e.g. operators 1A, 1B, 1C and 1D)*
- *Inter-port competition at operator level: competition between operators within same range serving more or less the same hinterland*
- *Inter-port competition at port authority level: competition between port authorities – be it national, regional or local – which directly affects the determinants of port competition*

From a different point of view, according to UNCTAD (2004, p. 26-27), if a port is seen as a gathering of multiple actors, competition is pinpointed on the port itself. There are two kinds of competition at this level.

- *The segmented form: this refers to intra-competition in which different organisations compete with each other horizontally and vertically. It can be horizontal activity between warehousing companies, or be vertical competition between terminal operators and logistics providers.*
- *The aggregate form: this refers to relationship in which every organisation has a direct or indirect effect on other organisation. Port competitiveness is a concept that represents a whole efficiency of all actors, which means, if one actor fails to acquire efficiency, it can risk the entire port competitiveness. Port competition is the aggregation of all organisations' performance.*

According to Midoro *et al.* (2005, p. 103), port competition occurs on two levels. They claimed that port competition in transpacific trades, in European ports and in Far East Asia was relatively intense, and concluded that progressing the character of the dedicated terminals can benefit both pure stevedores and liner shipping companies.

- *Strategic competition: focused on developing business by bidding for concessions and making acquisitions*
- *Operational competition: occurs with smaller, geographically defined markets, either between terminals located in the same port or between neighbouring ports*

Yap and Lam (2006) investigated competitive dynamics amongst major container ports in East Asia with evaluation of their level and concentration, using time series data which were container throughput. They summarised that although developments could raise severe competition, cooperation can bring opportunities for adding economic values in their hinterland.

In the case of West European regions, Wiegmans *et al.* (2008) argued that hinterland accessibility is one of the critical elements in port competition, which is consistent with Van Der Horst and Van Der Lugt (2011). Hinterland connection is also a great aspect of success for ports (Van de Voorde and Winkelmans, 2002). Hinterlands have expanded from confined areas to contestable areas in which one port competes with others, because geographic coverage of ports are enlarged by containerisation (Van Der Horst and Van Der Lugt, 2011). Port competition in Europe is only concentrating on expanding cargo handling capacity to increase direct calls of larger container vessels, but some ports are supposed to serve feeders as a secondary port (Notteboom and Winkelmans, 2001). Furthermore, this competition in Europe has decreased the profits of container terminal operators due to threats by the greater bargaining power of shipping lines, but it does not mean that terminal operators cut final prices owing to the oligopolistic market structure (Ferrari and Benacchio, 2002).

After ports examine the structure of market, their major strategies are normally a mixture of overall cost leadership, differentiation and focus (UNCTAD, 2004). However, these strategies of ports appear to be quite different in North-East Asia including South Korea because a few terminal operators have drastically discounted their charges towards marginal costs due to cut-throat competition. UNESCAP (2005) pointed out that paying attention to only national advantages in North-East Asia leads to fierce competition, implying that the national relationship is totally different in the EU, but it is possible for them to cooperate and establish an economic bloc. In this regard, Heaver (1995) put forward that an over-investment in port facilities may result in excess capacity if there is a lack of principal arrangement. Therefore regional cooperation of ports or an agreement between countries is required to prevent the risk of over-investment (UNCTAD, 1985).

Meanwhile, a high level of port competition compels terminal operators to provide differentiated services from simple operations to value-added services beyond a price strategy (Ferrari and Benacchio, 2002). Global terminal operators attempt to fulfil a product differentiation such as inland services and logistics networks, not merely handling activities (Musso *et al.*, 2000). Port competition may facilitate various services for shipping lines that assist the productivity of vessels in the long-term perspective.

With regard to intra-port competition, De Langen and Pallis (2006) surveyed the advantages of intra-port competition and a relation between intra-port and inter-port competition. They argued that intra-port competition may prevent market power and rent extraction by a port service provider and may encourage new port services. Moreover, it can foster innovation and specialisation. This study underlined the introduction of intra-port competition only in favour of it in an effort to gain benefits from it. However, there is no discussion about severe intra-port competition that might bring numerous drawbacks such as terminal operators' loss in terms of profits.

Consequently, a considerable body of literature has started to explore port competition, focusing more on its strategic relationship to supply chains owing to the proliferation of the integrated logistics concept and SCM philosophy from shippers rather than traditional elements of port competition such as physical port facilities and equipment. In the next section, this study investigates how the role of maritime transport and logistics in supply chains is transforming dramatically.

2.4 The role of maritime transport and logistics in global supply chains

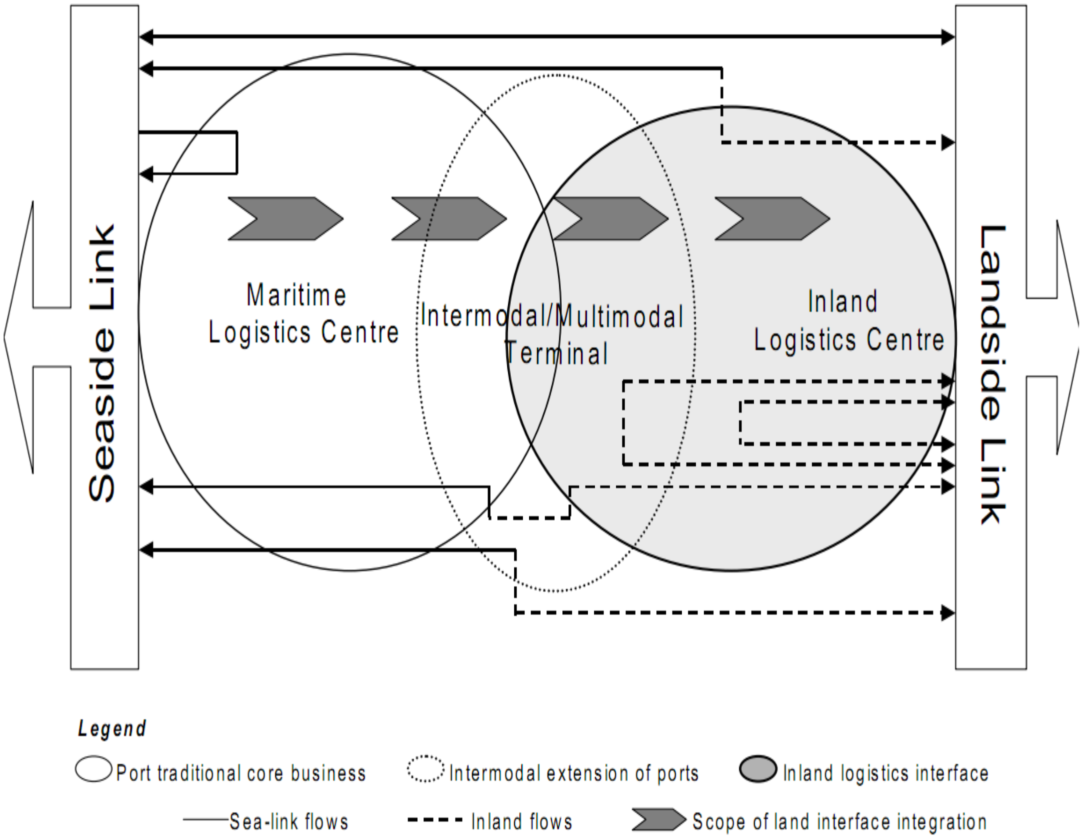
Traditionally, ports tended to concentrate only on the seaside linkage e.g. container cargo loading/ unloading, nautical approaches and acquisition of cranes rather than value-added services. As Martin and Thomas (2001) discussed, notwithstanding heavy interdependence between members in the port, there has been a lack of coordination and communication in a traditional break-bulk port community in the past. Conventionally, the decision regarding where to make a port of call by shipping lines was determined by a geographical or territorial view, but today this is more affected by total transport cost considering global logistics chains (Van de Voorde and Winkelmans, 2002). This has gradually changed a trend in the shipping liners' loyalty to ports. In addition, shipping lines tend to recognise container terminals as nodes in the development of global supply chains (Heaver *et al.*, 2001).

Today, ports are regarded as the catalysts for economic growth of the hinterland, but due to the development of door-to-door services arising from supply chain practice, ports have progressed toward a new role of integrated global supply chain systems (Song and Panayides, 2008). Due to a changing environment, shipping liners, container terminal operators and inland transport companies have horizontally and vertically integrated their operation and services (Jacobs and Hall, 2007). In addition, ports have started to provide value-added activities as well as a traditional role as a nodal point between sea and land transportation, as it leads to additional income, employment and competitive advantage over adjacent ports in competition relationship for ports.

The availability of an intermodal transport system is also a growing issue as an important way of ensuring seamless cargo movements (Notteboom and Winkelmans, 2001), so cooperation and coordination seem to be vital elements for developing a port without disconnectedness of cargo movements (Brooks *et al.*, 2009). These kinds of coordination and efficient management of supply chain would be one of the important elements of port competitiveness (Van de Voorde and Winkelmans, 2002). In addition, coordination among MLOs within the port is a key element to shape an integrated intermodal chain (Franc and Van der Horst, 2010).

To achieve an efficient movement of cargoes, two types of geographical approach should be satisfied, including both seaside and landside. Figure 2.3 illustrates that due to door-to-door systems ports are integrating all roles in maritime, intermodal/multimodal and inland logistics for unified cargo flows (UNCTAD, 2004).

Figure 2.3 Scope and potential for ports to develop beyond a maritime logistics centre



Source: UNCTAD (2004, p. 24)

The maritime transport cargos, which are a derived demand from the trade between countries, now seem to be an integrated demand originating from the need for lowering costs, increasing reliability and adding value for shippers from the origin of manufacture to the destination of consumption (Panayides, 2006). In addition, shippers demand optimised transportation chains to integrate different types of transport modes toward seamless distribution (UNCTAD, 2004). This integration amongst port supply chain members may contribute to higher performance for the whole transport chain (Carbone and De Martino, 2003).

Logistics involves complicated activities in which a firm optimises the flow of the product for cost reduction, whilst SCM is a wider concept than logistics in which various organisations in networks collaborate with each other. A supply chain approach considers maritime transportation as an integrated part of supply chain management in which separate organisations develop networks from production to sales, including managing purchase, product and inventory, so ports can be recognised as an important logistics centre not a sub-directory of sea transport. Carbone and De Martino (2003) identified the role of ports in the SCM, conducting a case study in Le Havre port in terms of an automotive supply chain from a managerial and organisational perspective. They contended that procurement and pre-assembly stages are regarded as important factors for future ports. Moreover, operational efficiency no longer satisfies customers in the context of supply chain, so a wide-ranging method to manage both the operational system and the managerial organisation is indispensable within the whole supply chain (Carbone and De Martino, 2003).

As for ports, firstly, seamless cargo movements across diverse actors from shipping liners to inland transport companies are crucial. Secondly, all movement units such as ships, tugs, gantry cranes, trucks, lorries and trains should interact with each other so as not to delay at the connection point of movement (UNCTAD, 2004). In practice, identifying the weakest link in the transport chains is particularly crucial. Paixão and Malrlow (2003) asserted three levels of development for fourth generation ports that have seamless transport systems: (1) *the interoperability of the modes, (2) the interconnectivity of land networks with sea and (3) the compatibility of information systems.* Faster access to information can be possible due to developed communication systems, providing higher productivity of ports. Therefore, they suggested that agile concept should be adapted to ports to become key centres amongst the transport chains. As a result, ports could meet demands as crucial supply chains whilst reducing inventory costs, decreasing delivery time, and increasing productivity.

2.5 Summary

A literature review on changing environment of maritime industries and global supply chains was undertaken in this chapter. Section 2.1 discussed globalisation and recent developments in containerisation in response to the dramatic growth of world trade. Section 2.2 reviewed demands for container port facilities whilst changes in the maritime industry are presented in the section 2.3. Finally, section 2.4 elaborates the role of maritime transport and logistics in global supply chains. The discussions of the changing maritime environments provide a comprehensive understanding for the changing role of the maritime industry to facilitate the global supply chains and to fulfil shippers' requirement.

Chapter 3. Supply chain collaboration, collaborative advantage and port performance in containerised maritime logistics

This chapter focuses on the literature review for both theoretical and empirical studies. The main aims of this chapter are: (1) to provide a theoretical framework on which this research is based; (2) to define supply chain collaboration (SCC), collaborative advantage (CA) and port performance (PP); (3) to investigate what the main activities and dimensions of SCC, CA and PP. The framework of this chapter is composed in the following way. The chapter starts with a review of the theories which originated from multi-disciplinary management issues. Next, the term SCC is clarified as a strategic inter-organisational weapon to achieve CA, and how SCC between ports and port users has been conducted is explored. Subsequently, the characteristics of CA and PP will be discussed as the main construct.

3.1 Theoretical paradigms

Positioning the theoretical position of a thesis is a demanding task, since there is no "one best way" of doing it, and it involves underlining some insights at the expense of others (Barney, 2001). Altering the positioning of theory may significantly change the argument (Barney, 2001). The aim of this study is to investigate the impact of SCC along the containerised MLOs, especially between the port and port users on CA and PP. Given that the theme of this research is relatively new and interdisciplinary in the maritime context, it is appropriate to involve various theories from other academic fields to illuminate the intricate trend. Accordingly, the theoretical positioning of this study is conducted by clarifying how those theories are related to this thesis. Therefore, this section is devoted to investigate theoretical paradigms, since this study is mainly based on following theories: transaction cost theory (TCT), resource based theory (RBT) and relational view (RV). RBT and RV have their foundation in strategic management.

3.1.1 Transaction cost theory

In Coase's (1937) article 'The Nature of the Firm', TCT was originated. A transaction cost refers to a cost using the price mechanism. Coase (1937, p. 3) attempted to find "*why a firm emerges at all in a specialised exchange economy*", and contended that firm would expand until costs of organising transactions within the firm reaches the same costs of implementing the exchange transactions on the open market or the costs of organising in another firm.

TCT is vitally related to the efficient governance structure of transactions. TCT is regarded as an influential theory which is useful in explaining relationships between organisations (Williamson, 1975). Williamson (1975) investigated how hierarchies and markets represent alternative governance mechanisms to carry out transactions, and argued that hierarchies turn into a dominant mechanism if a price system cannot offer accurate and reliable market signals. TCT introduces three types of organisational forms: *intermediary, hybrid and of collaboration mode*, so collaboration is regarded as a hybrid form of governance (Williamson, 1991). TCT primarily queries which kinds of governance structure are the most cost-minimising for the attributes of the actors, environmental uncertainty and the frequency of a transaction. Such diversity of organisational forms is an advantage of TCT. Transaction costs contain realised costs of drafting, running, negotiating and safeguarding agreements including *ex post* reasons such as haggling, maladaptation, establishment, operational and bonding costs arising from misalignment between organisations (Williamson, 1985).

Kaufman *et al.* (2000) asserted that the choice of either vertical integration, hierarchies or market mechanisms hinges on the monitoring costs that occurred from bounded rationality and uncertainty due to partners' opportunism, and pointed out that SCC may assist firms to reduce the cost of opportunism and monitoring based on mutual trust and integration for mutual interest through the partnership. Hybrid governed structures with relational governance mechanisms have been referred to as collaborative relationship (Nyaga *et al.*, 2010). TCT gives the rationale why organisations collaborate with one another. Organisations not only can share the markets and internal organisations as a form of governance, but reduce the uncertainty (Park and Russo, 1996). Organisations under collaborative activities with others are likely to possess a willingness to give and take in the relationship, which generates an opportunity for continuing administration of exchanges and assists the relationship to adapt over time (Williamson, 1993). TCT academics often mentioned that cooperative agreements could be the most efficient form of organisation (Hennart, 1988). Therefore, TCT sometimes advocates the presence of SCC in favour of information exchange amongst organisations since market mechanisms sometimes fail to transfer effective knowledge.

3.1.2 Resource based theory

This research is fundamentally interested in whether SCC between ports and port users influences CA and PP. To explain how competitive advantage is achieved by MLOs, it would be appropriate to begin with theoretical foundations from RBT. Traditionally academics who examined RBT have regarded firms as independent entities, and this view hardly provides a full explanation about the proliferation of inter-firm relationships (Lavie, 2006). Wernerfelt (1984) argued that firms can achieve and sustain competitive advantage by having and developing valuable resources and capabilities. A resource refers to an organisational asset that is either tangible or intangible for firms to create as a strategy (Barney, 1991). Specifically, the resources are broadly defined as all types of assets, organisational processes, knowledge, capabilities and other potential sources of competitive advantage that are owned or controlled by the focal firm. In other words, the three key elements of RBT were resources, capabilities and strategic assets (Barney, 1991). Amit and Schoemaker (1993, p. 35) also defined resources as *"stocks of available factors that are owned or controlled by the firm",* whilst Wernerfelt (1984, p. 172) defines resources as *"tangible and intangible assets which are tied semi-permanently to the firm"*. In addition, capabilities refer to the firm's ability to combine, develop and deploy its resources to generate competitive advantage (Amit and Schoemaker, 1993).

There are two prerequisites for competitive advantage: resource heterogeneity and imperfect mobility. Resource heterogeneity explains that every firm does not have the same amount and sorts of resources whilst imperfect mobility involves resources which are not non-tradable or less valuable to users other than the firm which owns them (Barney, 1991, Peteraf, 1993). Makadok (2001) argued that resources can be seen as tradable and non-specific to the firm whilst the feature of capability is viewed as firm-specific and used to utilise the resources within the firm. From the perspective of strategic alliance, resources are divided into property-based and knowledge-based resources (Das and Teng, 2000).

RBT argued that firm performance differs according to resources such as core competence (Prahalad and Hamel, 1990), abortive capacity (Cohen and Levinthal, 1990) and dynamic capability (Teece *et al.*, 1997). Firms can possess a sustained market advantage by having scarce resources and assets and excelling in core competencies and capabilities (Knudsen, 2003). Barney (1991) asserted that in order to sustain competitive advantage, which is rare, valuable, non-substitutable and difficult-to-imitate firm should invest in relation-specific assets. Gulati (1999) claimed that resources amongst alliance partners that can be transferred by interactions has a significant influence on firm performance, and these network resources can span the opportunity set of the firm. Collaboration between firms encourages them to concentrate on their core activities, so they can develop specific skills and economies of scale as well as learning effects so as to increase their positions (Park *et al.*, 2004). The level of whether resources and capabilities are reserved within the firm or transferred to other partners should be carefully considered according to the firm's strategy. Regarding this issue Prahalad and Hamel (1990) contended that less valuable resources can be outsourced to other firms whilst valuable resources and capabilities must be retained within the firm.

Ramanathan and Gunasekaran (2014) argued that SCC is viewed as one of the initiatives of RBT that encourages supply chain partners to exchange knowledge and share information for enhancing their supply chains. RBT regards complementary resources as an important factor for the driver of inter-organisational collaboration, so firms are willing to seek partners that have the complementary and appropriate resources they require. RBT maintains that concentration on relation-specific assets and uniting complementary resources can yield success (Knudsen, 2003). The relational assets and the causal ambiguity between supply chain partners are not likely to be imitated by rivals (Jap, 2001).

3.1.3 Relational view

Dyer and Singh (1998) argued that the relational view (RV) supplements RBT by contending that resources can extend beyond firm boundaries and become embedded in inter-firm resources and routines. Relational rents are generated in an exchange relationship through joint contributions amongst collaborative partners. If partner firms exchange and combine idiosyncratic assets, capabilities and knowledge complementary by escaping from simple arm's-length exchanges, resulting in inter-organisational competitive advantage through relation-specific investments, knowledge-sharing routines, complementary resource/capabilities and effective governance, relational rents can be obtained. They discussed not only how the relational view provides normative prescriptions in terms of the firm-level to complement RVT or industry structure theory, but also how organisations can maintain inimitability. However, these theories do not cover a procedure for how these features interconnect to one another so as to create collaborative advantage.

In addition, they argued that TCT and RBT ignored a fact that a firm can be sometimes connected to the network of a relationship in which the firm is embedded, so it is not appropriate to explain inter-organisational competitive advantage. From this perspective, a relationship between organisations can be a source of competitive advantage. Previous empirical research showed that productivity acquisitions in the value chain are viable if partners make relation-specific investments and mix resources in distinctive ways. For example, a close relationship between Japanese suppliers and their automakers created surplus profits and competitive advantage (Asanuma, 1989). Lavie (2006) contended that an alliance governance structure and inter-firm routines can enable firms to share knowledge and information within the alliance, creating relational rents. Therefore, RV effectively complements both RBT and TCT.

This implies that relational rents accrue due to resource complementarities amongst firms, and firms which have combined resources in such ways may achieve advantage over competitors who are unwilling to do so (Dyer and Singh, 1998). However Dyer and Singh (1998) did not postulate the amount of relational rents appropriated by each firm in the inter-firm relationships, and argued that final relational rents may be barely allocated equally between them. Besides, latent advantages of partner firms resulting from the joint relational rents would be limited to those of the focal firm (Lavie, 2006). Regarding this issue, Stuart (2000) demonstrates that a petty firm that owns limited resources takes more advantages than other rich firms. Cao and Zhang (2011) argued that collaborative advantage is based on RV that highlights common advantages which firms cannot create alone. For mutual benefits, relational rents accumulate at the collaboration level. The RV underlines common advantages that inter-firm partners can hardly generate independently (Lavie, 2006). As a result, collaboration allows firms to create relational rent. In the maritime context, the ability of containerised MLOs to recognise and exploit interdependencies between ports and port users will shape their capability to generate value in maritime logistics (De Martino and Morvillo, 2008). For this study, collaborative advantage is the principal foundation of the RV.

3.2 Supply chain collaboration

This purpose of this section is to investigate the concept of supply chain collaboration (SCC) as a major construct of this study.

3.2.1 Supply chain management and supply chain collaboration

SCM philosophy highlights that optimising service to customers at the lowest total cost needs not only a strong commitment to close relationships amongst supply chain members, but also an alteration away from arms-length toward long-term and partnership-type relationships in order to generate greatly competitive supply chains (Stank *et al.*, 2001). The major difference between SCM and traditional material management is how collaboration of trading partners is dealt with (Li, 2012). Firms in various industries such as agriculture, automotive, computer, retailing, logistics, construction, health care, tourism, manufacture and distribution have recognised the potential benefits of applying an SCM philosophy. The immediate benefit originating from SCM is to generate efficiencies and reductions in warehousing, distribution, transport costs and inventory risks across a wide range of business processes, whilst the most significant benefits are to raise customer responsiveness, flexibility for fluctuating market circumstances, customer service and satisfaction, customer loyalty and effective marketing (Horvath, 2001).

Numerous academics have defined SCM in various ways, so it is difficult to seek a perfect definition for SCM. Nonetheless, investigating diverse definitions appears to be useful. SCM is defined as the coordination of activities, within and between vertically linked firms for serving customers at a profit (Larson and Rogers, 1998). Stank *et al.* (2001, p. 30) stated that SCM concept incorporates "*the broad array of activities needed to plan, implement, and control sourcing, manufacturing, and delivery processes from the point of raw material origin to the point of ultimate consumption*". Mentzer *et al.* (2001, p. 18) defined it as *"the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across* *businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole"*. Spekman *et al.* (1998, p. 54) considered SCM as *"a process for designing, developing, optimising and managing the internal and external components of the supply system, including material supply, transforming materials and distributing finished products or services to customers, that is consistent with overall objectives and strategies"*. Strategic SCM requires collaboration amongst supply chain members in the value chain (Horvath, 2001). Stank *et al.* (2001) argued that SCM extensively involves integration, coordination and collaboration throughout the supply chain.

A magnitude of terms such as integration, collaboration, coordination and cooperation are interchangeably used to describe supply chain relationships because they are comprised of similar concepts (Arshinder *et al.*, 2008). According to Spekman *et al.* (1998), the main activities from cooperation, coordination and collaboration between organisations are different. In addition, Huxham (1996) contended that terms cooperation, collaboration, coordination, alliance, network, partnership and coalition are apt to be generally used to depict positive forms of inter-organisational relationships. Therefore, in order to fully understand those terms, it is imperative to define related words such as cooperation, coordination, collaboration and integration respectively. The followings definitions assist.

Cooperation

Generally, cooperation may represent a relationship between related parties with compatible aims for reciprocal advantage. Fritsch (2004) argued that there is no typical definition of cooperation in the extant literature. According to

Gnyawali *et al.* (2006), for the aim of mutual benefit, organisations interact with each other by sharing complementary capabilities and resources. Wilhelm and Kohlbacher (2011) assumed that cooperation operates in circumstances in which firms attempt to attain mutual benefits through joint activity for compatible goals. Cooperation relies on trust and mutuality in pursuit of harmonious relationships by entail collective actions (Bengtsson and Kock, 1999). From a supply chain context, cooperation encompasses complementary, similar and coordinated actions within firm relationships with the intention of achieving excellent mutual outcomes (Fawcett and Magnan, 2002).

Coordination

Coordination starts with an assumption of differences to achieve efficiency. It is a context that disparate parts will pull in harness (Denise, 1999). Malone and Crowston (1994, p. 90) defined coordination as *"managing dependencies between activities. If there is no inter-dependence, there is nothing to coordinate"*. According to Himmelman (1996) coordination involves an information exchange and activity alteration in pursuit of mutual benefit and a common purpose. As an example of coordination, two different organisations share information concerning their activities and then agree to modify its schedules or details so that they can better satisfy their customer's needs.

Collaboration

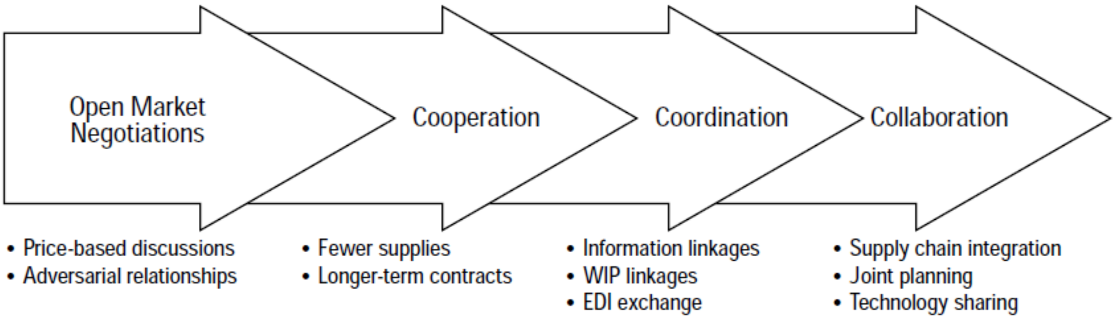
Gray (1989) stated that collaboration is different from cooperation since it needs the inter-dependence of the stakeholders, the ability to solve the differences, joint ownership for decisions and collective obligation for the partnership. In addition, collaboration is a dynamic and emergent process whilst cooperation is a static process (Gray, 1989). Sumpor (2006, p. 2) also contended that collaboration is regarded as the most advanced form of cooperation, and it needs *“establishments of formalised inter-institutional relationships, consensus building, and agreements as well as respect for positive informal institutional relations, such as openness for communication and fulfilment of agreements”*. Collaboration is defined as a decision making process between inter-reliant firms, sharing commitment, resources and bond (Stank *et al.*, 2001). According to Ang (2008) collaboration is defined as voluntary cooperation in sharing and exchanging resources, joint production development, technologies and services amongst players. Collaboration is an official form of relationship by working together amid different organisations (Osarenkhoe, 2010). In addition, McCarthy and Golicic (2002) defined collaboration as a procedure in which clusters of independent stakeholders in a common issue are involved in using shared rules, norms and structure. According to Kanter (1994), the strongest form of the collaboration is value-chain partnerships. Different but complementary expertise can connect capabilities between firms in different industries to generate value for future users. In such relationships commitment not only occurs, but also shared activities can be developed. Consequently, the collaboration relationship markedly changes each partner’s organisation (Kanter, 1994). Taken overall, Harrison and Van Hoek (2005) and Spekman *et al.* (1998) typified three kinds of different partnerships, elaborating each characteristic as Table 3.1 and Figure 3.1. They asserted that commitment and trust are the most important aspects to achieve some advantages from these partnerships, whilst representing both advantages and disadvantages of partnerships. In summary, the meaning of cooperation, coordination and collaboration is slightly different according to various academics. Nonetheless, from the aforementioned definitions, as a result, collaboration appears to encompass cooperation and coordination.

Table 3.1 Characteristics of partnership types

Partnership type	Activities	Time horizon	Scope of activities
Cooperation	Fewer suppliers Longer-term contracts	Short-term	Single functional area
Coordination	Information linkages WIP linkages EDI exchange	Long-term	Multiple functional areas
Collaboration	Supply chain integration Joint planning Technology sharing	Long-term with no fixed date	Firms see each other as extensions of their own firm

Source: Harrison and Van Hoek (2005, p. 254)

Figure 3.1 The key transition from open-market negotiations to collaboration



Source: Spekman *et al.* (1998, p. 57)

Particularly, Spekman *et al.* (1998) argued that the difference between cooperation, coordination and collaboration is that cooperation and coordination are implemented during their normal activities with other firms whilst collaboration is acquired only when there is a certain level of trust and commitment and information sharing between firms beyond simple exchanges of information. For example, supply chain integration, planning together and sharing technology are central activities of collaboration that firms share (Spekman *et al.*, 1998).

It is important to know what integration precisely means because sometimes it looks similar to the activities of collaboration, coordination, cooperation, partnerships or alliances.

Integration

In Webster's Third New International Dictionary (1966, p. 1175), the term *integration* defined as *"the unified control (or ownership) of several successive or similar process formerly carried on independently"*. Dyer (2000) stated that vertical integration may involve the extent to which the firms keep control over offering all its own inputs. It should be noted that vertical integration has collaborative advantage related to partnerships, but it entails some liabilities when circumstances are uncertain. It might cause loss of high-powered market incentives, loss of scale and access to outside customers, loss of strategic flexibility and higher labour costs. In terms of a loss of high-powered incentives, although vertical integration can reduce opportunism, it might eliminate the strong incentives for output and rewards. Moreover, vertical integration leads to a loss of scale and access to outside customers because of a loss of economies of scale and information from customers, offering a lot of valuable ideas. Another liability of vertical integration may increase the size of firms with extra layers and centralisation, causing communication distortions and slowness in decision making. Finally, there is a general trend that a larger firm size needs to pay higher wages and benefits than a small firm size, and worker unions' power would be strengthened These reasons demonstrate why vertical integration is not always superior to partnerships (Dyer, 2000). The fact that effective integration should encompass a common vision, shared resources, mutual understanding and collective goals is regarded as a challenging task (Kahn and Mentzer, 1996).

In the SCM context, although the term supply chain integration (SCI) and SCC are interchangeably used by many academics, both represent a close collaborative relationship and processes amongst supply chain partners (Cao and Zhang, 2011). However, the integration requires investments in the relationship and resource sharing. Effective integration comprises the mutual understanding, shared vision and resources and accomplishment of collective goals (Kahn and Mentzer, 1996). Cao and Zhang (2011, p. 163) pointed out that SCI involves an "*emphasis on central control, ownership, or process integration governed by contract means*". Instead, the term *collaboration* indicates governance through relationships rather than contracts (Nyaga *et al.*, 2010). In the maritime context, Heaver (2010, p. 458) highlighted that *"attention has focused more than previously on the effective coordination among operations in and related to ports irrespective of ownership. This makes it appropriate to distinguish between the use of 'integration' referring to corporate and related organisational relationships and 'coordination' referring to communication and operating relationships. This is to avoid the use of 'integration' for both common ownership and the coordination of services and to give greater recognition to the challenges of achieving effective coordination along logistics chains"*.

A considerable body of literature has made endeavours to adequately define SCC. Collaboration amongst supply chain members is one of the growing issues that have received much attention in SCM. Both academics and practitioners have indicated gradual interests in SCC under the banner of concepts such as Collaborative Planning Forecasting and Replenishment

(CPFR), Efficient Consumer Response (ECR), Vendor Managed Inventory (VMI), Collaborative Transportation Management (CTM) and Continuous Replenishment (CR) (Esper and Williams, 2003, Holweg *et al.*, 2005). Notwithstanding its rising attentions to SCC, it is not as well defined as it needs to be (Holweg *et al.*, 2005). Simultaneously, various models such as Voluntary Inter-industry Commerce Standards (VICS) and the Supply-Chain Operations Reference (SCOR) model were developed due to the demand for implementing effective SCC (Vereecke and Muylle, 2006). The driving force of effective SCM is collaboration (Horvath, 2001). In a similar vein, Matopoulos *et al.* (2007) stated that SCC has become an essential and integral element of SCM. Consequently, SCC is a strong means in obtaining effective and efficient SCM as an ultimate core capability (Mentzer *et al.*, 2000), vital dynamic capability (Fawcett *et al.*, 2012), requiring partnership-type arrangements rather than arms-length interactions (Stank *et al.*, 2001). The underlying motivation behind SCC is that a single organisation barely competes by itself (Min *et al.*, 2005).

As for the term SCC, there appears to be little consensus on its definition under different names, including supply chain coordination, collaborative supply chain, supply chain partnering (partnership) and demand collaboration. Simatupang *et al.* (2004, p. 57) defined SCC as *"two or more independent firms jointly working to align their supply chain processes so as to create value to end customers and stakeholders with greater success than acting alone*". It is also similarly defined as *"diverse entities working together, sharing processes, technologies, and data to maximise value for the whole group and the customers they serve"* (Foster and Sanjay, 2005, p. 31). Fawcett *et al.* (2008, p. 93) distinguished *"SCC as the ability to work across organisational boundaries to build and manage unique value-added processes to better meet customer needs"*. In the logistics context, SCC starts with customers and spans back through the organisation from finished goods distribution to manufacturing and raw material procurement as well as to material and service suppliers (Stank *et al.*, 2001). Simatupang and Sridharan (2002, p. 19) introduced SCC as *"two or more chain members working together to create a competitive advantage through sharing information, making joint decision, and sharing benefits with result from greater profitability of satisfying end customer needs than acting alone"*. Holweg *et al.* (2005) mentioned that SCC stands for simply holding consignment stock for some parties; for others it means a comprehensive philosophy on how to manoeuvre the stock replenishment and production rates across supply chain systems. Wiengarten *et al.* (2010) claimed that SCC is conceptualised as the extent to which a firm shares information, costs, risks, benefits and makes joint decisions with its key suppliers. SCC can be conceptualised as external collaboration with customers and suppliers and internal collaboration between departments (Stank *et al.*, 2001, Wiengarten *et al.*, 2013).

Boddy *et al.* (2000, p. 1004-1005) defined supply chain partnering *"as a situation in which there is an attempt to build close, long-term links between organisations in a supply chain that remain distinct, but which choose to work closely together"*. However, the term *collaboration* compared to *partnership* is slightly different because the former embraces both conflict and partnership with some form of mutuality without a clear requirement for lifetime commitment or total openness and trust (Burnes and New, 1997).

3.2.2 The characteristics of supply chain collaboration

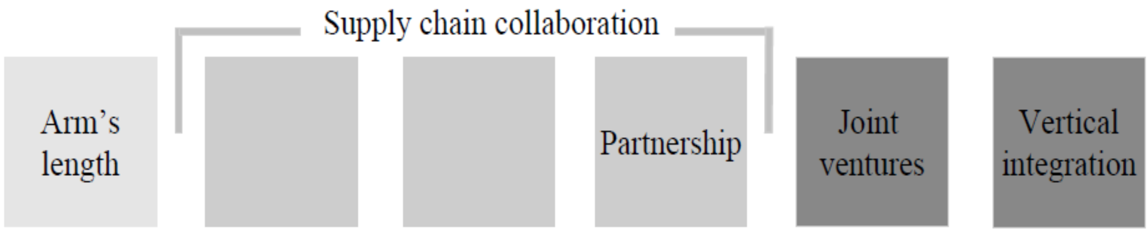
It is imperative to acknowledge that collaboration is an evolving process rather than a static process (Lambert *et al.*, 1999). The term *collaboration* has been changed from a purely theoretical concept to a broadly adopted supply chain practice in recent last decades (Wiengarten *et al.*, 2010). In fact, the concept of SCC is not only getting broader and spanning numerous dimensions of supply chain (Arshinder *et al.*, 2008), but also very extensive with different targets (Kampstra *et al.*, 2006). Nonetheless, collaboration strategies and processes yet were to be understood comprehensively (Fawcett et al., 2012).

The collaborative buyer-seller dyad relationship was primarily investigated during the 1980s as an advent of traditional SCC approaches. This relationship may be considered as an overarching supply chain concept (Wiengarten *et al.*, 2013). The transactions between the buyer and seller primarily hinged on arms-length based on price, whilst in the 1990s their relationships have transformed to highlight the importance of trust stemming from collaboration and sharing information (Hoyt and Huq, 2000). Then, this dyad relationship has been spanned with multiple supply chain partners involving more stakeholders and organisations. Now, SCC partners encompass first, second, and even third tiers of suppliers and customers, third-party logistics providers, retailers and distribution centres with numerous functions such as material management, production planning, transport, inventory, information and control, storage, warehousing, purchasing, procurement and packaging over lengthy time horizons. In addition, the dyad relationship based on one partner would influence relationships with other linked partners, which adjust the whole practices and supply chain performance based on the goals of the network rather than the dyad (Kähkönen, 2014).

SCC is different from arm’s length relationships, which are concerned with transactions based on price as a zero-sum case without any collaboration forms.

SCC is also different from joint ventures or vertical integration, whereby it entails some degree of common ownership across the various organisations (Kampstra *et al.*, 2006). Figure 3.2, SCC shows the scope of SCC in this study.

Figure 3.2 Types of relationships



Source: Kampstra et al. (2006, p. 314)

The organisation attempts to initiate SCC because of numerous antecedents or contexts: (1) external market-driven forces (Esper and Williams, 2003); (2) uncertain environments (Cao and Zhang, 2011); (3) organisation's strategic intentions for sharing risks and resources (Esper and Williams, 2003); (4) shorter product life cycles (Soosay *et al.*, 2008); (4) competitive pressure to reduce costs (Soosay *et al.*, 2008, Fawcett *et al.*, 2012); (5) Customer demands for higher service levels (Fawcett et al., 2012); (6) need to establish global reach. Managers recognise today's turbulent and intimidating environments, so they strive to grasp collaboration, which is crucial to changes and competitiveness (Fawcett et al., 2012).

A prerequisite for the presence of SCC is the existence of supply chains in addition to collaboration (Matopoulos *et al.*, 2007). It is well-known that collaboration includes a power game amongst supply chain member (Simatupang *et al.*, 2004). Powerful retailers often shift some revenues arising from supply chain activities to their upstream supply chain members (Munson *et al.*, 1999). In this sense, Turnbull *et al.* (1992) argued that less powerful players may lose as much in ostensibly collaborative relationships as in an adversarial one.

In general, close SCC is characterised by various traits as below (De Leeuw and Fransoo, 2009, p. 721).

- *A long-term business relationship between organisations;*
- *Close cooperation and coordinated activities between business partners on aspects such as information sharing, joint planning, joint demand management and joint inventory management;*
- *Bridging distinct groups within and across firms;*
- *Shared or common objectives*
- *Shared perspective of the merits of close ties;*
- *Creating visibility*

Fawcett *et al.* (2008) proposed a three-stage process model for SCC: (1) create commitment and understanding; (2) remove resisting forces to SCC; (3) continuously improve collaboration capabilities. They justified their model by applying both a contingency approach and force field approach, since a contingency approach helps to identify the driving and resisting forces of SCC whilst the force field approach enables definition of the interactions between those forces and their impact on SCC. Three-stages, which are interdependent, may expand the boundaries suggested by the force field approach. This second stage appears to be very important. It consists of five factors such as (1) information sharing and systems integration; (2) people management and development; (3) SC performance management; (4) retionalisation and simplification; (5) relationship management and trust building. To achieve higher degrees of SCC, the change towards the next stage is encouraged. This model assists managers to understand the required behaviours and skills to obtain SCC.

3.2.3 Benefits and barriers of supply chain collaboration

A variety of benefits can be achieved via SCC from prior research. Close SCC under high uncertainty or in highly volatile markets is normally perceived as advantageous (De Leeuw and Fransoo, 2009). The underlying rationale behind SCC is because a single organisation cannot efficaciously compete by itself (Min *et al.*, 2005). In fact, SCC can reap the benefits of vertical integration without the onus of financial ownership (Daugherty *et al.*, 2006).

The aim of SCC is to plan and conduct better ways to solve problems and convey value for customers (Fawcett *et al.*, 2008). Generally, SCC amongst supply chain members results in lower total cost, revenue enhancements, operational flexibility, demand planning, inventory visibility, new knowledge and skills, reduced inventory, more efficient use of human resources, reduced cycle times, sharing risks, improved technology capabilities, stronger focus on core competencies, increased sales and returns, enhanced customer services, enhanced customer responsiveness, and improved service performance to deal with high demand uncertainty (Lee *et al.*, 1997, Andraski, 1998, Mentzer *et al.*, 2000, Stank *et al.*, 2001, Sabath and Fontanella, 2005). Notably, Mentzer *et al.* (2000) found that unexpected benefit was enhanced supply chain partner's public image. Organisations also achieve benefits by sharing risks and rewards. Cetindamar *et al.* (2005, p. 239) identified the three main benefits of SCC by interviewing managers in the Turkish textile supply chain as follows.

- *Customer related benefits: lead time reduction, market share increase, responsiveness to customer needs, on time product delivery, enhanced customer satisfaction, and improved product quality;*
- *Productivity related benefits: productivity increase, energy, labour, and material cost reductions;*
- *Innovation related benefits: ability to implement new processes and improvement in product/process development cost and time*

Holweg *et al.* (2005) posited that negative bullwhip effects can be mitigated by decreasing inventory fluctuations and turbulence of markets via SCC. Moreover, it creates synergy to encourage joint planning and real-time information exchange (Whipple and Russell, 2007). Accordingly, more and more companies have started to collaborate with their supply chain members owing to several advantages of adopting SCC (Soosay *et al.*, 2008). Table 3.2 shows various benefits from collaborative supply chain activities.

Table 3.2 Collaboration benefits according to supply chain activities

Supply chain activities	SCC benefits
Procurement	-Less time searching for new suppliers and tendering -Easier management of a reduced supply base -More stable prices
Inventory management	-Lower stock holdings -Increased asset utilization
Product design and new product development	-Faster product development -Knowledge sharing & increased innovation capacity -Better quality following from involvement of supplier in design
Manufacturing (planning)	-Increased product quality -Minimised supply disruptions
Order processing Distribution	-Increased responsiveness -Faster delivery -Flexible delivery
Sales	-Rapid access to markets -Increased market share -Improved promotional events

Demand management	-More accurate forecasts -Joint resolution of forecast exceptions
Customer service	-Improved product availability -Improvements in lead times

Source: Matopoulos *et al.* (2007, p. 179)

Notwithstanding the various benefits stemming from SCC, SCC entails barriers and risks. SCC is not a completely unproblematic concept as a panacea due to its difficulty in practical implementation (Barratt, 2004). Many organisations are reluctant to enter into formal SCC arrangements owing to a lack of comprehensive understanding of SCC and its positive impact on outcomes (Ramanathan and Gunasekaran, 2014). Sabath and Fontanella (2005, p. 24) pointed out that *"collaboration arguably has the most disappointing track record of the various supply chain management strategies introduced to date"*.

Confusion around the optimum number of partners, duration of partnership and the investment in collaboration are regarded as obstacles of healthy collaboration (Ramanathan, 2014). Major barriers to SCC are categorised into organisational and operational dimension (Ramanathan, 2014). A deficiency of internal integration as an organisational barrier may be a demanding obstacle to utilise demand and forecast information as an operational barrier (Smaros, 2007). Boddy *et al.* (1998) contended that undertaking supply chain partnering is difficult because it entails radical changes, considerable workloads, and they recognised six underlying obstacles in supply chain partnering: (1) underestimating the scale of change which partnering involves; (2) underestimating the changing environments surrounding partnering; (3) priority conflicts; (4) over-dependence on relations; (5) inadequate definition of cost, benefit and value-adding models; (6) insufficient focus on the long-term relations. From the Turkish textile supply chain, Cetindamar *et al.* (2005)

posited three barriers to SCC: (1) lack of common goals for cooperation; (2) risk-benefit evaluation; (3) lack of trust. Fawcett *et al.* (2008) noted that inappropriate information sharing, inconsistent metrics and turf conflicts are predominant barriers to SCC.

Sometimes, due to the discrepancy of power, supply chain members tend to look for a common lever that encourages them to realise the potential benefits of SCC (Simatupang *et al.*, 2004). Although the chief motivation in SCC is to obtain a win-win situation, there is often a huge discrepancy between the potential and the practice. Indeed, the influence of SCC on outcomes may be determined by the exercise of power in asymmetric relationships as a critical obstacle. Power refers to the ability to influence decision-making and actions of the other party (Kähkönen, 2014). The more resources and capabilities the organisation possess, the more power there will be. Kähkönen (2014) found that the depth of collaboration hinges on the actors' complementary capabilities and resources to optimise their efficiency and utilisation of their own capabilities.

Additionally, the lack of common goals, which is defined as the belief in benefits of SCC and risk or benefit sharing among supply chain partners, may result in opportunistic behaviours and weaken trust (Cetinmadar *et al.*, 2005; Fawcett *et al.*, 2012). Collaboration is frequently hampered by inter-functional and inter-organisational conflicts (Barratt, 2004).

In the maritime contexts, the number and complexity of the relationships are the major factors that make it difficult to achieve collaboration amongst activities in ports, since MLOs influence and are influenced by relationships along a single chain and by interactions with other MLOs of other chains (Heaver, 2011). The major risks include the loss of substantial investments in money, time and delay or abandonment of business plans (Matopoulos *et al.*, 2007). In addition, due to lock-in of partners, close SCC may result in inertia, which lets suppliers wait for customers to take actions to improve and *vice versa,* and therefore lack of progress in a partnership (De Leeuw and Fransoo, 2009).

Conducting SCC is not an easy task, even when previous communication restraints in regard to efficient data and information exchanges, have been more or less surpassed by the information and communication technology revolution and the development of e-business applications (Matopoulos *et al.*, 2007).

3.2.4 Components of supply chain collaboration

Conceptualising a phenomenon by recognising components of it is important if it is, in nature, abstract, or hard to define (DeVellis, 1991). A wide adoption of SCC philosophy needs measurements to objectively measure the degree of collaborative practice in order to benchmark the best practices (Simatupang and Sridharan, 2004, 2005a). In spite of the diffusion of SCC related studies, not many instruments to measure SCC are available. SCC is complex, vague, and multidimensional in nature involving constructs that go beyond the mere exchange of information (Wiengarten *et al.*, 2010). Intensive efforts were performed to conceptualise SCM and SCC.

Stank *et al.* (2001) classified SCC as internal collaboration and external collaboration from the logistics firms' stance in the US. Their measures for internal collaboration are concerned with the extent to which information sharing is internally performed, whilst several scales such as integrating operations, supply chain arrangements, operational flexibility and benchmarking best practices are employed to conceptualise external collaboration. Similarly, Barratt (2004) conceptualised SCC by dividing it into internal collaboration within employees and departments and external collaboration amongst organisations. Simatupang and Sridharan (2005a) developed scales of SCC based on (1) information sharing; (2) decision synchronisation; and (3) incentive alignment. However, their measurement seems to be excessively simplified given the complicated facets of SCC. In order to supplement this conceptualisation, Wiengarten *et al.* (2010) included (1) information quality; (2) information sharing; (3) incentive alignment; and (4) joint decision making as the main constructs of SCC. They argued that the quality of the information exchanged determines the success of SCC practices by comparing the effects of SCC on performance for German automotive firms exchanging high and low quality information along the supply chains.

Holweg *et al.* (2005) identified four different supply chain configurations for SCC by analysing firms in automotive, construction and electronics sectors. This configuration is classified by the degree of inventory and planning collaboration: (1) traditional supply chain; (2) information exchange; (3) synchronised supply; (4) vendor managed replenishment. Vereecke and Muylle (2006) measured SCC by dividing it into collaboration with suppliers and customers. Their measurement for collaboration with suppliers covers a variety of aspects such as (1) information sharing about inventory levels; (2) information sharing about production planning decisions and demand; (3) forecast; (4) agreements on delivery frequency; (5) co-location of plants; (6) use of Kanban systems to acquire materials; (7) manage or hold inventories of materials at own site, while that of customers encompass a nearly similar dimensions. They viewed (1) and (2) as information exchange, while (3)–(7) were considered as structural collaboration. Manthou *et al.* (2004) propositioned a virtual e-Chain (VeC) model for SCC that is categorised into four modules: (1) E-supply chain intelligence; (2) E-supply chain partner relationship management; (3) E-supply chain process modelling; (4) E-supply chain integration. Min *et al.* (2005) recognised several constituents of SCC involving information sharing, joint planning, joint problem solving, joint performance measurement, and leveraging resources and skills by conducting a qualitative survey based on open questionnaires and interviews with practitioners in supply chains so that they can identify the key antecedents and consequences of SCC.

Amongst the extant measurements of SCC, it appears that Cao *et al.* (2010) proposed the most comprehensive conceptualisation by providing a useful framework that considers multidimensional nature of SCC. In their conceptualisation, SCC is viewed as a long-term partnership process whereby supply chain members with common goals work closely together to gain mutual benefits that are greater than organisations would obtain individually. They developed and validated seven constructs based on the US manufacturer markets: (1) information sharing; (2) goal congruence; (3) decision synchronisation; (4) incentive alignment; (5) resource sharing; (6) collaborative communication; and (7) joint knowledge creation. Interestingly, these measurements were in line with Min *et al.*'s (2005) empirical results by interviews. Incentive alignment is akin to joint performance measurement while decision synchronisation is alike to joint planning. Table 3.3 shows components of SCC according to numerous prior studies.

Table 3.3 The components of supply chain collaboration

Literature	Components or measurements of SCC	
Min *et al.* (2005)	Information sharing; Joint planning; Joint problem solving; Joint performance measurement; Leveraging resources and skills	
Vereeche and Muylle (2006)	Collaboration with supplier	Information sharing about inventory levels; Information sharing about production planning decisions and demand forecast; Agreements on delivery frequency; Co-location of plants; Use of Kanban systems to acquire materials; Manage or hold inventories of materials at own site
	Collaboration with supplier	Information sharing about inventory levels; Information sharing about production planning decisions and demand forecast; Agreements on delivery frequency; Co-location of plants; Use of Kanban systems to deliver products; Supply customer to consignment stock and/or VMI
Whipple and Russell (2007)	Collaborative transaction management; Collaborative event management; Collaborative process management	
Holweg *et al.* (2005)	Information exchange; Vendor managed replenishment; Synchronised supply	
Barratt (2004)	Cultural elements	Collaborative culture; External and internal trust; Mutuality; Information exchange; openness and communication
	Strategic elements	Resources and commitment; Intra-organisational support; The corporate focus; Demonstrating the business case; The role of technology; Openness and honesty
	Collaboration	Managing change; Cross-functional activities; Process alignment; Joint decision making; Supply chain metrics
Stank *et al.* (2001)	Internal collaboration	Integrated database and access method to facilitate information sharing; Sharing operational information between departments; Adequate ability to share both standardised and customised information internally; Providing objective feedback to employees regarding integrated logistics performance; Compensation, incentive, and reward systems encourage integration
	External collaboration	Sharing operational information externally with selected suppliers and customers; Developing performance measures that extend across supply chain relationships; Improved performance by

		integrating operations with supply chain partners; Supply chain arrangements with suppliers and customers that operate under principles of shared rewards and risks; Increased operational flexibility through supply chain collaboration; Benchmarking best practices/processes and sharing results with suppliers
Akintoye *et al.* (2000)	Trust; Reliability of supply; Top management support; Mutual interest; Free flow of information; Joint Business planning; Closer links between demand/supply; Integrated information systems; Manpower development; More frequent meetings	
Horvath (2001)	Open, low-cost connectivity; Very large, flexible, multimedia data storage capabilities; Systems and channel integration; High-level self service capabilities; Intelligence gathering and analysis; Supply chain collaboration exchanges; Sophisticated security capabilities; New electronic commerce capabilities	
Matopoulos *et al.* (2007)	Designing & governing SC activities	Selecting information & data sharing techniques & technologies; Selecting partner; Collaboration width; Collaboration depth
	Establishing & maintaining SC relationships	Managing trust; Sharing risks; Managing dependence; Sharing rewards; Managing power
Simatupang and Sridharan (2005a)	Information sharing	Promotional events; Demand forecast; Point-of-scale (POS) data; Price changes; Inventory-holding costs; On-hand inventory levels; Inventory policy; Supply disruptions; Order status or order tracking; Delivery schedules
	Decision synchronisation	Joint plan on product assortment; Joint plan on promotional events; Joint development of demand forecasts; Joint resolution on forecast exceptions; Consultation on pricing policy; Joint decision on availability level; Joint decision on inventory requirements; Joint decision on optimal order quantity; Joint resolution on order exceptions
	Incentive alignment	Joint frequent shopper programmes; Shared saving on reduced inventory costs; Delivery guarantee for a peak demand; Allowance for product defects; Subsidies for retail price markdowns; Agreements on order changes
Soosay *et al.* (2008)	Maintaining standardised operations; Joint planning; Sharing knowledge; Sharing processes; Joint investment; Synchronisation	

Cao *et al.* (2010); Cao and Zhang (2011)	Information sharing; Goal congruence; Decision synchronisation; Incentive alignment; Resource sharing; Collaborative communication; Joint knowledge creation	
Singh and Power (2009)	Customer relationship	Knowing the requirements of its customers; Measuring customer satisfaction; Process and activities that are designed to increase customer satisfaction levels; Encouraging customers' feedback; Customer feedback that is used to improve customer relations, processes, products and services; Systematic process for handling complaints; Rare misunderstandings between customers and organisation about orders; Customers contribute to the development of the organisation's values
	Supplier involvement	Seeking long-term stable relationships with suppliers; The interests of suppliers were considered when values of the organisation were developed; Seeking assurance of quality from suppliers; Suppliers are provided with information so that they can improve their quality and responsiveness; Suppliers are involved in the development of new products; The gains resulting from cooperation with suppliers are shared with them
Wiengarten *et al.* (2010)	Information quality; Information sharing; Incentive alignment; Joint decision making	
Li (2012)	Collaborative planning; collaborative forecasting and replenishment	
Nyaga *et al.* (2010)	Information sharing, Joint relationship effort, Dedicated investment	
Manthou *et al.* (2004)	E-supply chain intelligence; E-supply chain partner relationship management; E-supply chain process modelling; E-supply chain integration	
Fawcett *et al.* (2008)	Stage 1: creating commitment and understanding	Managerial commitment; SC mapping to solidity commitment and create understanding
	Stage 2: remove resisting forces to SCC	Information sharing and systems integration; People management and development; SC performance measurement; Rationalisation and simplification; Relationship management and trust building

	Stage 3: continuously improve collaboration capability	Benchmark environment, technology, and industry to keep the company focused on appropriate collaboration and at the cutting edge of SC practice; Implement collaborative improvement initiatives to constantly upgrade the company's culture of collaboration
Wilding and Humphries (2006)	Relationship quality	Creating a win-win relationship in which each side is delighted to be a part
	Relationship reliability	Concentrating on service & produce delivery, lowering joint costs & risks, building up trust
	Relationship creativity	Promoting quality, innovation & long-term approach by encouraging high performance
	Relationship stability	Synchronisation of objectives & confidence-building
	Relationship communication	Frequent, open, dialogue & information-sharing

Source: compiled by Author

3.2.5 The rising adoption of supply chain management in a maritime logistics context

Much SCM literature has primarily focused on the manufacturing industry to crystallise three key processes: planning, execution and performance measurement (Lee *et al.*, 2003). When manufacturers, the main and final consumers of maritime logistics service providers adopt new SCM practices, the latter are in turn driven to reconsider their practices and adapt their business activities accordingly. It is evident that transport and logistics should be handled within the context of optimising the holistic supply chain system (Mason *et al.*, 2007). Since the early 2000s, much maritime literature has given great emphases to SCM philosophy as a new paradigm for the definition of port competitiveness (De Martino and Morvillo, 2008). Since manufacturers in global supply chains mostly rely on maritime transport services both in inbound and outbound logistics, shipping plays a fundamental role in global SCM (Lam, 2011). In this regard, the provision of port services is a vital link in international logistics (López and Poole, 1998). Further, Bichou and Gray (2004) investigated the role of the logistics and SCM approach with an assumption that ports may gain a better use of port capacity by employing this approach.

Given the wide adoption of SCM into the maritime logistics context, diverse maritime researchers have interchangeably used various terms such as maritime supply chain, port supply chains, maritime port logistics chain, port-oriented landside supply chain and terminal supply chains. Frankel (1999) used the term *total trans-ocean supply chains*, which not only involve sea and land transport but also inter- and intra-modalism as well as storage, buffer and inspection links. He pointed out that trans-ocean supply chains can enhance the economic effectiveness of international trade by closely controlling courier package services on the basis of door-to-door in order to decrease the shippers' inventory. Lam (2011) used the term *maritime supply chain* by defining it as the connected series of activities in regard to shipping services which are concerned with planning, coordinating and controlling containerised cargoes from the point of origin to the point of destination. She considered maritime supply chain as customer-supplier vertical linked relationships between shipping lines, ports and shippers. López and Poole (1998) employed the term *port logistics chain* to describe the integrated and sequential physical and other transport activities which make the preferred products available to the final customer in ports and the maritime-land transport interface. Paixão and Marlow (2005) put forward the term *multimodal logistics supply chains* to identify service attributes of short shipping operations within multimodal transport chains. Lee *et al.* (2003) proposed the term *port supply chain* by decomposing a supply chain into a simple linear chain, comprising supply chain members, information and cargo flow, and logistics regarding export and import operations. Bichou and Gray (2005b) and Bichou (2007) pinpointed *port supply chains* including a multitude of maritime logistics organisations such as shippers, freight forwarders, port authorities, third-party logistics providers, shipping lines and terminal operators.

Identifying the parameter of the supply chain is complex. In terms of the port supply chain, it is difficult to grasp the concept of the supply chain due to the complexity and variety of entities engaged in maritime logistics. Table 3.4 indicates the different characteristics between a manufacturing supply chain and port supply chain. The port supply chain is different from the manufacturer supply chain in service characteristics, logistics characteristics, strategic and operational policies (Lee *et al.*, 2003).

Table 3.4 Comparison between manufacturing and port supply chain

	Manufacturing supply chain	Port supply chain
Objective in business entity	Same objective (low conflict) -Supplier: inventory -Manufacturer: inventory -Distributor: inventory	Different objective -Shipper: punctuality and reliability -Shipping line: turnaround time -Port: resource management, inventory, quick loading/unloading
Value-added business process	Manufacturing and assembly	Logistics (including load/unload)
Objective in business process	Lower inventory cost	Lower port time
Initiative in business process	Manufacturer	Ship and port
Business entity	Supplier, manufacturer, assembler, distributor	Supplier, shipping lines, terminal operator, ship management company, inland transport company, freight forwarder, third party logistics, port authority, shipper, consignee, distributor

Source: Lee *et al.* (2003, p. 245)

A large body of literature has attempted to adopt SCM into maritime logistics contexts for the last decade. Panayides and Song (2009) advocated that an integrated port in the context of supply chains featured unified communication, removal of wastage, cost cutting, interconnectivity, value-added services and customer satisfaction in port operations. They conceptualised four constructs: (1) information and communication systems; (2) value-added services; (3) multimodal systems and operations; and (4) supply chain integration practices to measure seaport terminal supply chain integration (TESCI) through synthesis of ports and supply chain literature. Their empirical study firstly revealed that the development of constructs related to port integration activities with other MLOs such as shipping liners leads to a rise in the degree of TESCI, so it contributed to enlightening an abstract concept of TESCI. They concluded that TESCI practices positively influence port performance, but there is a limitation in this finding because it only covers terminal operators' stances (Panayides and Song, 2009). On the other hand, Tongzon *et al.* (2009) discovered that terminal supply chain oriented does not positively on the impact performance of Incheon port in South Korea, which is not consistent result with Panayides and Song's finding (2009). Remarkably, Tongzon *et al.* (2009) found a gap in the perception of supply chain oriented between shipping lines and terminal operators. It concluded that terminal operators tend to recognise that they are providing sufficient supply chain practices, whilst shipping lines require more integrated and value-added services from terminal operators. Bichou and Gray (2004) pointed out that little research on ports addressed the aspects of logistics and SCM related to organisational networks, although ports play an important role in integrating all kinds of logistics channels as a distribution systems. The research related to SCM encourages either partnerships or integration, whereas port studies typically focus on conflict with one another or institutional fragmentation. It might be overwhelming for channel members to coordinate and integrate in the port. Organisational coordination is, however, necessary for them. This study regarded ports as not only a facilitator for value-added logistics where integral transport activities are processed, but also a sub-system of the production and supply chains. Ports even can be seen as networking sites amongst channel members in the supply chains. They discovered three different kinds of channels: *the trade channel, the logistics channel and the supply chain channel*, and pointed out that those channel interactions positively influence the degree of port integration and port performance. This empirical study showed that respondents emphasise the need for partnership or collaboration with other logistics channel members and the lack of information sharing. Further, the respondents in the port community tend to show a lack of full understanding of SCM concepts (Bichou and Gray, 2004).

Bichou and Bell (2007) attempted to evaluate channel structure and relationships of the container port industry, highlighting two ways of categorising channel approaches: *focusing on channel control, or the appreciation of conflict amongst organisations*. They asserted that the aspects of conflict differentiate the marketing channel approach from the supply chain approach that requires cooperation and integration amongst organisations, but in reality a relationship of international logistics channel has been more hostile than collaborative hitherto. Channel conflict mainly occurs when one player obstructs other players' objectives. The factors such as goal incompabilities, perceptual and expectation differences and channel power cause channel conflict. This research contributed to investigating the extent of channel power, role, conflict, performance and concentration of shipping liners as container terminal operators.

Robinson (2002) articulated that recently a port is considered not only as a place in which third party logistics service providers create, share and compete over value with one another within supply chains, but also as an intervener in a set of different organisations' supply chains. This results in a fact that competitive advantage of the port is more focusing on the level to which it is embedded in supply chains, which provide shippers with greater value for customers, not traditional efficiency or geographical location. To sum up, value creation of a port is aligned with value creation of shippers. However, this study barely examined what kinds of capabilities of a port are necessary to satisfy customers as a facilitator of successful global supply chain players.

To adopt SCM into maritime contexts, a considerable body of maritime literature advocates the use of information technology (IT). IT helps different vertical actors to exchange related information quickly and precisely in order to make an important decision readily and grasp the exact position of cargoes. Information which is created at one side of the sea leg is likely to flow all along the transport chain to the destination of the cargo (UNCTAD, 1996). In fact, sharing real-time information has been imperative to enhancing supply chain performance (Devaraj *et al.*, 2007). Through IT supply chain members within the port can facilitate collaborative activities and planning by sharing information on seamless cargo movements. Van Der Horst and Van Der Lugt (2011) argued that use of information and communication technology (ICT) eases the rationality and objectivity of decision-making for coordination between organisations, improving trust in making decisions and reducing transaction costs. By increasing collaboration of port activities through IT systems, the port can improve the infrastructures and connections (De Martino and Morvillo, 2008). Paixão and Malrlow (2003) also contended that in any logistics system information flow has to precede physical flow, and information flow refers to the transfer of all related information regarding the bureaucratic process from ship to other modes or *vice versa*. They also argued that the port should act as information distribution centres for all related parties in order to smoothly connect towards the direction of their hinterland. Further, advanced IT would reduce turnaround times for ships, which can offer lower freight rates to shippers (Tongzon *et al.*, 2009). Installing information systems offers cheap, reliable and accessible information for all actors in a port (Jacobs and Hall, 2007). This aspect is one of important roles of the port in helping other MLOs to reduce costs in operating along the port supply chain. As a result, such IT and smooth flows of information and cargoes assist shippers to lessen total logistics costs.

3.2.6 Collaboration amongst maritime logistics organisations within a port

Increased global competitiveness, the evolution of integrated logistics concepts and the increased container throughput via ports have provoked needs for collaboration amongst MLOs in the global logistics chain (Heaver, 2011). The willingness of MLOs of the port community to collaborate may have originated from a multitude of factors such as external threats, the risk of losing container traffic to other port supply chain and prominence of a vision to the provision of gateway functions to serve global supply chains (Heaver, 2011). However, SCC philosophy within the port is still in its infancy. Despite the adoption of SCM philosophy in a port context (Carbone and De Martino, 2003, Paixão and

Marlow, 2003, Bichou and Gray, 2004, Notteboom and Rodrigue, 2005, Wang and Cullinane, 2006, Carbone and Gouvernal, 2007, Song and Panayides, 2008, Panayides and Song, 2009, Heaver, 2014), the maritime industry has been a slow adopter of SCC concepts. Nonetheless, a substantial body of maritime literature has examined the importance, roles and examples of collaboration amongst MLOs.

Heaver (2011) commented that technological changes in ports and ships and the larger volume of containers via ports have provoked the importance of collaboration at the interface of ports and their hinterland, so much attention to collaboration signifies the importance of relationships between MLOs for individual functions' efficiency and the whole ports' logistics systems. Panayides (2006) explained that due to the emergence of SCM it is important that other channel members collaborate in the transport industry. In addition, the deployment of mega-carriers has caused operational bottlenecks and synchronisation disputes between transport chains, which encourage them to cooperate (Notteboom and Rodrigue, 2005). Ferrari and Benacchio (2002, p. 171) asserted that *"Cooperation between different players in the transport chain is to be positively considered because it allows the concentration of each player in its own business implementing the efficiency of the logistical service and a more rational infrastructure policy exploiting economies of scale and reducing sunk costs".* Notteboom and Rodrigue (2005) suggested that port managers should consider collaborating with other organisations such as shipping lines, shippers, railway companies, and inland transport companies to enhance supply chain practice within a port. According to UNESCAP (2005), all organisations in the port network can be beneficial by cooperation between shipping lines and container terminal operators or port authorities. Collaborative relationships between the port and shipping line enable the shipping line to be satisfied, leading to the higher degree of loyalty to the port, which contributes to the ability to solve their problems. Port tariff bargains or loyalty rebates are an example of implied cooperation between terminal operators and shipping lines (UNESCAP, 2005). Paixão and Marlow (2003) stated that as two side directional logistics nodes, ports need high coordination since their function is highly complex. The level of coordination in these port supply chain actors from seaside to landside affects the efficiency and effectiveness of ports (Brooks *et al.*, 2009).

For hinterland connection as an important factor of port success, De Langen (2004) pointed out that coordination amongst MLOs such as container terminal operators, port authority and freight forwarder is a prerequisite. The superiority of connection to hinterland depended on whether they efficiently coordinate or not (De Langen, 2004). However, there has been little attention on coordination to improve hinterland transport so far. According to Van Der Horst and De Langen (2008, p. 110-111), there are a number of reasons identified why coordination and cooperation of hinterland connection amongst MLOs are difficult as below, which gives a rise to the free-rider problem.

- *The unequal distribution of the costs and benefits of coordination;*
- *The lack of resources or willingness to invest on the part of at least one firm in the transport chain;*
- *Strategic considerations;*
- *The lack of a dominant firm;*
- *Risk-averse behaviour and a short-term focus of firms in hinterland chains*

To this point, Heaver (2011, p. 158-159) pinpointed specific conditions affecting the degree of coordination in port communities although those conditions differ according to the institutional structure of ports and logistics systems.

- *The division of responsibility along the logistics chain*
- *The mismatch of transport capacities and operating practices by mode;*
- *The complexity caused by the number of parallel logistics chains;*
- *Inadequate information exchange among actors;*
- *The effects of traffic growth*
- *The interaction of gateway logistics with the local community*

To deal with those difficulties, Van Der Horst and De Langen (2008) suggested several coordination mechanisms and feasible arrangements between hinterland transport chains as shown in Table 3.5. Effectively enhanced hinterland networks can attract more container cargo throughput. However, this study mainly focused on the European Region, especially in port of Rotterdam, so it is difficult to generalise to other regions.

Table 3.5 Four coordination mechanisms and possible coordination arrangements

Coordination mechanism	Possible coordination agreements
Introduction of incentives	Bonus, penalty, tariff differentiation, warranty, auction of capacity, deposit arrangement, tariff linked with cost drivers
Creation of an inter-firm alliance	Subcontracting, project-specific contract, standardised procedures, standards for quality and service, formalised procedures, offering a joint product, joint capacity pool
Changing scope	Risk-bearing commitment, vertical integration, introduction of an agent, introduction of a chain manager, introduction of an auctioneer, introduction of a new market
Creating collective action	Public governance by a government or port authority, public-private cooperation, branch association, ICT system for a sector of industry

Source: Van Der Horst and De Langen (2008, p.118)

Soppé *et al.* (2009) empirically identified partnerships between shipping lines and terminal operators. Although competition between shipping lines and terminal operators was intense for preoccupying the control of the port phase over the last few years, they are gradually transforming their attitude to each other with some forms of cooperation: contract, joint venture, partially owned subsidiary and wholly owned subsidiary. This empirical research found that some forms of strategic alliances between shipping lines have a propensity to establish either partnerships or networks with particular global terminal operators.

The MLOs within the container ports to a large extent may be viewed in inter-organisational relationships since terminal operators as well as other related MLOs have often suffered dominance from shipping lines with a greater bargaining power. Each MLO in the port is a member of a series of port supply chain having a different role and decision-making (De Martino and Morvillo, 2008). If the supply chain is complex, the efficient flows of information or materials amongst supply chain members are crucial (Jonsson and Zineldin, 2003). The inter-organisational relationships may be viewed to be the most crucial priority congruence in this environment so as to generate reciprocal benefits and especially satisfy a customer's need for seamless movement of information and cargoes.

Cooperation between channel members is required since each member is influenced by the other channel members to complete its mission (Osarenkhoe, 2010), leading to significant benefits such as channel efficiency, goal achievement and higher degrees of satisfaction (Jonsson and Zineldin, 2003). Nowadays terminal operators in search of integrating both horizontally and vertically are cautious about probable channel conflicts since their customers (cargoes) are likely to be footloose (UNCTAD, 2004). The others also attempt to focus on horizontal and vertical integration so as to strengthen their market positions and reduce uncertainty, transactions and transport costs because they can control and integrate within the logistics chains as an appropriate weapon in the era of global logistics (Notteboom and Winkelmans, 2001, Haezendonck and Notteboom, 2002). According to Notteboom (2002), notwithstanding the prevalence of integration in the port industry, from the terminal operator’s perspective it does not necessarily suggest that they should initiate integrated transport companies. Cooperation with related organisations in transport chains would be sufficient to facilitate the terminal function in terms of total logistics networks. Similarly, Panayides (2006) wondered whether long-term partnership activities between MLOs would be as effective as integration or not, and suggested that this topic could be a future research direction in maritime industry. To become a fourth generation port, a port should possesses aspects of agility, leanness, flexibility, JIT and virtual partnerships between MLOs in both horizontal and vertical ways (Paixão and Marlow, 2003).

Consequently, a greater level of cooperation is necessary between maritime channel organisations in order to flourish in that the port is recognised as a link of the logistics chain (De Souza *et al.*, 2003). The higher the degree of collaboration, the larger the advantages they will gain in promoting reciprocal interdependencies (De Martino and Morvillo, 2008). For instance, a shipping line based in a foreign county and a container terminal operator launch a joint venture for mutual interest (UNESCAP, 2005). Table 3.6 shows the examples of strategic agreements in the maritime industry across the world.

Table 3.6 Strategic agreements in the maritime sector

Market players	Shipping companies	Stevedores	Port authorities
Shipping companies	Vessel sharing agreement (148 agreements being with the European Commission in 2001) Joint venture (e.g. Lloyd-Triestino and Zim (2003) in AUX-service) Consortia (e.g. Cosco, K-Line, Yangming at PSW-service) Alliances (Grand Alliance, New World Alliance etc.) M & A (e.g. OMI's bid on Stelmar in the tanker sector) Conferences (Italy alone e.g. is served by 19 conferences)		
Stevedores	Joint ventures (e.g. Maersk/APM 50/50 in Xiamen Port) Dedicated terminals (e.g. HPH in four Mexican ports) Share (COSCO 17.5% in Shekou terminal) Consortia (e.g. SAGT terminal Sri Lanka with a.o. P&O Ports, P&O Nedlloyd and Evergreen)	M & A (e.g. PSA in HesseNoorNatie) Joint venture (e.g. P&O Ports and modern terminals in Shekou together with China Merchant an Swire Pacific	
Port authorities	Concessions for dedicated terminals (e.g. MSC and HesseNoordNatie in Antwerp)	Concessions (vb. Deurganckdock Antwerp PSA and P&O) Joint ventures (e.g. Ningbo Port Authority and HPH in local port)	Alliances (e.g. Port of Rotterdam and Humber Trade Zone)

Source: Van de Voorde (2005, p. 261)

According to Musso *et al.* (2000), an important role of information flows across transport networks is that they should be managed effectively whilst maritime logistics companies have to cooperate in horizontal and vertical ways in order to dominate a higher market positioning. Therefore, to generate mutual benefits and a high degree of engagement of the port in supply chains, collaborative spirit and mutual trust are essential (De Martino and Morvillo, 2008).

From traditional views by many researchers, maritime transport and logistics have been looked at as independent sub-disciplines, so they are investigated respectively without overlapped areas (Panayides, 2006). Essentially, all organisations related to the maritime industry aim to satisfy the same targets, which are shippers' needs in providing services with reliability and punctuality. Shipping lines are likely to offer homogeneous services and transportation in general. A relationship between ports and shipping lines can be regarded as a vertical relationship because ports are in charge of the provision of their facilities such as berths, container yards, gantry cranes and so on with shipping lines as its main customers. In a narrow perspective, the shipping lines are only one customer of the port. However, in a broader view, ports consider both shipping lines and other parties such as shippers, freight forwarders, inland transport companies, ship management companies and third-party logistics providers as their customers while shipping lines view shippers as their customers and regard themselves as customers of the ports. Ports have strived to satisfy the needs for both shipping lines and shippers by providing incentives in order for customers to retain a loyalty to them while shipping lines are struggling to keep their eye on shippers' demands. It may be inferred that the interests of related organisations overlap. This point of overlap might be a catalyst promoting SCC between MLOs in satisfying customers' demand in order to achieve collaborative advantage. Table 3.7 lists the motivations for SCC in the maritime context compared to the strategic management context.

Table 3.7 Motives for collaboration in a strategic management and maritime context

Motives for collaboration in a strategic management context	Motives between ports and port users in a maritime context
Shorter lead times	-Shorter time for transport of cargoes on the basis of door-to-door -A quicker response to unexpected circumstances during transporting cargoes and changed customer requirements
Focus on core competence	-Enhanced core competence as competitive advantage compared to that of other port supply chains
Knowledge and information sharing	-Information sharing between ports and port users for efficient transport of cargo to satisfy final customers -Sharing knowledge for the whole transport chain. e.g., latest knowledge regarding IT system, dangerous cargoes, value-added services
Reduction of cost and risk	-Reduced transaction costs and uncertainty through SCC between ports and port users -Reduce cost and risk through various activities. e.g., SLs initiate partially owned subsidiary acting as TO
Entry into new markets	-Entry into new market. e.g., SLs enlarged their activities towards inland transport or terminal operations
IT development	-ICT development between ports and port users
Influencing legal environment	-Affecting maritime policy to be changed by requesting together for efficient transport

Source: adapted from Seo *et al.* (2013, p. 10)

3.2.7 Supply chain collaboration in containerised maritime logistics

Maritime logistics is concerned with maritime transport (e.g. shipping, moving cargo and loading/unloading), traditional logistics functions (stripping/stuffing, storage and inventory management) and integrated logistics activities (distribution center, quality control, assembly and packaging) by applying the principles of logistics and SCM to maritime transport (Nam and Song, 2011). It acts as a bridge in the link of all relevant organisations such as suppliers, customers, warehouses, plants and other channels within logistics (Lee and Song, 2010). As members of supply chains, MLOs such as terminal operators, shipping lines, inland transport companies, freight forwarders, third-party logistics providers and ship management companies are regarded as a cluster of organisations in a port in which various logistics operators are concerned with a shared aim to convey greater value to final customers (Panayides and Song, 2008). In supply chains, the pivotal role of maritime logistics is as an intermediate stage which offers cost and capacity advantages in physical flows of goods from origins to destinations which attracts approximately 90% of global trade by volume (Nam and Song, 2011), and container shipping accounts for around 60 % of the goods by value by sea-borne transportation (Mason and Nair, 2013). The various MLOs may be viewed within inter-organizational relationships, which are complicated. If the supply chain has become complex, efficient flows of information or materials as well as successful working relationships amongst organisations within supply chains are important (Jonsson and Zineldin, 2003). Today, MLOs seek to gain competitive advantage by effectively managing the port supply chain (Carbone and De Martino, 2003, Marlow and Paixão, 2003, Paixão and Marlow, 2003, Notteboom and Rodrigue, 2005, Panayides, 2006, Wang and Cullinane, 2006, Bichou and Bell, 2007, Carbone and Gouvernal, 2007, Panayides and Song, 2008, Song and Panayides, 2008, Panayides and Song, 2009). The trend towards door-to-door container operations and the need to satisfy final customers forces traditional maritime transport to adopt a supply chain context by extending its scope (Seo *et al.*, 2013) because the provision and operation of transport by one organisation in maritime logistics is denied by spatial considerations.

A port is a complex entity engaging a series of supply chains, each of which is an independent unit aiming to maximise its members' profits (Meersman *et al.*, 2005, De Martino and Morvillo, 2008, Pallis and Vitsounis, 2011). Moreover, traditional MLOs consist of series of related but separated activities by each organisation being in charge of a narrow part of the transport service (Lam, 2011), since they are characterised by fragmentation of operating units (Graham, 1998). Due to the heterogeneity of services and service providers, collaboration between them in port services is regarded as a demanding task (López and Poole, 1998, Meersman *et al.*, 2005). However, a traditional hostile attitude between them has been transformed into a collaborative attitude due to a competitive environment and adoption of SCM in the maritime context. For example, a terminal operator who seeks a long-term relationship with other MLOs may consider them as strategic partners by developing collaborative relationships rather than contractual relationships, which might reduce channel complexity and enhance quality service (Tongzon *et al.*, 2009, Woo *et al.*, 2013). To create reciprocal benefits by satisfying final customers' requirements, MLOs in supply chains have started to conduct inter-organisational collaborative efforts within the port (Seo *et al.*, 2013). To this point, Carbone and Gouvernal (2007) contended that critical success factors in maritime logistics depend on the ability to create synergies, as well as converging interests between MLOs in the maritime and port community to guarantee reliability and high level of services and productivity. With this in mind SCC in maritime logistics is defined. It involves management of multiple collaboration processes and relationships whereby supply chain partners jointly work to ensure the provision of reliability, punctuality, value-added services, productivity and high supply chain performance in an effort to satisfy final customers' needs by creating synergies that are greater than an organisation would gain individually. In this regard, De Martino and Morvillo (2008) claimed that networks among MLOs within the port assist them to be involved in the process of customer satisfaction by co-managing diverse activities and co-overseeing critical resources so as to satisfy the customers as a decisive factor for competitive advantage.

The measurement of SCC in maritime logistics requires inclusion of collaboration which recognizes mutual interests between organizations within a port and also reflects the nature of the maritime industry. Based on exhaustive literature reviews in SCC and maritime contexts, six dimensions of SCC in containerised maritime logistics were identified:

- Information sharing (IS);
- Knowledge creation (KC);
- Collaborative communication (CC);
- Goal similarity (GS);
- Decision harmonisation (DH);
- Joint supply chain performance measurement (JPM);

Many aspects were revised and modified after in-depth discussion with academics and practitioners. Some facets focus on operational (functional) collaboration, which is geared towards efficiency improvements, while others concentrate on collaboration at the strategic level such as goal similarity (Ireland and Crum, 2005, Daugherty *et al.*, 2006, Vereecke and Muylle, 2006). Further detail of each dimension will be presented in the “observed and latent variables” section of SCC in chapter 4.

3.3 Collaborative advantage

With the emergence of strategic management, it is taken for granted that competitive advantage explains a firm’s profits and performance, particularly focusing on two views: competitive strategy and resource based theory (RBT), but the crucial fact that a firm must be connected to other firms to interact or collaborate with them has been largely overlooked (Dyer, 2000). According to Huxham (1996), collaboration is characterised by a positive form of working in close connection with other parties for mutual benefit. Hansen and Nohria (2004) explained that collaboration is considered as a source of competitive advantage since firms can sharpen distinct organising capabilities that are barely imitated by other firms. Collaboration can arise in any operational market economy, and firms pursue collaboration owing to its greater advantages compared to non-collaboration (Foss and Nielsen, 2012). In this study, collaboration only draws attention to a relationship between ports and port users, not individuals, representing inter-organisational collaboration.

Traditionally, a vertical chain of dependencies between suppliers and customers have been regarded as normal forms of interactions for companies. Either competition or compromise were the only options to compete with rivals (Verma, 2004). In a competitive environment, collaborative advantage has attracted many academics attempting to effectively explain the creation of joint competitive advantage between organisations. An individual company's strategy no longer only focuses on its own profit but it must be willing to be in harmony with its partners in the extended enterprise (Dyer, 2000).

3.3.1 Definition of collaborative advantage

Much research in management, economic geography and innovations has dealt with collaborative advantage that occurs at multiple levels as a growing conceptual construct (Foss and Nielsen, 2012). In fact, collaborative advantage receives a great deal of attention because it impinges both cooperative and competitive issues (Teng, 2003). The scope and range of collaborative advantage have increasingly expanded from the mere dyadic exchange to the national level over the last two decades (Foss and Nielsen, 2012).

Before defining collaborative advantage, from a strategic management perspective, it is necessary to review the definition of advantage. Advantage is defined as *“a relative construct, namely the potential to create and capture more value than the relevant competition over some specified period”* (Foss and Nielsen, 2012, p. 14). Collaborative advantage contrasts with competitive advantage. Collaborative advantage has been seen as a relational view of joint competitive advantage between organisations. It originated from common benefits partners accumulated through exchange, combination and co-development resources (Dyer and Singh, 1998). Lavie (2006) argued that collaborative advantage is regarded as a relational rent that maximises a common profit for joint rent-seeking activities while competitive advantage only pays attention to a firm’s own profit. In the context of collaborative advantage, the term *advantage* necessarily does not require an advantage over other organisations. In other words, it would be an advantage that may exist unless there was collaboration between organisations (Huxham and Macdonald, 1992).

Collaborative advantage, which cannot be gained by any player alone, is achieved when different players pursue collaborative action for synergistic consequences (Vangen and Huxham, 2003). It focuses on the advantage that can be achieved through any kind of collaboration between different organisations at any level of analysis, which apparently contrasts with competitive advantage (Huxham, 1993). Huxham (1993, p. 603) stated that *“Collaborative advantage is concerned with the creation of synergy between collaborating organisations”*. According to Huxham and Vangen (2004), inter-organisational collaborations such as joint ventures, strategic alliances, partnerships in public and private sector or not-for-profit organisations can be considered as a means of pursuing synergy from working together. They used the term *collaborative advantage* in the very broad way of *"achieving something that could not have been achieved by any one of the organisations acting alone"* (Huxham and Vangen, 2004, p. 30). Jap (2001) argued that collaboration that aims at expanding profit for both suppliers and buyers can produce the synergistic and supernormal outcomes, which could not be created in isolation. This implies that although this study did not directly mention collaborative advantage, this profit-expansion may be subtly interpreted as collaborative advantage, which focused on a relationship between suppliers and buyers. In this empirical research, the results suggest that collaboration between organisations is a source of competitive advantage.

According to Cao and Zhang (2011, p. 164), *"collaborative advantage is joint competitive advantage and focuses on joint value creation in dyadic relationship"*. Ferratt *et al.* (1996, p. 132) stated that *"collaborative advantage is defined as the benefit gained by a group of participants as the result of their cooperation rather than their competition".* Kanter (1994) mentioned collaborative advantage as a key asset to become a good partner, and collaborative advantage can be produced if firms improve their activities that underline altruism, trust and reciprocity. This asset may sustain collaboration allowing firms to sustain a competitive advantage.

Foss and Nielson (2010, p. 7) propose that collaborative advantage is *"potential super-normal gains from trade; specifically, because of its collaborative activities a firm is capable of creating and capturing more value that other* *meaningfully comparable firms".* It can be obtained not only from collaboration in horizontal dimensions with complementors or competitors, but also from vertical dimensions with suppliers or customers (Foss and Nielsen, 2010, 2012). To better understand collaborative advantage, the term *a relational rent* should be defined. "*A relational rent is defined as supernormal profit jointly generated in an exchange relationship that cannot be created by either firm in isolation and can only be created through the joint contributions of the collaborative partners"* (Dyer and Sigh, 1998, p. 662). Relational rents are concerned with the significance of more intangible features on cooperation such as trust, reputation, goodwill, individual level skills and competence (Knudsen and Nielsen, 2010). For example, Toyota secured its relational rents with suppliers through knowledge sharing (Dyer and Hatch, 2006). This collaborative paradigm gives a perspective that the business world is made up of a network of interdependent relationships and encouraged by collaboration for mutual benefits (Lado *et al.*, 1997).

A leading company searched opportunities to collaborate with its competitors, rather than seeking to achieve competitive advantage alone (Ferratt *et al.*, 1996). The winners in the future will develop capabilities to share knowledge within the extended enterprise that boosts the competencies of all players through their relationships. They are not only able to form trust with partners but also lower transaction costs (Dyer, 2000). According to Teng (2003), collaborative advantage has two different approaches for value creation. It not only allows firms to increase added value, but also might reduce added value of competitor firms. He proposed a variety ways of increasing value by creating buyer-supplier relationships, relationships with complementors or competitors for collaborative advantage. Table 3.8 shows a variety of alliances types for collaborative advantage.

Table 3.8 Collaborative advantage in various alliance types

Collaborative advantage	Value creation	Buyer-supplier alliances	Alliances with complementors	Alliances with competitors
Increasing one's added value	Unit sales	-Enter new market -Product development -Help buyer survive	-Explore emerging segments -Product bundling	-Enhance market power -Joint R&D -Inter-firm learning
	Unit price	-Improve quality -Enhance differentiation -Customer customisation	-Co-marketing	-Higher bargaining power against buyers -Reputation effect
	Unit cost	-Inventory management -Co-specialisation	-Economies of scope -Product/ process technology	-Power against suppliers -Economies of scale
Reducing competitors' added value	Unit sales	-Vertical relationships that exclude competitors -Entry barrier	-Pre-empt similar alliances -Diminish distinction	-Pre-empt similar alliances
	Unit price	-Affect competitors' image	-Diminish distinction -Affect competitors' image	-Joint bidding to lower competitors' profit
	Unit cost	-Intensify scarcity of supplies and distribution channels	-Increase competitors' R&D, marketing and operational cost	-Win industry standard battles -Intensify scarcity of suppliers

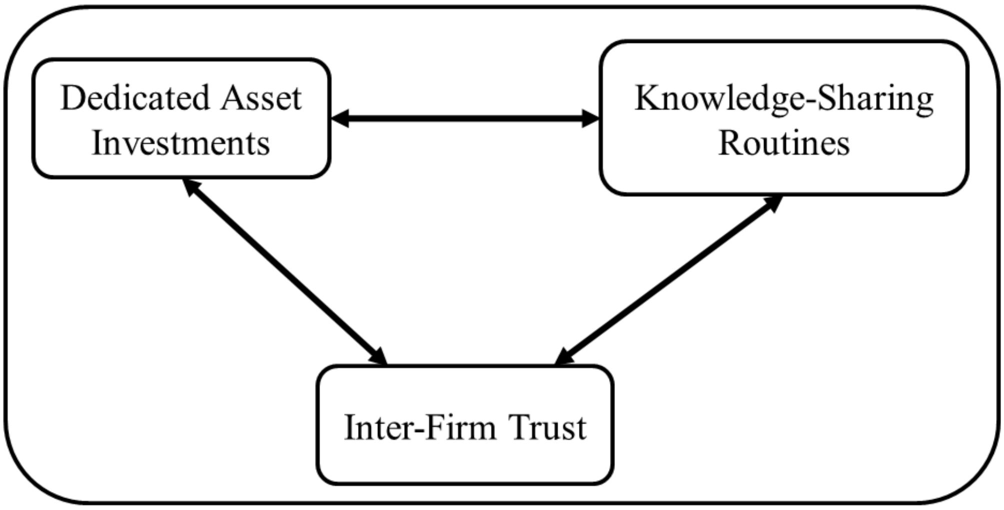
Source: Teng (2003, p. 6)

3.3.2 The antecedents of collaborative advantage

The antecedents of collaborative advantage encompass upgraded knowledge of partners and opportunities which might be recognised by learning economies, trust building and scale and scope advantages from resource pooling (Foss and Nielsen, 2010). Pouloudi (1999) stressed IT as collaborative advantage through installing inter-organisational information systems in the healthcare industry. It allows organisations to share information such as customer data, while reducing purchasing costs and allocating resources. Synergy can be achieved by collaborating with one another rather than a mere resource exchange (Lasker *et al.*, 2001). Synergy refers to the power to conjoin the perspectives, resources, expertise between different organisations (Mayo, 1997), generating valuable new products and services that are greater than the sum of their parts.

Dyer (2000) asserted that three preconditions are necessary to obtain collaborative advantage: *dedicated assets, knowledge-sharing routines and trust*. Firstly, dedicated assets are defined as investments in equipment, factory sites, procedure and human resources customised for a customer and supplier. This develops productivity and quickness within the network, so that partners can coordinate in co-developing new products and services. Secondly, knowledge-sharing routines indicate exchanges of valuable and proper knowledge between suppliers and customers. An organisation's ability to learn more quickly than its major competitors can be a sustainable competitive advantage, so knowledge management is a growing issue. In other words, identifying and accessing valuable knowledge from suppliers, customers and complementors can be regarded as one of the important factors. Thirdly, trust is regarded as the most important element for success because suppliers and customers do not need to spend substantial time and money in negotiating, transacting and agreeing contracts or issues (Dyer, 2000).

Figure 3.3 Three key source of collaborative advantage



Source: Dyer (2000, p. 38)

Dyer and Singh (1998, p. 663) identified four key determinants of relational rents that can be interpreted as collaborative advantage. In line with Dyer (2000) their research had common denominators such as assets, knowledge-sharing routines. In terms of effective governance, they emphasised the informal and intangible governance mechanisms such as trust, reputation and goodwill.

- *Relation-specific assets:*
    - *Duration of safeguards;*
    - *Volume of inter-firm transactions;*
- *Knowledge-sharing routines:*
    - *Partner-specific absorptive capacity;*
    - *Incentives to encourage transparency and discourage free riding;*
- *Complementary resources and capabilities*
    - *Ability to identify and evaluate potential complementarities;*

    - *Role of organisational complementarities to access benefits of strategic resource complementarity;*
- *Effective governance*
    - *Ability to employ self-enforcement rather than third-party enforcement governance mechanisms;*
    - *Ability to employ informal versus formal self-enforcement governance mechanisms;*

Huxham (1993, p. 605) suggested key antecedents of collaborative advantage as below.

- *Participants involved share a common:*
    - *Sense of mission and strategy;*
    - *Set of values;*
    - *Ability to manage change;*
- *Participants involved share:*
    - *Power among those involved;*
    - *Decisions about how to manage the collaboration;*
    - *The resources themselves;*
- *Participants involved agree over:*
    - *The legitimacy of participants to be involved in the collaboration including the convener;*
    - *Perceived stakeholder inter-dependence;*
    - *The values of collaboration per se;*
    - *The importance of the issue over which collaboration is to occur (or, if not, find an inducement for other to collaborate);*
- *Participants involved reflect:*

- *Through their different roles and values, the complexity of the issue;*
    - *The participants are geographically proximate;*
    - *There is supportive communication and evocative leadership to promote:*
    - *Good interpersonal relationships between individuals involved;*
    - *High awareness of each organisation's goals, services and resources:*
    - *Mutual trust;*

Kanter (1994) proposed eight criteria in achieving collaborative advantage through true partnerships: individual excellence, importance, interdependence, investment, information, integration, institutionalisation and integrity whilst highlighting relationships with commitment lead to generated value for each partner.

3.3.3 Difficulties in achieving collaborative advantage

Collaborations are not straightforward tasks to manage, so numerous organisations are likely to fail. Organisations are willing to attain collaborative advantage for synergy through heterogeneous resources, experiences, capabilities and information along the supply chain. However, sometimes those differences unavoidably compel them to seek different advantages that may result in discrepancies amongst them.

The term *collaborative inertia* signifies the negligible rate of output of pain and hard grind that are concerned with collaborative arrangements in practice (Huxham and Vangen, 2004). For example, although organisations have committed to collaborating with each other, one firm's aim might hamper the success of the others. This circumstance can be seen as *collaborative inertia*. Huxham (1996, p. 4) defined collaborative inertia as "*the situation when the apparent rate of work output from a collaboration is slowed down considerably* *compared to what a casual observer might expect it to be able to achieve"*, and indicated why this happens. Mainly, there are three reasons for this. First of all, there exist differences in aims, language, procedures, culture and perceived power between organisations. Organisations have different reasons for engaging in collaboration and sometimes their reasons may differ. Some may have a subtle purpose that cannot be disclosed easily. The reasons may vary if the language, procedures and culture amongst the organisations involved are different, resulting in inefficient communication. The imbalances of perceived power between organisations also may cause a difficulty in understanding their potential activities especially from a small organisation's perspective. The second reason stems from the tension between autonomy and accountability as well as the lack of authority structure. The organisations under collaborative activities necessitate a certain level of autonomy so as to make a process because specific activities may have influence on their parent organisations, so they require accountability to a variety of organisations. A third reason is the time needed to manage the logistics. Organisations may be physically remote from each other, so it takes time to coordinate and plan meetings. In other words, spontaneous meetings may be time-consuming as well as cost- and resource-consuming.

In order to diminish collaborative inertia, Huxham and Vangen (2005b) established a theory of collaborative advantage, which started from practical issues with a theme-based approaches, leading practitioners to give either pain or reward when collaborating. Although their study focused on collaboration in public and voluntary sectors it can be applied to any industry (Devine *et al.*, 2011). Collaboration takes costs. Huxham and Vangen (2005b) concluded that collaboration is a resource consuming activities, which has to be undertaken after thoroughly considering both advantages and disadvantages.

3.3.4 The components of collaborative advantage

Notwithstanding the rising concept of collaborative advantage derived from collaborative activities, partnerships and supply chain collaboration, little maritime literature has examined it. However, in the SCM and general management contexts, much research has explored the components of collaborative advantage. In the maritime context, De Martino and Morvillo (2008) put forward the value constellation concept that is created by the joint effort of various organisations within the port in the satisfaction of the final customer's needs through the exploitation of their interdependencies. They viewed a port as a network of players who co-create value by fostering interdependencies (sequential, pooled and reciprocal) amongst MLOs. Although they did not straightforwardly mention the term *collaborative advantage*, it can be inferred that the value constellation concept is akin to collaborative advantage in that both underline the importance in the generation of joint competitive advantage and reciprocal benefits.

Notwithstanding much attention in grasping and applying the concept of collaborative advantage, few studies have attempted to develop and validate it except for Cao and Zhang (2011). They comprehensively conceptualised collaborative advantage with five components: process efficiency, offering flexibility, business synergy, quality and innovation by validating their developed instruments using confirmatory factor analysis (CFA) and providing the validation of second-order constructs. Their measurements of collaborative advantage originally derived from competitive advantage, but they attempted to measure it by synthesising and modifying various measurements of competitive advantage in order for multiple organisations to perceive them. Table 3.9 shows the components of collaborative advantage. Due to the lack of the measurements of collaborative advantage only except for Cao and Zhang (2011) up to now, other extant studies, which measured competitive advantage, are also shown in Table 3.9 so as to facilitate the understanding of how collaborative advantage is derived from competitive advantage. The more detailed components of collaborative advantage for this study in the containerised maritime context will be presented in section 4.2.2.

Table 3.9 The components of collaborative advantage

Literature	Components or measurements of collaborative (competitive) advantage
Cao and Zhang (2011)	Process efficiency; Offering flexibility; Business synergy; Quality; Innovation
Navarro *et al.* (2010)*	Product differentiation; Distribution; Promotion or communication; Human resources; Costs; Prices
Li *et al.* (2006)*	Quality; Delivery dependability; Product innovation; Time to market; Price/cost
Teo and Pian (2003)*	Innovation; Growth; Differentiation; Alliance; Cost
Feng *et al.* (2010)*	Product quality; Customer service; Process flexibility; Delivery reliability; Cost leadership
Delmas *et al.* (2011)*	Innovation/differentiation; Reputation; Cost

Source: compiled by Author,
Note: *competitive advantage literature

3.3.5 Collaborative advantage in containerised maritime logistics

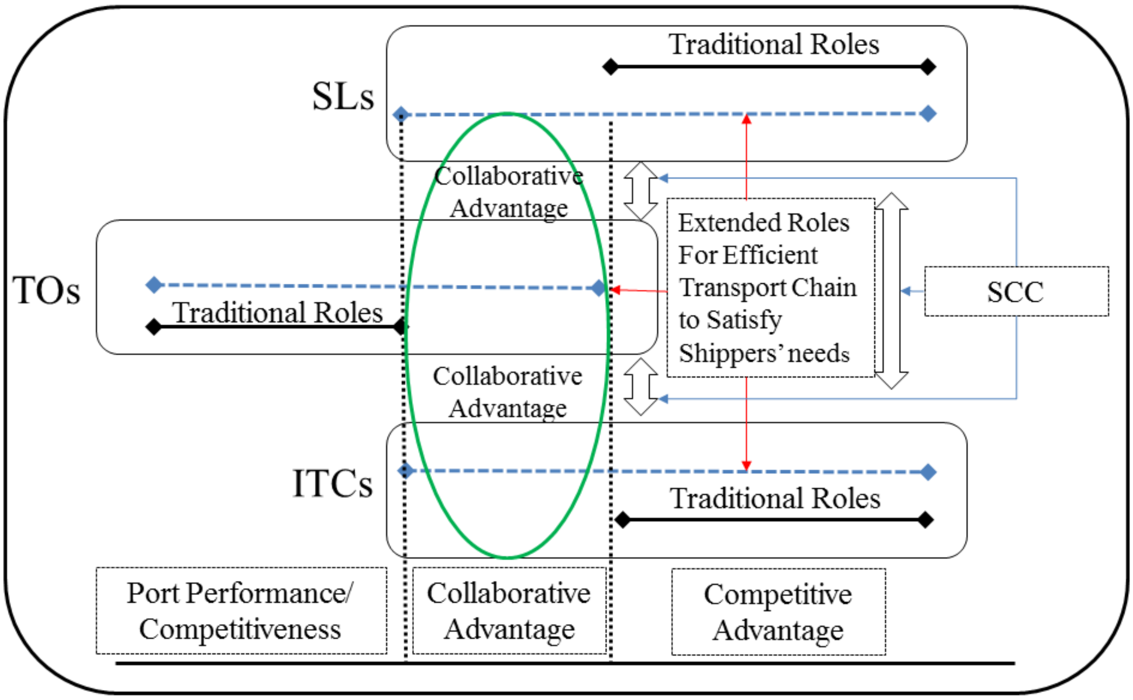
Maritime logistics is defined as a set of maritime transport processes involved in the entire logistics flows (Lee and Song, 2010). Lee and Song (2010, p. 563) explained that the value created by the maritime logistics systems can be seen as a maritime logistics value, which refers to "*the extent of how well the maritime logistics system responds to the customer demands through the successful management of the flow of goods, services and information over the maritime logistics*". They pointed out that if maritime logistics value is high it results in higher customer satisfaction and performance of both a port and related MLOs. In addition, Marlow and Paixão (2003) claimed that the application of lean production theory to ports would drive various MLOs involved in the multimodal process performance to provide the high degree of effectiveness and efficiency in operations across the port supply chain. In Robinson (2002)'s work, a concept of ports as a value-driven chain system or value chain constellation was proposed so that they deliver value to shippers. He ascertained that shippers may be likely to choose amongst port supply chains based on competitive advantage and great value gained.

In a similar vein, Vitsounis and Pallis (2012) discovered that effective networking and interdependence of port supply chain members are beneficial to the total value proposition (port value chains) to the port supply chain members in four major Belgian and Greek ports. They defined port value chains "*as a system of functionally and spatially interacting regionalised units, rather than to individual terminals, warehouses, rail or trucks and so forth only"* (Vitsounis and Pallis, 2012). They also highlighted the importance of synergies through co-creation of port value chains between key port actors such as shipping lines, shippers, freight forwarders, port authorities and terminal operators through matching resources. Those aforementioned concepts of maritime logistics value, lean production theory, competitive advantage of port supply chains and co-creation of port value chains to ports can be interpreted as the context of collaborative advantage.

Figure 3.4 conceptualises the whole system within which ports and port users seek to generate collaborative advantage through SCC as well as port competitiveness and competitive advantage sought by an individual firm. Indeed, the MLOs within a port have turned into transport chains for international trade.

After the ports initiate collaboration with port users, their traditional roles in the port may extend across a new demand derived from their final customers for an efficient transport chain and higher value-added services. Amongst extended roles apart from traditional roles collaborative advantage as a common denominator can be created through inter-organisational activities as well as competitive advantage and port competitiveness for port users and ports. This collaborative advantage is hardly grasped by each individual MLO even though it is still gaining its own competitive advantage. Eventually each MLO may have a rationale for building both collaborative advantage and competitive advantage at the same time through SCC.

Figure 3.4 Collaborative advantage through supply chain collaboration



Source: adapted from Seo et al. (2013, p. 13)

3.4 Port performance

The seaports are the gateway, trading centre and distribution centre to trade, so each government and related institution has strived to more develop seaports, specifically in terms of technology, efficiency and strategies (Branch, 2007). In terms of international logistics, the container seaport acts as an intermediate transport service provider by providing efficient transfer of containers from container ships to shore and *vice versa*. Port performance contributes to regional development via the economic benefits accrue (López and Poole, 1998).

3.4.1 The characteristics of port performance

Finding an adequate assessment of port performance is not an easy task in that ports are very dissimilar in terms of scope and nature, e.g. (1) organisational, (2) operational, (3) physical and spatial, and (4) legal and regulatory differences (Bichou and Gray, 2005a).

Traditionally, academics have assessed port performance by comparing actual and optimum throughputs. In addition, the emphasis on quayside operations ignored other processes of port operations and interests of other relevant port users in a port's supply chain network, given the fact that ports are one element of logistics chains (Bichou, 2007, Comtois and Slack, 2011). However, ports are now concerned with efficiency as well as effectiveness in the provision of services (Talley, 2009).

Performance measurement plays a critical role in all business sectors, since it can provide guidance on how to improve it to better achieve an organisation's goals. A meaningful assessment of port performance requires sets of measures involving the various facets of port operations (Tongzon and Ganesalingam, 1994). The performance of activities in processes should be reflected in performance measures to adequately capture the performance of objects such as organisations or firms. Therefore, the critical question that occurs in assessing port performance is how to measure it (Talley, 2007).

Performance measurement in the maritime context has been perceived as an important issue amongst researchers and practitioners (Woo *et al.*, 2011b). Most prior studies have made a relative comparison between seaports or terminals to measure efficiency or performance (Roll and Hayuth, 1993, Barros and Athanassiou, 2004, Wang and Cullinane, 2006, Cullinane and Wang, 2007, Panayides *et al.*, 2009). Therefore, Bichou (2007) contended that port performance measures are often fragmented and biased towards sea access. From an economic perspective, Talley (2007) asserted that port performance indicators are choice variables that can be under the control of port management in pursuit of optimising some factors such as technical efficiency, cost efficiency and effectiveness by comparing actual throughput with optimum throughput.

Many recent studies has argued that traditional port performance measurements hardly reflect diverse factors such as fluctuating environments, demanding customer needs and adoption of SCM philosophy, and they have only focused on traditional efficiency metrics without discerning effectiveness (Robinson, 2002, Carbone and De Martino, 2003, Marlow and Paixão, 2003, Paixão and Marlow, 2003, Bichou and Gray, 2004, Bichou, 2007, Brooks, 2007, Carbone and Gouvernal, 2007, Song and Panayides, 2008, Woo *et al.*, 2011b). Hop *et al.* (1996) widened port performance measures by attempting to encompass customer-oriented measurements such as time, price, availability and reliability. Particularly, Woo *et al.* (2011b) stressed the importance of port performance measures that cover effectiveness in provision of the customers' requirements beyond traditional efficiency metrics. In this regard, Bichou (2007) argued that port performance measures have failed to grasp both internal efficiency and external effectiveness, and it should include both of them to enhance port performance. In addition, Brooks (2007) pointed out that air, rail and road transportation studies have focused on external measurements such as reliability, service and customer orientation while port performance has suffered a lack of those items, and little attention is given to effectiveness or customer or stakeholder's needs. She indicated growing attention given in airport performance measures to measures of third-party customer satisfaction to seek a customer-driven strategy, in spite of the fact that port research has not touched these domains. Woo *et al.* (2011b) suggested that port evaluation systems should incorporate all aspects of operations as well as organisational goals. By doing so, port evaluation can provide various maritime logistics organisations with valid information, leading them to better decisions.

Performance measurement should be intended to guide and affect the decision-making process by using useful measures and avoiding complexity in order not to end up being discarded (Bichou, 2007). In addition, it not only assists port managers to detect operational problems as a diagnostic tool, but also to increase port supply chains' visibility (Comtois and Slack, 2011)

3.4.2 The components of port performance

A large number of academics attempted to investigate the components of port performance. The components of port performance sometimes have common denominators with those of port competitiveness and port selection. Hence, this study discussed the various existing research on port performance as well as port competitiveness and port selection.

Woo *et al.* (2013) conceptualised port performance as the third-order construct, which composes of effectiveness and efficiency. They suggested that effectiveness includes (1) service quality; (2) customer orientation; and (3) service price, whilst efficiency embraces (1) sea and land operations; and (2) cargo operation. Tongzon (2009) assessed the major determinants of port choice from the freight forwarders' perspective by using indicators such as (1) frequency of ship visits; (2) port efficiency; (3) adequate infrastructure; (4) location; (5) port charges; (6) quick response to port users' needs; and (7) port's reputation for cargo damage. Chang *et al.* (2008) identified five factors as important port selection factors: (1) advancement/convenience of port; (2) physical/operational ability of port; (3) operational condition of shipping lines; (4)

market-ability; and (5) port charge. Tongzon and Ganesalingam (1994) divided port performance into operational efficiency measures and customer-oriented measures. Operational efficiency measures deals with (1) capital and labour productivity and (2) asset utilisation rates, whilst customer-oriented measures encompasses (1) direct charges; (2) ship's waiting time; (3) inland transport; and (4) reliability. Yeo *et al.* (2008) proposed seven factors that determine port competitiveness. It includes (1) port service; (2) hinterland condition; (3) availability; (4) convenience; (5) logistics cost; (6) regional centre; and (7) connectivity. Table 3.10 shows various components of port performance.

Table 3.10 The components of port performance

Literature	Components or measurements of port performance (port competitiveness)	
Tongzon and Ganesalingam (1994)	Operational efficiency measures	Capital and labour productivity; Asset utilisation rates
	Customer-oriented measures	Direct charges; ship's waiting time; Inland transport; Reliability
Chang *et al.* (2008)	Advancement/convenience of port	Berth availability; Special requirement; Communication with staff; Service reliability; worldwide reputation; IT ability; Customs regulation
	Physical/operational ability of port	Cargo profitability; Land connection; Cargo volume; Feeder connection; Port location; Management/workers relationship; Water draft
	Operational condition of shipping lines	Competing carriers; Slot exchanges; TS volume
	Market-ability	Niche market; Balance between I/O bound
	Port charge	Terminal handling charge; Port dues
Wiegmans *et al.* (2008)	Port physical and technical infrastructure (Nautical accessibility profile: maximum draft and maximum vessel length, tidal windows and restrictions to vessels; Terminal infrastructure and equipment: terminal capacity as a function of terminal surface, number of berths, number and type of quay and yard cranes and stacking height; Hinterland accessibility profile: intermodal interface for trucks, rail, barge and short-sea); Geographical location (Vis-a-vis the immediate and extended hinterland: centrality index versus main economic centres in the hinterland; vis-a-vis the main shipping lanes: diversion distance); Port efficiency (Port turnaround time: berth performance ratio, ship waiting times due to congestion; terminal productivity: moves per hour; cost efficiency: out-of-pocket and time costs of port calls and cargo handling; port operating hours: 24/7/365); Interconnectivity of the port (sailing frequency of deep-sea and feeder shipping services); Reliability, capacity, frequency and costs of inland transport services by truck, rail and barge (if any); Quality and costs of auxiliary services such as pilotage, towage, customs, etc; Efficiency and costs of port management and administration (e.g. port dues); Availability, quality and costs of logistic value-added activities (warehousing); Availability, quality and costs of port community systems; Port security/safety and environmental profile of the port; Port reputation (satisfactory ranking in benchmarking studies)	
Song and Panayides (2008)	Cost; Quality; Reliability; Customisation; Responsiveness	
Ng (2006)	Monetary cost (terminal handling charge and port dues); Time efficiency; Geographical location; Cases of delays in loading/unloading containers; Record of damage during container-handling; Custom procedures (inspection and documentary); Port authority policy and regulations; Accessibility of the port; Quality of port	

		infrastructure in container-handling; Quality of port superstructure in container-handling; IT and advanced technology; Dedicated terminals and facilities for transhipment; Supporting industries (warehousing and insurance); Quality of other services (pilotage, towing and mooring); Availability of professional personnel in port; Preference of shipping lines' clients/shippers; Relations between port operator and shipping lines; Efforts of marketing on the port by port authority; Reputation of port within the region; Speed in responding to liner's new demands and requests
Song and Yeo (2004)		Application of EDI system; Ability of port personnel; Average hours of port congestion; Port accessibility; Berth/terminal availability; Port congestion; Building Port MIS; Port facilities; Capacity of transportation connectivity; Port marketing; Capacity/status of facilities available; Port operation; Cargo volume of handling transhipment; Port operation by government; Changes in social environments; Port operation by local autonomous entity; Changes in transport and cargo function; Port operation by private sectors; Complete preparation of multimodal Transport; Port operation strategies; Concentration of volume by export/import; Port operation time; Customs clearance system; Port ownership; Dredging; Port productivity; Easy access to port; Port service; Economic scale of hinterland; Port size; Effectiveness of terminal operations; Port tariff; Existence of cargo tracing system; Possibility of mutual reference of electronic computation network; Existence of port hinterland road; Existence of terminal operating system; Price competitiveness; Existing pattern of navigation routes; Response of port authorities concerned; Extent of port EDI; Road network to be fully equipped; Financial factors of port; Sea transportation distance; Free time of container freight station; Securing deep draft; Frequency of ships calling; Securing exclusive use of equipment; Handling charge per TEU; Securing fairway; Handling volume of export/import cargo; Securing navigation facilities/equipment; Inland transportation cost; Securing railroad connection; Inter-linked transportation network; Status of national economy; Internal politics; Sufficiency of berth; Loading time; Sufficiency of securing information equipment; Location factors of the port concerned; Technical factors of port; Market position within the area; Terminal facilities; Mutual agreement of port users; Trade market; Navigation distance; Trade/commerce policy; Nearness to hinterland; Transportation distance; Nearness to main trunk; Types of port operation/management; Number of liners calling at ports; World business
UNCTAD (2004)	Inland and intermodal terminals	Accessibility and connectivity to ports; Availability of port facilities; Productivity and economic efficiency; Safety and security; Time; Reliability and quality of services
	warehousing	Throughput/output; Operational efficiency; Safety and security; Service level
Roll and Hayuth (1993)	Output	Ship calls; Users' satisfaction; Level of service; Cargo throughput

	Input	Capital; Manpower; Cargo uniformity	
Wang and Cullinane (2006)	Output	Cargo throughput	
	Input	Terminal length (Capital); Terminal area (Land); Equipment cost (Labour)	
Feng *et al.* (2012)	Availability of shipping services (destination and frequencies); Price of shipping services; Port/terminal handling, warehousing and other charges; Feeder connections to the deep-seaports and the major shipping lines; The cheapest overall route to the destination; Speed of port cargo handling; Congestion and risks; Security and safety; Technical infrastructure of the port (handling equipment and ICT); Proximity of the port to the customers and/or sources of supply; Availability of skilled employees; Quality of landside transport links (inter-modal links); Availability and quality of logistics services (warehousing, freight forwarding and cargo handling); Government supports for logistics activities and new developments in the region; Depth of navigation channel		
Tongzon (2009)	Efficiency; Shipping frequency; Adequate infrastructure; Location; Port charges; Quick response to port users' needs; Reputation for cargo damage		
Tongzon *et al.* (2009)	Ship calls; Handling (TEU); Amount of sales; Number of ship calls per employee		
Woo *et al.* (2013)	Effectiveness	Service quality; Customer orientation; Service price	
	Efficiency	Sea and land operations; Cargo operation	
Woo *et al.* (2011b)	Service	Service quality	Reliability; Timeliness; Lead time; Information
		Customer orientation	Responsiveness; Flexibility
		Service price	Total price; Cargo handling charge; Auxiliary service charge; Port charge
	Operation	Operation efficiency	Throughput; Throughput per crane; Ship waiting time; Ship working time
		Safety and security	Regulation; Accident
	Logistics	Connectivity	Cargo waiting time; Cargo working time
		Value-added service	Cargo; Value-added; Facility
Tongzon (1995)	Determinants of throughput	Location; Frequency of ship calls; Port charges; Economic activity; Terminal efficiency	
	Determinants of efficiency	Container mix; Work practices; Crane efficiency; Vessel size and cargo exchange (economies of scale)	

Lirn *et al.* (2003)	Carriers cost	Carrier's loading/discharging cost; Ownership of the port and terminal; Privileged terms to the carriers; Government levy and duty
	Port management	Port administration and custom regulation; Berthing delay and loading/discharging rate; Port safety; Terminal security
	Port geographical location	The closeness to the import/export consumption areas; The closeness to the main navigation route; Proximity of the feeder ports; Proximity of competing ports and modes
	Port basic physical characteristics	Infrastructure improvements; Port facilities and equipment; Convenience of inter-modal link; Size of marshalling yard and container yard
Yeo *et al.* (2008)	Port service	Prompt response; 24hour/seven days a week service; Zero waiting time service
	Hinterland condition	Professionals and skilled labours in port operation; Size and activity of free trade zone in port hinterland; Volume of total container cargoes
	Availability	Availability of vessel berth on arrival in port; Port congestion
	Convenience	Water depth in approach channel and at berth; Sophistication level of port information and its application scope; Stability of port's labour
	Logistics cost	Inland transportation cost; Cost related vessel and cargo entering; Free dwell tiem on the terminal
	Regional centre	Port accessibility; Deviation from main trunk routes
	Connectivity	Land distance and connectivity to major shippers; Efficient inland transport network
Tongzon and Heng (2005)	Port (terminal) operation efficiency level; Port cargo handling charges; Reliability; Port selection preferences of carriers and shippers; The depth of the navigation channel; Adaptability to the changing market environment; Landside accessibility; Product differentiation	

Source: compiled by Author

3.5 Summary

This chapter mainly focused on reviewing three related theories to SCC, CA and their outcomes so as to establish a foundation of the theoretical framework for this thesis. TCT, RBT and RV were discussed to explain the effects of SCC and CA that may receive if ports and port users collaborate with each other. In addition, major constructs, SCC, CA and PP are discussed.

Section 3.2 not only clarified the main terms SCM and SCC, but also compared the terms cooperation, coordination, collaboration and integration. In addition, it includes the characteristics, benefits, barriers and components of SCC. It found that MLOs have started adopting SCM philosophy. Section 3.3 delineated the definition, antecedents, barriers and components of CA, and examined how various concepts such as maritime logistics value, lean production theory, competitive advantage of port supply chains and co-creation of port value chains to ports can be interpreted as the context of CA. Finally, section 3.4 explained the nature of PP, which covers effectiveness in provision of the customers' requirements beyond traditional efficiency metrics.

During the intensive literature review in chapter 2 and 3, few prior studies, which explored the relationship between SCC, CA and PP in the maritime logistics contexts, were revealed. Notwithstanding the rising adoption of collaboration between ports and port users, the empirical evidence of the effect of SCC and CA has not examined. Therefore, the further empirical research is required to theoretically support the associations and provide managerial implications. This issue will be addressed in this thesis as a research gap.

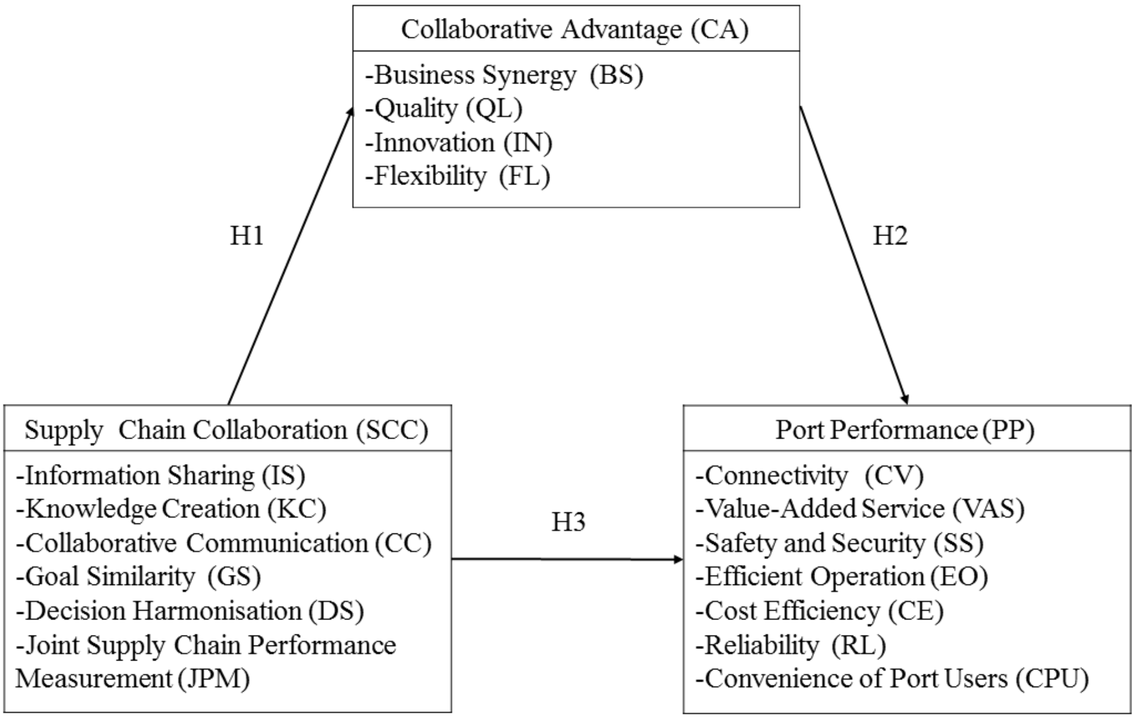
Chapter 4. Conceptual model and hypotheses

The previous chapter reviewed the related theories and existing body of knowledge to seek an appropriate theoretical framework and to construct a foundation of hypotheses development. Based on the abovementioned theories, they presented feasible relationships between supply chain collaboration (SCC), collaborative advantage (CA) and port performance (PP) in the containerised maritime context. In chapter 4, this study includes a conceptual model describing the relationships between those constructs. In addition, hypotheses of this study concerning relationships between the latent variables are built. Lastly, the observed variables of each latent variable are investigated and selected.

4.1 Conceptual model and hypotheses

The aim of this study is to investigate the possible relationships between the three variables: SCC, CA and PP in the containerised maritime context. Figure 4.1 depicts the conceptual research model in this study. As already discussed in chapter 3, SCC can be conceptualised as the extent to which ports collaborate with pertinent port users in the six dimensions identified. The conceptual model in Figure 4.1 presumes that SCC has a positive impact on CA and PP, whilst an impact of CA on PP is positively significant.

Figure 4.1 A conceptual model for this study



Source: Author

Asanuma (1989) argued that the buyer and the supplier are involved in investments in relation-specific skills and resources in an effort to create surplus profits and competitive advantage. In a similar vein, Fawcett *et al.* (2008) stated that SCC includes the sharing of resources such as information, technology and human amongst actors to generate synergies for competitive advantage. It is likely that those surplus profits and synergies for competitive advantage may be interpreted as collaborative advantage. Kalwani and Narayandas (1995) contended that collaborative relationships can lead to significant financial payoffs for both buyers and suppliers. From the SCM perspective, Kotzab and Teller (2003) noted that vertical collaboration between supply chain partners could increase value-adding activities by leveraging knowledge and skill so that it helps to create competitive advantage in the total chain. Boddy *et al.* (1998) noted that developing long-term cooperation, collaboration and partnering assists organisations to remove waste out of the supply chain and lead them to a potential way of capturing the best commercial advantage.

Kanter (1994) posited that a cooperative relationship represents a firm asset that generates collaborative advantage. Close collaboration assists supply chain partners to augment their ability to satisfy customer needs by the flexible provision of services (Simatupang and Sridharan, 2005a). Some facets of SCC such as decision synchronisation and incentive alignment may have an impact on responsiveness (Fisher, 1997). Indeed, synchronised SCC may also result in increased responsiveness (Holweg *et al.*, 2005). It is implied that the characteristics of this responsiveness is akin to flexibility to fulfil the customer's requirement whilst flexibility is one of the important components of CA. In this regard, Gosain *et al.* (2004) posited that relevant information processing capabilities between supply chain members would indicate supply chains' progress on the way to flexibility of the supply chain linkages that are combined in alignment in response to customer needs. Boddy *et al.* (1998) noted that innovation and quality are expected through sharing information and the more open process of problem-solving, which takes place in effective SCC. Those aforementioned aspects of flexibility, innovation and quality are the core components of CA. Jenssen (2003) also found that there appears to be an agreement regarding the value of creating more inter-organisational collaboration such as good communication and information sharing procedures in order to achieve innovation in the Norwegian shipping industry. Such collaboration can lessen uncertainty and boost innovation success. In addition, he argued that in particular strong relationships with demanding customers are imperative for innovation. This innovation is also one of the crucial factors for CA. Lee and Song (2010) put forward that the knowledge creation by the port and port user may be a basis for greater maritime logistics values as well as add value to the whole port supply chain, leading to the high performance of both participants, and claimed that it also contributes to generating differentiated capability and organisational innovation. This increased added value to the whole port supply chain might be considered as CA, and innovation is one of the core elements in CA. Woo *et al.* (2013) claimed that a terminal operator pursuing a long-term relationship with port users may view them as strategic partners by developing collaborative relationships rather than contractual relationships, which might diminish channel complexity and heighten quality services. In De Martino and Morvillo (2008)' study, a port is considered as a network of players that perform diverse activities in the supply chain in close collaboration by sharing different resources. They presumed that the higher the degree of collaboration between MLOs, the more superior the benefits that they would perceive in fostering strong interdependencies amongst various supply chain partners by highlighting a collaborative spirit so as to create reciprocal benefits.

Therefore, this study develops the following hypothesis:

Hypothesis 1: Supply chain collaboration has a positive influence on collaborative advantage.

A number of academics asserted that collaborative relationships between suppliers and customers is a way of increasing firm performance (Duffy and Fearne, 2004, Sheu *et al.*, 2006). To achieve SCC, expanding the total amount of profit for synergy effects is imperative amongst supply chain partners (Simatupang and Sridharan, 2005b). In general, a firm involved in a higher level of collaboration relationships tends to show higher firm performance (Mohr and

Spekman, 1994). Gulati (1999) claimed that resources amongst alliance partners that can be transferred by interactions has a significant influence on firm performance, and these network resources can span the opportunity set of the firm. According to Yu *et al.* (2013), today's firm should strive to shape situations whereby all supply chain partners work together toward recognising business synergy to compete effectively with other supply chains, and such collaborative advantages would enhance financial performance for each supply chain partner. Mason and Nair (2013) asserted that the provision of flexibility in the container shipping liner sector may lead to improved efficiency and effectiveness. These efficiency and effectiveness appear to be the main components of newly perceived port performance in changing environments (Woo *et al.*, 2011b).

Thus this study hypothesises:

Hypothesis 2: Collaborative advantage has a positive influence on port performance.

An organisation's performance is increasingly determined by its role in supply chain ecologies and the competiveness of the supply chains it is engaged in (Gosain *et al.*, 2004). It is commonly supposed that improved SCC drives improved performance. A large number of empirical studies proved a positive association between SCC and enhanced performance (Yu *et al.*, 2013). Stank *et al.* (2001) empirically investigated the effect of SCC on logistical service performance. Their finding was that internal collaboration enhanced logistical service performance including delivery speed, dependability, responsiveness, flexibility and overall customer satisfaction. However, interestingly, external collaboration has no effect on logistical service performance, whilst the correlation between internal and external collaboration is significant. By adopting the three-step regression analysis, they found that external collaboration such as information, measurement, reward and risk collaboration can influence logistical service performance through increased internal collaboration.

In addition, Vereecke and Muylle (2006) found that SCC augments performance improvement from the engineering and assembly industry across eleven European countries. They assumed that collaboration (information exchange and structural collaboration) with customers and suppliers was positively related to performance improvement. Interestingly, whilst separate SCC with suppliers or with customers slightly affects performance improvements, SCC both with suppliers and customer was proved to provide the greatest rates of improvement, especially for information exchange. In this vein, Simatupang and Sridharan (2005a) found that the SCC index is positively related to operational performance. Wiengarten *et al.* (2010) examined a relationship between SCC and operational performance when the high quality information is exchanged compared to low quality information based on the survey in German automotive sectors including the original equipment manufacturers (OEMs), their first-tier suppliers, the sub-tier suppliers and the infrastructure suppliers. Their findings showed that some aspects of SCC positively affect performance only when information exchanged between supply chain members is high quality, and asserted that the quality of information may rely on its timeliness, accuracy, relevance and added value. Hence, they concluded that firms must invest in exchanging high quality information exchanged amongst supply chain members to obtain the full potential benefits of SCC. Li (2012) discovered that firms that have collaborative relationships with their supply chain partners had a substantial competitive edge over their rivals in terms of operational performance, which translated to better market performance by drawing 177 Chinese firms as a sample in diverse manufacture industries.

In terms of the port supply chain, Lee *et al.* (2003) conducted a simulation model that compares the impact of a strong partnership and weak partnership with respect to sufficient resources and speedy cranes between supply chain members within the port on operational efficiency to keep customer loyalty. They verified that the strong and reliable partnership between shipping lines and terminal operator reduces the cargo handling time. Martin and Thomas (2001) commented that information exchange occurred amongst port supply chain members to facilitate the physical flow of container cargoes and to boost performance, and pointed out that the lack of collaboration may result in poor control and utilisation of assets in ports. Vitsounis and Pallis (2012) claimed that the efficiency and effectiveness of the cargo movements are determined by collaboration and the matching of the resources between port supply chain actors. Heaver (2011) also asserted that the demand for effective collaboration is reflected in port communities' endeavour for the efficient gateway performance, as increased growth of container traffic causes congestion in the inland transport services. In Acosta et al.'s (2007) empirical study in Spanish ports, they discovered that collaboration of the MLOs involved in the port activities eases the accessibility of ships to the port, the transhipment of cargoes, lowered maritime safety and improved efficient operations.

Hypothesis 3: Supply chain collaboration has a positive influence on port performance.

4.2 Latent variables and observed variables

This section shows the observed variables of each latent variable to build a solid foundation before adopting structure equation modelling. To statistically evaluate the proposed hypotheses, those constructs should be measured. Without operationalising the constructs, it is impossible to further develop scientific knowledge of the phenomenon, or foster the successful application of the study's results in practice (Min and Mentzer, 2004). However, latent variables represent theoretical constructs such as collaborative communication and innovation that are abstract and can barely be measured directly. A measurement instrument is a collection of measuring items applied collectively to reveal a theoretical construct, such as SCC, which cannot be assessed directly, and if it cannot be measured, it cannot be improved (DeVellis, 1991). Consequently, the measurements are indirectly derived by linking the latent variable to more than one observed variable, so these observed variables are measured using multiple indicators. Churchill (1979) contended that a construct should be measured by using at least two items, while Baumgartner and Homburg (1996) recommended that each construct be evaluated with a minimum of three or four observed variables each. Even, Anderson and Gerbing (1988) posited that sometimes only a single observed variable is possible although employing multiple observed variables for the corresponding construct is strongly advocated. It is because there are potential problems with a dependence on just a single observed variable by disregarding an underlying concept (Bryman and Bell, 2011).

SCC, CA and PP are latent variables which cannot be measured directly. Hence, these are measured using observed variables from a diversity of SCM and maritime literature reviews and in-depth discussion with practitioners in containerised maritime logistics. In particular, in terms of measuring SCC and CA, the theoretical components of them have not been directly identified in the maritime literature, so this study adopted many instruments from SCM and general management literature, and modified them after discussions with six experts to make sure the variables reflect what they intend to measure for ensuring content validity. To check ambiguities in operationalsation, experts including one SCM academic, one maritime academic and four senior maritime practitioners were recruited to assess measurement items from the stance of domain representativeness to ensure content validity. In addition, the pilot test amongst 22 postgraduate part-time students in Korea Maritime University who are also container maritime logistics practitioners engendered further modification and simplification. Finally, scrutiny by invited port industry practitioners ensured the content validity of revisions.

4.2.1 Observed and latent variables of supply chain collaboration

This section mainly deals with introducing SCC studies into containerised maritime logistics contexts as a major intermediary in global supply chain process. Despite the fact that many efforts were focused on conceptualising the concept, phenomenon and measurements of SCC, no extant measurements exist in the containerised maritime context. SCC engages both MLOs and final customers, but current measures fail to reflect either its multi-faceted nature or to measure its entire domain. Maritime logistics has been a late-adopter of SCC concepts. Harrington (1991, p. 164) stated that *"If you cannot measure it, you cannot control it. If you cannot control it, you cannot manage it. If you cannot manage it, you cannot improve it"*. Empirically validated measures of SCC in maritime logistics are needed to foster understanding and to offer MLOs a self-diagnostic tool to assist managers to respond proactively when SCC is required.

Prior studies provided some theoretical and operational bases with which to conceptualise SCC. Synthesis of prior definitions in maritime and supply chain contexts identifies SCC as a multifaceted concept which defines the extent to which ports collaborative with pertinent port users in the six dimensions identified. The parameters identified in the current SCC and maritime literature to develop the concept of SCC in containerised maritime logistics include 'information sharing (IS)', 'knowledge creation (KC)', 'collaborative communication (CC)', 'goal similarity (GS)', 'decision harmonisation (DH)', 'joint supply chain performance measurement (JPM)'. These sub-components were operationalised by modifying existing instruments following in-depth discussions, item review and sorting with experts and adaptations to suit container maritime logistics.

SCC involves management of multiple collaboration processes and relationships whereby ports and port users jointly work to ensure the provision of reliability, punctuality, value-added services, productivity and high supply chain performance in an effort to satisfy final customers' needs by creating synergies that are greater than organisations would gain individually.

The easiest way to implement collaboration at a low cost is to exchange and share information regarding the status of the container, availability of port facilities, port traffic statistics, berth occupancy, tug and pilot requirements, aids to navigation monitoring and so on. For instance, Hanjin Newport Co. in Busan port has established state-of-the-art integrated systems (i.e. port-MIS) to collaborate with their various port users including CKYHE (Cosco, K-Line, Yang Ming, Hanjin shipping and Evergreen line), freight forwarders and ship management companies as a customer-driven strategy so that they can recognise exact container movements and facilitate vessel scheduling. Shipping lines are also willing to share their information with ports, resulting in reducing vessel turn-around time for ships, enhancing hinterland accessibility and intermodal-connectivity, which can offer lower freight rate, reduced lead time and to shippers. Also, collaborative planning of empty containers between ports, shipping lines and inland transport companies could lessen empty movements. Indeed, creating effective hinterland accessibility needs the high degree of collaboration between the ports and port users, as the quality of hinterland access hinges on the behaviour of many port actors (Van Der Horst and De Langen, 2008). Canadian ports are dedicating to sharing information for reducing dwell time of loaded containers on terminals and transit time to Toronto and Chicago, as major collaboration between ports, shipping lines, rails and shippers (Heaver, 2014).

The measurement of SCC in maritime logistics requires the inclusion of collaboration which recognises mutual interests between organisations within a port and also reflects the nature of the maritime industry. Based on exhaustive literature reviews and in-depth discussion with practitioners (chapter 3 and 5), six dimensions of SCC in containerised maritime logistics were identified. As discussed in chapter 3, the parameters identified in the current SCC and maritime literature to develop the concept of SCC in containerised maritime logistics include 'information sharing (IS)', 'knowledge creation (KC)', 'collaborative communication (CC)', 'goal similarity (GS)', 'decision harmonisation (DH)', 'joint supply chain performance measurement (JPM)'. Table 4.1 shows definitions of sub-components of SCC in containerised maritime logistics.

Table 4.1 Definition of sub-components of SCC in maritime logistics

Construct	Definition	Literature
IS	the sharing of information in performing maritime transport services between ports and port users, contributing to supply chain visibility and sharing frequent, relevant and accurate information that may assist the whole port supply chain	Min *et al.* 2005; Simatupang and Sridharan 2005a; Song and Panayides 2008; Panayides and Song 2008; 2009; Sheu *et al.* 2006; Carbone and De Martino 2003; Paixão and Marlow 2003; Spekman *et al.* 1999; Frankel 1999; UNCTAD 2004; Heaver 2011; Bennett and Gabriel 2001
KC	the extent to which ports and port users develop and create knowledge that may be useful for ports and port users by working together	Heaver 2001; Malhotra *et al.* 2005; Kaufman *et al*. 2000; Cao and Zhang 2011; Harland *et al.* 2004; Panayides and Song 2013; Song and Lee 2012; Lee and Song 2010
CC	A frequent and two-way communication to help ports and port users to formulate their strategy and decision-making	Min *et al.* 2005; Paulraj *et al.* 2008; Prahinski and Benton 2004; Cao *et al.* 2010; Chen and Paulraj 2004
GS	the extent to which similar goals between ports and port users are pursued to increase the efficiency and effectiveness of the whole supply chains	Simatupang and Sridharan 2005; Min *et al.* 2005; Angeles and Nath 2001; Lejeune and Yakova 2005; Carbone and Gouvernal 2007; Jap 2001; Goffin *et al.* 2006; UNCTAD 2004; Vitsounis and Pallis 2012
DH	the process whereby ports and port users harmonise decisions in arranging transport plans and operations in an attempt to optimise supply chains	Simatupang and Sridharan 2005a; Corbett *et al.* 1999; Min *et al.* 2005; Harland *et al.* 2004; Carbone and Gouvernal 2007; Spekman *et al.* 1999; Lee *et al.* 1997; Islam *et al.* 2005
JPM	the desire to jointly measure and manage supply chain performance in common with port supply chain partners	Simatupang and Sridharan 2005a; Min *et al.* 2005; Angeles and Nath 2001; Spekman *et al.* 1999; Bichou and Gray 2004; UNCTAD 2004; Heaver 2011

Source: Author

The first dimension of SCC is information sharing (IS) in performing maritime transport services between ports and port users, contributing to supply chain visibility and sharing frequent, relevant and accurate information that may assist the whole port supply chain. The contents of IS may encompass container tracking for shippers, flows of container cargo, security related data, environmental issue data, hinterland connection, port data and auxiliary services and may facilitate goods flows in the port supply chain. In fact, IS amongst supply chain partners can facilitate flows of goods in the supply chain (Ramanathan, 2013). IS can trigger rapid and adequate actions pertaining to the seamless flows of container cargo and shippers' requirements, avoid duplication of documents and reduce total port costs (Paixão and Marlow, 2003) Where port supply chain strategies define a high level of IS, terminal operators are able to prepare their resources on a fixed schedule. In addition, where they receive ship arrival information in advance, which implies more information exchange between port supply chain members, more container cargoes and vessels can be handled quickly and efficiently raising berth utilisation and reducing average berth service times, resulting in enhanced performance measures (Lee *et al.*, 2003). Abundant IS is a prerequisite for higher degrees of interdependence and effective IS can augment reliability and productivity in the port supply chain (Carbone and Gouvernal, 2007). These characteristics of IS are imperative for the ports, as they act as information distribution centres to all the MLOs involved in the ports' activities towards the direction of their hinterlands (Marlow and Paixão, 2003).

Knowledge creation (KC), the second dimension of SCC refers to the extent to which ports and port users develop and create knowledge that may be useful for their port supply chain by working together. Zacharia *et al.* (2011) viewed

SCC as a mechanism to create, acquire, combine and deploy external and internal knowledge, which is the most strategically salient firm's resources. Dyer and Singh (1998) also recognised the importance of sources of external knowledge that complements a focal organisation's own internal knowledge. MLOs have realised the need for integrated knowledge within port supply chains to build close collaborative relationships (Panayides and Song, 2013). KC assists port supply chain members to engage in creating and interpreting new knowledge, to contribute to adding value and to respond to customers' need (Kaufman *et al.*, 2000). The exchange, seizure and assimilation of knowledge regarding shipping markets, latest technology (i.e. port-MIS, vehicles for inland transport, automated guided vehicle and gantry cranes) and processes (i.e. packages, value-added services and faster loading/unloading) facilitate innovation and long-term competitiveness of the whole port supply chain (Harland *et al.*, 2004). In particular, developing fourth generation (agile) ports needs the efficient application of knowledge, as the situation in which ports implement their operations that is governed by a knowledge-based economy (Marlow and Paixão, 2003). Creating and gathering relevant and reliable knowledge including customer needs, new technology, other port supply chains' capabilities and intentions is imperative to collaborate effectively with one another (UNCTAD, 2004). MLOs can create and acquire more knowledge through inter-organisational cooperation in the port supply chain so that they can mitigate the uncertainty of environment and learn new business patterns (Lee and Song, 2010, Song and Lee, 2012). In addition, by creating knowledge together, MLOs broaden and absorb new knowledge so that they can improve physical operations and customer satisfaction, and outperform other port supply chains (Heaver, 2011). KC is slightly different from IS in that KC aims to create knowledge for the strategic level of collaboration, whilst IS aims at providing information for that of tactical or operational level. For example, a port supply chain may benchmark others' superior performance, or out-perform them by providing better services and the latest port-MIS through the learning of the level of others' service capabilities and discovery of new technology. Further, a recent strategic attempt to propose P3 vessel-pooling accord amongst the three largest shipping lines, Maersk, MSC and CMA-CGM may considerably influence competition of port community. By acquiring and disseminating the latest trends and movements of the shipping lines and global terminal operator that may affect MLOs' future, they can prepare for the viable market turbulence and risks in advance.

Thirdly, CC is defined as a frequent and two-way communication to help ports and port users to formulate their strategy and decision-making (Prahinski and Benton, 2004, Min *et al.*, 2005, Paulraj *et al.*, 2008, Cao *et al.*, 2010, Cao and Zhang, 2011). Anderson and Narus (1990) defined communication as both meaningful and timely information sharing, which is both formal and informal between organisations. According to Mohr and Nevin (1990) communication under the partnerships is characterised by more frequency, bi-direction, informality and indirect content compared to a transactional relationship. Dynamic and collaborative communication is, in effect, a foundation of collaborative effort and a critical factor in facilitating strategic collaboration between organisations as a relational competency (Daugherty *et al.*, 2006, Paulraj *et al.*, 2008). CC between inter-organisations may help them to integrate and exchange valuable information and knowledge. CC differs from IS in that it emphasises how supply chain members interact through regular meetings and various forms of interactions. Miscommunication may trigger conflicts and misunderstanding amongst supply chain partners, leading to SCC failure (Paulraj *et al.*, 2008). The aim of CC is to explore opportunities and areas for supply chain improvements (Min *et al.*, 2005). Frankel (1999) stated that communication plays a key role in effective timely decisions as required goods and timely information can be efficiently provided in a most practical way. In general, the degree of CC may indicate close inter-organisational relationships. Formal communication is established by structured rules and fixed procedures whilst informal communication is spontaneous and non-regularised (Cao *et al.*, 2010).

The fourth dimension of SCC, goal similarity (GS) defines the extent to which similar goals between ports and port users are pursued to increase the efficiency and effectiveness of whole supply chains. To obtain the full benefits of SCC, practices require the setting of converging goal and strategies (Vitsounis and Pallis, 2012). GS includes efforts to raise supply chain performance, emphasise the importance of collaboration and present collaborative activities for shippers as final customers by assimilating goals. It is reflected by the degree of goal similarity, compatibility or fit amongst supply chain members (Angeles and Nath, 2001). By developing similar goals between ports and port users, a perception can be generated that what is valuable for the port users will also be beneficial to the ports (Jap, 2001). Sometimes, as each supply chain member pursue its own economic value, there are unavoidable conflicts in respective goals (Mason and Lalwani, 2006). Convergent strategic planning amongst supply chain members is crucial because it is related to supply chain interaction and strategies (Stank *et al.*, 2001). In maritime contexts, Carbone and Gouvernal (2007) asserted that converging interests between MLOs promotes efficient supply chains. For example, APM terminals, A.P Moller-

Maersk's subsidiary company accommodate container vessels from various shipping liners. More than 50% of vessels come from other shipping lines rather than Maersk. APM strives to build collaborative relationships with these shipping lines through a frequent meeting in order to set similar goals of efficient hinterland connection, reduced ship waiting time and seeking most efficient routes for containers. In addition, Slack (1993) contended that ports should develop new value-added functions by setting up similar goals, such as partnerships with port users.

The fifth dimension of SCC is decision harmonisation (DH), the process whereby ports and port users jointly harmonise decisions in arranging transport plans and operations to optimise the port supply chain. DH may be derived from IS, as inefficient IS may cause inadequate joint transport planning (Van Der Horst and De Langen, 2008). DH drives collaboration that begins with joint planning between supply chain partners (Min *et al.*, 2005) but disharmony in important decisions may lead to sub-optimal solutions (Lee *et al.*, 1997). A way to judge DH may rely on the effectiveness of arranging joint planning in improving supply chain profitability (Corbett *et al.*, 1999). Harland *et al.* (2004) argued that the degree of harmonisation in the decision-making process typifies SCC for building and maintaining mutual partnerships. UNESCAP (2005) pointed out that a lack of DH amongst various MLOs is regarded as one of obstacles in the development of maritime logistics, and asserted that better results cannot be achieved without more harmonisation in the process of collaborating interested MLOs. Islam *et al.* (2005) argued that fierce competition between port supply chains forced MLOs to collaborate with each other, sharing common interests for mutual benefit by harmonising crucial decisions. In this vein, Marlow and Paixão (2003) noted that ports and MLOs as a collaborator should be able to make decisions just-in-time so as to solve any problems that may arise within the port supply chain without wasting time. One driver of the willingness of MLOs within the port to try to jointly harmonise decisions regarding transport planning and operations involves countering external threats and risks of losing traffic to other port supply chains (Heaver, 2011). For example, ports and freight forwarders plan on altering schedules and amending container transport routes to the point of final destination in response to shippers' sudden requirement. Additionally, shipping liners such as Maersk, APL, Hanjin and MOL have planned on port-to door time guaranteed service in Asia-Europe or Asia-US routes by harmonising operational decisions with ports and inland transport companies.

Finally joint supply chain performance measurement (JPM) represents the desire to jointly measure and manage supply chain performance in common with port supply chain partners. Fawcett *et al.* (2008, p. 103) asserted that *"measures that communicate the value of SCC must be identified, refined, and implemented to document the competitive power of collaboration and justify the pain an expense created by change".* A performance measure can assess the effectiveness of an existing system or compare other design alternatives (Lee *et al.*, 2003). JPM involves jointly optimising related port activities including container handling time, number of vessels to be accommodated, port time, berth utilisation and joint actions in security and risks. JPM identifies supply chain gaps and further necessary actions which can be implemented by collaborative efforts. JPM precedes the achievement of collaborative attempts and must empower port supply chain members to obtain pertinent information to enable enhanced collaboration. JPM may contribute to optimisation of port supply chains and seamless flows of cargoes (UNCTAD, 2004). The achievement of collaborative attempts cannot be guaranteed if supply chain performance is not suitably measured. On the basis of this measurement, supply chain members can obtain pertinent information to enable enhanced collaboration for greater supply chain performance. In addition, such alignments can create a seamless customer value delivery process by reviewing joint supply chain performance to identify appropriate changes to tactical situations (Min *et al.*, 2005). Heaver (2011) typified JPM in a container terminal scheduling committee in Canada which initiated metrics to measure and track the performance of container logistics systems, offering a factual review of performance to various MLOs. Such metrics do not replace the need for individual MLOs to monitor internal metrics of movements through terminals.

Table 4.2 Latent and observed variables for SCC

Latent variables	Observed variables	References
Information sharing	Our port and port supply chain partners	Min *et al.* 2005; Simatupang and Sridharan 2005a; Sheu *et al.* 2006; Carbone and De Martino 2003; Paixão and Marlow 2003; Carbone and Gouvernal 2007; Cao and Zhang 2011; Cao *et al.* 2010; Lee *et al.* 2003; Frankel 1999; Co and Barro 2009; De Martino and Morvillo 2008; Holweg *et al.* 2005; Heaver 2011; Cetindamar *et al.* 2005; Fawcett *et al.* 2008; Manthou *et al.* 2004; Ramanathan 2013; Bennett and Gabriel 2001; UNCTAD 2004; Song and Panayides 2008; Panayides and Song 2008; 2009; Spekman *et al.* 1999; Heaver 2011; Mentzer *et al.* 2000; UNESCAP 2005; Daugherty *et al.* 2006
IS1	provide any information that might help within our port supply chain.	
IS2	frequently exchange information within our port supply chain.	
IS3	have informed each other of changing needs in advance within our port supply chain	
IS4	keep each other informed about events or changes that may affect our port supply chain	
IS5	exchange accurate information within our port supply chain	
Knowledge creation	Our port and port supply chain partners	Malhotra *et al.* 2005; Kaufman *et al.* 2000; Cao and Zhang 2011; Cao *et al.* 2010; Heaver 2011; Heaver 2001; Harland *et al.* 2004; Panayides and Song 2013; Song and Lee 2012; Cao and Zhang 2011; Lee and Song 2010; Mentzer *et al.* 2000
KC1	search and acquire new and relevant knowledge within our port supply chain	
KC2	assimilate and apply relevant knowledge within our port supply chain	
KC3	identify customer needs for our port supply chain	
KC4	discover new technology for our port supply chain	
KC5	learn the intensions and capabilities of other port supply chains in competition	
Collaborative communication	Our port and port supply chain partners	Min *et al.* 2005; Paulraj *et al.* 2008; Prahinski and Benton 2004; Cao and Zhang 2011; Cao *et al.* 2010; Frankel 1999; Heaver 2011; Cetindamar *et al.* 2005; UNESCAP 2005; Daugherty *et al.* 2006
CC1	have frequent contacts on a regular basis for our port supply chain	
CC2	have open and two way communication for our port supply chain	
CC3	have informal communication for our port supply chain	
CC4	have many different channels to communicate for our port supply chain	
CC5	have influence each other's decisions through discussion for our port supply chain	
Goal similarity	Our port and port supply chain partners	Simatupang and Sridharan, 2005; Min *et al.* 2005; Angeles and Nath 2001; Lejeune and Yakova 2005; Paixão and Marlow, 2003; Cetindamar *et al.* 2005; Fawcett *et al.* 2008; Manthou *et al.* 2004; Carbone and Gouvernal 2007; Jap 2001; Goffin *et al.* 2006; UNCTAD 2004; Vitsounis and Pallis 2012
GS1	pursue efficient multi-modal transport of container cargoes for our port supply chain	
GS2	stress the importance of collaboration within our port supply chain	
GS3	pursue the provision of value-added logistics services for our port supply chain.	

GS4	pursue cost reduction throughout our port supply chain	
GS5	pursue reduced cycle times and enhanced inventory management for our port supply chain	
Decision harmonisation	Our port and port supply chain partners	Simatupang and Sridharan 2005; Corbett *et al.* 1999; Min *et al.* 2005; Harland *et al.* 2004; Carbone and Gouvernal 2007; Cao and Zhang 2011; Cao *et al.* 2010; Fawcett *et al.* 2008; Spekman *et al.* 1999; Lee *et al.* 1997; Islam *et al.* 2005; Simatupang *et al.* 2002; Marlow and Paixao 2003; Simatupang and Sridharan 2008; Daugherty et al. 2006
DH1	plan on emergent situations within our port supply chain	
DH2	plan on altering schedules and amending orders when customers demand them within our port supply chain	
DH3	manage the flow of cargoes within port supply chain	
DH4	plan on transport planning and scheduling transport within our port supply chain	
DH5	advise each other of any potential problems in meeting the shipper's needs within our port supply chain	
Joint supply chain performance measurement	Our port and port supply chain partners	Simatupang and Sridharan 2005; Min *et al.* 2005; Angeles and Nath 2001; Bichou and Gray 2004. Lee *et al.* 2003; Heaver 2011; Cetindamar *et al.* 2005; Fawcett *et al.* 2008; Bennett and Gabriel 2001; Spekman *et al.* 1999
JPM1	develop systems to evaluate supply chain performance for our port supply chain	
JPM2	deal with security and risks that may occur for our port supply chain	
JPM3	develop systems to enable shippers to identify their cargoes' location for our port supply chain	
JPM4	keep seamless transport flows even in a peak time for our port supply chain	
JPM5	solve the problems together (i.e. delay and accidents in transport) for our port supply chain	

Source: Author

4.2.2 Observed and latent variables of collaborative advantage

Collaborative advantage (CA) is interpreted as a joint competitive advantage, which resides not only within an individual terminal operator, but across the port supply chains including port users through its collaborative relationships (Huxham and Macdonald, 1992, Huxham, 1993, Kanter, 1994, Huxham, 1996, Jap, 2001, Vangen and Huxham, 2003, Huxham and Vangen, 2005a, Foss and Nielsen, 2010, 2012). By synthesising the prior studies, CA has been conceptualised into four dimensions: business synergy, quality, innovation and flexibility. As for this study, CA is viewed from the perspective of an individual MLO.

Business synergy is defined as the extent to which ports and port users combine complementary and relevant activities and efforts to gain supernormal benefits. Business synergy may occur between the port and port user when they complement each other through certain activities in attaining greater results than the sum of the parts. These joint results originated from the collaborative activities for better services in the port supply chain, including jointly scheduled physical movements and knowledge creation. Synergistic benefits that can be acquired by designing informal inter-organisational relationships based on mutual benefits and commitment are the foundation for competitive advantage reduced transaction costs by collaborating between parties (Zineldin, 1998). As a facet of business synergy, an integrated IT infrastructure plays an important role because the seamless movements of containers hinge on the adoption of electronic data interchange (EDI) and computerised information systems that facilitate the information flows amongst port supply chain partners (Martin and Thomas, 2001). Therefore, MLOs have strived to identify changes in technologies, test new technologies as well as information on the behaviour or shippers for marketing purposes (UNESCAP, 2005).

Quality refers to the extent to which ports and port users provide service quality that builds higher value for the shippers. From a port's stance, whilst focusing on rankings in the worldwide context, there is a lack of information about the quality of the provisions of services (Marlow and Paixão, 2003). In terms of maritime logistics, quality refers to the provision of pertinent maritime services that meets the expectation of customers (López and Poole, 1998). In this regard, maritime logistics value can be generated if the system of maritime logistics fulfil customers' requirements via great quality of services (Lee and Song, 2010). The efficient function of supply chains needs the provision of high quality maritime logistics services. López and Poole (1998) contended that although a single organisation or port provides high quality, it cannot guarantee the high quality in the logistics chains. In fact, the value of the quality of service that is needed in a logistics chain is critical to the whole structure of chains (Heaver, 2010). Therefore, the provision of high quality between ports and port users would result in the improvement of the overall quality of port supply chains. In turn, it may affect port performance. De Martino and Morvillo (2008) argued that resources that allow the MLOs to offer higher quality infrastructures and services should be identified, and stated that offering quality in terms of infrastructure and services determines port competitiveness. Vitsounis and Pallis (2012) also ascertained that via the accurate and punctual delivery of cargoes with no delay, value co-creation can be achieved.

Innovation refers to the extent to which a port works jointly with port users in quickly initiating and boosting new services and processes. Innovation in the maritime port logistics chain is as imperative as in any other part of the supply chain (López and Poole, 1998). The severe competition forces shipping lines to focus on innovation in order to survive in the international markets (Jenssen, 2003). In addition, innovation is a fundamental factor in global port management (Branch, 2007). Innovations, which seek tailor-made services and economies of scale in order to closely connect customers to MLOs, may create sustainable competitive advantage (Jenssen, 2003). De Martino and Morvillo (2008) argued that MLOs strived to mobilise and combine diverse activities and resources in order to promote innovation with an emphasis on strengthening inter-organisational relationship. Through information sharing, knowledge creation and collaborative communication between ports and port users, they may enhance absorptive capacity to adopt new services fast and frequently.

Flexibility refers to the extent to which the port supports the provision of diverse services in conjunction with port users in response to changes of the final customer's needs. In other words, it is concerned with an ability to rapidly adjust the services when the port faces unexpected circumstances such as emergent delays of goods and change of weather (Lee and Song, 2010). Flexibility is dependent on the ability of dynamic collaborating organisations to rapidly change process structures or to amend the structure of information sharing for transforming the characteristics of service offering (Gosain *et al.*, 2004). The commoditisation of transport, where shippers exploit their bargaining power, leads MLOs to offer flexibility, which is envisaged as a valuable competency or competitive advantage for them in uncertainty (Naim *et al.*, 2006, Mason and Nair, 2013). The characteristics of flexibility embedded into the transport service providers' behaviour, strategy and technology has to be proactive (Naim *et al.*, 2006). Marlow and Paixão (2003) proposed a lean and agile port that has flexibility for rapid response to changes in customer demand. To this point, Pettit and Beresford (2009) pointed out that ports have remained more responsive in tailoring their services to customers' requirement for becoming agile. Those above features are akin to responsiveness and customer orientation in the maritime context research (Song and Panayides, 2008, Woo *et al.*, 2011b). However, those studies have only focused on the responsiveness and customer orientation of the focal firm (i.e. port and terminal operator), so offering flexibility by multiple supply chain partners has been overlooked. The current competitive scenario needs to offer flexibility with diverse activities amongst various MLOs in the pursuit of satisfying final customers (De Martino and Morvillo, 2008). Fluctuating customer preferences and growing business dynamics have created a greater demand for flexibility (Gosain *et al.*, 2004).

Table 4.3 Latent and observed variables for CA

Latent variables	Observed variables	References
Business synergy	Our port and port supply chain partners	Jap 2001; Dyer 1996; Dyer and Singh 1998; Kanter 1994; Vangen and Huxham 1996; Martino and Morvillo 2008; UNESCAP 2005; Zineldin 1998; Martin and Thomas 2001
BS1	have an integrated IT infrastructure for our port supply chain	
BS2	have integrated knowledge bases and know-how for our port supply chain	
BS3	have integrated marketing efforts for our port supply chain	
BS4	have integrated services for our port supply chain	
Quality	Our port and port supply chain partners	Garvin 1998; Gray and Harvey 1992; Li *et al.* 2006; Marlow and Paixão 2003; Vitsounis and Pallis 2012; López and Poole 1998; Lee and Song 2010; Heaver 2010; De Martino and Morvillo 2008; Vitsounis and Pallis 2012
QL1	offer services that are highly reliable for our port supply chain	
QL2	offer services that are highly punctual for our port supply chain	
QL3	offer high quality services to our customers for our port supply chain	
QL4	have helped each other to improve service quality for our port supply chain	
Innovation	Our port and port supply chain partners	Dyer and Singh 1998; López and Poole 1998; De Martino and Movillo 2008; Jenssen 2003; Branch 2007
IN1	introduce new services to market quickly for our port supply chain	
IN2	have rapid new services development for our port supply chain	
IN3	innovate frequently (e.g., state-of-the art communication systems, latest skills for faster container transport) for our port supply chain	
Flexibility	Our port and port supply chain partners	Gosain et al. 2004; Holweg et al. 2005; Marlow and Paixão 2003; Pettit and Beresford 2009; Lee and Song 2010, Naim *et al.* 2006; Mason and Nair 2013; De Martino and Movillo 2008
FL1	offer a variety of services efficiently for our port supply chain	
FL2	offer customised services with different features quickly for our port supply chain	
FL3	meet different customer demands efficiently for our port supply chain	
FL4	have good customer responsiveness for our port supply chain	

Source: Author

4.2.3 Observed and latent variables of port performance

Because obtaining objective data from MLOs in South Korea would be very difficult owing to the policy and confidentiality concerns of each MLO, this study adopts subjective measurements. It is acceptable to employ subjective measures unless objective measures are available due to their high correlation (Dess and Robinson, 1984). As Woo *et al.* (2011b) postulated, this study also assumes that the measurements of port performance are multidimensional variables that both reflect diverse factors and involve the interests of various port users within the port. In total seven dimensions of port performance were derived and developed from the previous and existing literature followed by discussions with academics and practitioners in containerised MLOs in South Korea. However, some variables such as reliability and convenience of port users stemmed from SCM and other modes of transport studies. In conclusion, port performance measurements are second-order factors that govern seven sub-dimensions. Although some constructs such as connectivity and safety and security have only two observed variables, Churchill (1979) argued that a construct should be measurable by at least two, and preferably more, rather than single-item measures of their constructs.

Connectivity is first dimension of PP. The seaport is viewed as an important link in the transport chain, which has a diverse interface with other transport modes on the basis of door-to-door services. The port is a bidirectional logistics centre in that cargoes pass through it from vessels to land and inland waterway modes as a transport system, which requires a high degree of inter-connectivity (Panayides and Song, 2008, Pettit and Beresford, 2009). The conventional operation of container cargoes based on seaport-to-seaport is no longer suitable for demanding shippers. Therefore, connectivity is a critical tool to build customer loyalty by striving to satisfy the demand of the large global shipping lines and shippers (De Martino and Morvillo, 2008). Nevertheless, the previous port performance literature failed to reflect connectivity issues as landside operations by only emphasising quayside operations (Bichou, 2007). As the emphasis on port performance has transformed from the fragmented internal efficiency to the integrated supply chain efficiency, the aspect of connectivity is of great importance (Bichou, 2007). Connectivity is closely related to multi-modalism, which is *"the process of operating a door-to-door/warehouse-to-warehouse service for shippers involving two or more forms of transport with the merchandise being conveyed in the same unitised form for the entire transit"* (Branch, 2007, p. 401). Branch (2007) pointed out that multi-modalism stimulates the new role of seaports as well as containerised MLOs in developing logistics parks and free trade zones and in improving existing multi-modal networks. It can be deduced from aforementioned arguments that the capability of offering inter-connectivity as multimodal logistics centre in global supply chains is an essential variable of port performance.

Value-added service (VAS) is selected as second component of PP. Due to an increase in the range of customers' demands, ports should create competitive advantage based on the competencies that go beyond the traditional efficient movement of cargo, including the provision of VAS (De Martino and Morvillo, 2008, Mangan *et al.*, 2008). The provision of VAS plays a major role in port competitiveness (Notteboom and Winkelmans, 2001). Recently, ports started recognising an importance of the provision of VAS as a part of integrated supply chains. It provides a chance of developing a whole set of value-added activities and up-to-date information on labelling, repair, inventory management, cargo movements, inspection, continuous replenishment, stuffing/unstuffing containers, cross-docking activities, crafting, palletisation, shrink-wrapping, weighing, repackaging, pre-assembly, procurement and reverse logistics that may optimise the flows of goods and enhance the value of the product (Carbone and De Martino, 2003, Paixão and Marlow, 2003, World-Bank, 2007, Alderton, 2008, Woo *et al.*, 2013). As such, Robinson (2002) put forward a value-chain port that adds value to the cargoes passing through it. The port offering VAS is an essential prerequisite for the third-generation port (UNCTAD, 1995). Due to the demands for VAS, many ports have started constructing logistics parks in their proximity in order to add value to imported cargoes.

Safety and security (SS) is considered as a third component of PP. There has been a growing concern about SS, as it directly affects efficiency and competitiveness (Woo *et al.*, 2011b). Security is also a vital part of the major SCM paradigm because it is directly connected to performance measurement (Banomyong, 2005). Maritime security incidents that negatively influence international trade and MLOs trigger disruptions in maritime supply chains, as international trade relies on seaports (Talley, 2009). If a port remains secure, it may be likely to attract more container throughputs. Safety of port is also of importance. Any loss, damage or mishandling of container cargoes in the port may cause their customers dissatisfaction. In turn, it may possibly affect a port of call for the shipping lines.

Efficient operation (EO) for port users is vital components, since ports have traditionally constituted a bottleneck in global supply chains and international logistics (López and Poole, 1998). The port should handle ships and cargo with operational efficiency (Robinson, 2002). In addition, enhanced EO can give advantages of lower costs for port users. Due to the adoption of containerisation and dedicated terminals, containerised MLOs have paid much attention to efficient operation of cargo flows. To attract more customers such as shipping lines and shippers, EO is likely to influence the customers' port selection, satisfaction and loyalty, so it assists ports to retain the current satisfied customers. López and Poole (1998) pointed out that the prosperity of a port relies on the EO of transport. EO aims to maximise throughput in the employment of a given level of resources within an economic and institutional environment. If ports fail to provide EO, it gives related parties such as shipping lines and shippers disadvantages. As an example, inefficient operation in the port may cause a delay in vessel operations. In turn, shipping lines may suffer financial loss, and shippers may increase their inventory, resulting in higher inventory cost (Talley, 2009). EO can be generally measured by the productivity and speed to meet shippers' logistics demands (Heaver, 2010). Tongzon and Ganesalingam (1994) divided measuring operational efficiency into capital and labour productivity (crane rates, ship rates, TEUs per crane, shipcalls per tug and ship call per employee) and asset utilisation rates (TEUs per berth metre, berth occupancy and TEUs per hectare of terminal area). Marlow and Paixão (2003) put forward a range of new port performance indicators based on time such as loading/unloading time, dwell time for cargo and ship waiting time. Meersman *et al.* (2005) claimed that 24/7 service for customers' EO is required due to evolution of changing port environments. To measure EO, this study employed three major components: terminal productivity, ship waiting time and port operating hours.

Cost efficiency (CE) is also viewed as a dimension of PP for this study. Modern logistics practices, propelled by global manufacturers have forced transport service providers to reduce their costs, so there is a need for eliminating all the unnecessary costs for a handling operation (Marlow and Paixão, 2003). The flow of cargoes is likely to seek routes that provide the lowest cost. As a fundamental role of the port, it should handle ships and cargo within an economic efficiency framework (Robinson, 2002). Cost efficiency aims to minimise cost in the provision of a given level of throughput (Talley, 2009). Talley (2009) pointed out that poorly performing ports with cost inefficiency may tend to increase their service prices to cover revenue, which compels them to remain at a competitive price disadvantage. As such, Woo *et al.* (2011b) noted that cost efficiency (offering lower service price) is one of key strategies to attract the customers (shipping lines and shippers) by reducing total costs. In addition, the improvements of landside transport services should be taken into consideration because it hugely affects total transport costs (Meersman *et al.*, 2005)

This study posits that reliability is also a key indicator of port performance. It is required that terminal operators provide a high-quality service that is reliable due to the demand for Just-In-Time (JIT) strategy, SCM and door-to-door philosophy of shippers (Woo *et al.*, 2011b). From an external effectiveness stance, reliability is viewed as a subjective measurement of whether customer expectations of services are satisfied (Brooks, 2007). Reliability is concerned with the variations in the timeliness measures (Tongzon and Ganesalingam, 1994). In this regard, Hop *et al.* (1996) regarded reliability as a qualitative measurement for effectiveness. Heaver (2010) pointed out that ports are required to tailor their operations to satisfy the differentiated needs of shippers for fast movement of container in time-defined services.

Final dimension of PP is convenience of port users (CPU). It is generally taken for granted that successful ports should pay attention to convenience of their customers. The port should handle ships and cargo within efficient administrative frameworks for its users (Robinson, 2002). Because the major role of ports is to foster the flows of cargoes, port performance may be assessed in terms of how convenient their services are to a multitude of port users. Consequently, comprehensive port performance measures should include the interests of port users (Bichou, 2007). In this regard, Bichou (2007) contended that port performance measures are needed to integrate the diverse dimensions and link them to external port supply chain members. In this study, the port users include shipping lines, inland transport companies, freight forwarders, ship management companies and third-party logistics providers, whose activities involve containerised maritime logistics. These organisations are generally deemed major port users. Port users are defined as choices, value drivers, and satisfaction thinking of ports as elements of value driven supply chains (Robinson, 2002, Pallis and Vitsounis, 2011).

Table 4.4 Latent and observed variables for PP

Latent variables	Observed variables	References
Connectivity		Wiegmans *et al.* 2008; Song and Yeo 2004; Yuen *et al.* 2012; Woo *et al.* 2011b; Tongzon and Ganesalingam 1994; Panayides and Song 2008; De Martino and Morvillo 2008; Bichou 2007; Branch 2007; Acosta *et al.* 2007; Pettit and Beresford 2009
CV1	Capacity of inland transport services is good.	
CV2	Transportation time to hinterland is short.	
Value-added service		Woo *et al.* 2011b; Acosta *et al.* 2007; De Martino and Morvillo 2008; Mangan *et al.* 2008; Notteboom and Winkelman 2001; World-Bank 2007; Woo *et al.* 2013; Carbone and De Martino 2003; Robinson 2002; UNCTAD 1995
VAS1	Cargo is attracted by VAS (warehousing).	
VAS2	VA is increased from VAS.	
VAS3	We have adequate facility for VAS.	
Safety and security		Woo *et al.* 2011b; Talley 2009; Carbone and Gouvernal 2007 ; Banomyong 2005
SS1	Our port is compliant to security regulations.	
SS2	The number of accident is low.	
Efficient operation		Wiegmans *et al.* 2008; Woo *et al.* 2011b; Heaver 2010; Hop *et al.* 1996; Meersman *et al.* 2005; Tongzon and Ganesalingam 1994; Malow and Paixão 2003; Lopez and Poole 1998; Robinson 2002; Talley 2009
EO1	Terminal productivity is high.	
EO2	Port turnaround time is short (ship waiting time due to congestion).	
EO3	Port operating hours (24/7/365).	
Cost efficiency		Wiegmans *et al.* 2008; Woo *et al.* 2011b; Hop *et al.* 1996; Meersman *et al.* 2005; Malow and Paixão 2003; Robinson 2002; Talley 2009
CE1	Our total price is low.	
CE2	Our cargo handling charge is low.	
CE3	Our auxiliary service charge is low (pilotage, towage, customers).	
CE4	Cost of inland transport services is low.	
Reliability		Woo *et al.* 2011b; Tongzon and Ganesalingam 1994; Malow and Paixão 2003; Brooks 2007; Hop *et al.* 1996; Heaver 2010; Carbone and Gouvernal 2007
RL1	Our port handles cargo on quoted or anticipated time.	

RL2	Our port handles cargo on time customers require.	
RL3	Our port's service lead time is short.	
RL4	Our port provides shipment information accurately.	
Convenience of port users		
CPU1	Our port has information technology ability (EDI; port-MIS).	Frankel 2001; Lirn *et al.* 2003; Chang *et al.* 2008; Murphy and Daley 1994; Song and Yeo 2004; Slack 1985; Yuen *et al.* 2012; UNESCAP 2005; Robinson 2002; Bichou 2007; Pallis and Vitsounis 2001;
CPU2	Our port has easy and fast operation process for port users.	
CPU3	Our port has convenience of custom procedures.	

Source: Author

4.3 Summary

This chapter proposed a conceptual model and developed hypotheses in the maritime logistics contexts. The proposed conceptual model is displayed in Figure 4.1. Section 4.1 developed the hypotheses based on rigorous prior literature review. H1 argued that SCC has a positive influence on CA, whilst H2 ascertained that CA has a positive influence on PP. H3 contended that SCC has a positive influence on PP.

In addition, section 4.2 showed the observed variables of each latent variable of SCC, CA and PP to build a solid foundation before adopting structural equation modelling. To statistically assess the proposed hypotheses, those latent variables should be measured by using proper observed variables. The next chapter discusses research design and methodology.

Chapter 5. Research design and methodology

This chapter discusses the research design and methodology. Since the aim of this study is to examine causal relationships between the latent variables, the methodology adopted in this study is chiefly quantitative, particularly based on structural equation modelling (SEM). SEM is regarded as the only tool to examine those relationships simultaneously. The chapter starts with a research design process, which seeks research philosophy, research approach, research strategies and time horizons for this study. The second section shows data collection method to present a proper method for this study. The third section employs Churchill's (2001) nine-step questionnaire process to offer a concise sequential procedure for the formation of the questionnaire instruments. The fourth section introduces characteristics of the population and sampling design. The next section explains the concepts of validity and reliability in details. The final section reviews data analysis techniques of this thesis.

5.1 Research design process

The choice of methodology should be guided by fundamental principles. The term *research philosophy* is concerned with the development and nature of knowledge (Saunders *et al.*, 2012). Research philosophy affects the quality of management research, so it is viewed as an important notion in research design (Easterby-Smith *et al.*, 2012). Moreover, the specific research philosophy which a researcher adopts can be considered as his or her assumptions in regards to the way in which he or she views the world, so this assumption will underpin the research strategy and methods (Saunders *et al.*, 2012). Easterby-Smith *et al.*

(2012) argued that this is why the research philosophy is useful because it leads researchers to clarify research designs. Further, researchers can not only identify and create research designs beyond their previous experience, but also can adapt designs in accordance with the constraints of different knowledge structures. The belief that one research philosophy is superior to another may be wrong as each philosophy suits different aims (Saunders *et al.*, 2012).

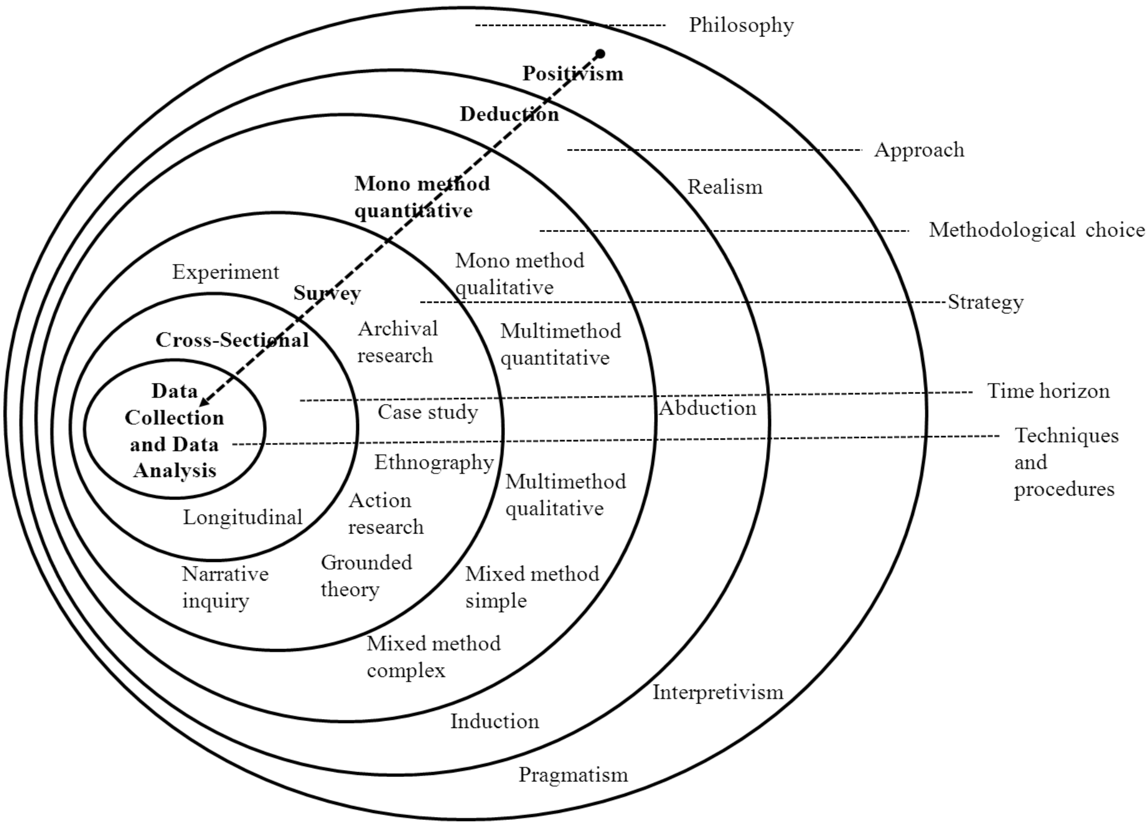
A research paradigm is *"a framework that guides how research should be conducted, based on people's philosophies and their assumptions about the world and the nature of knowledge"* (Collis and Hussey, 2009, p. 55). The philosophical paradigms reflect specific ontologies and epistemologies. Ontological assumptions concern the nature of reality whilst epistemology is concerned with valid knowledge (Collis and Hussey, 2009). The ontological perspective looks for not only objectivism, which contends that social phenomena have an existence that is a reality external to social actors, but also constructionism (constructivism), which argues that social phenomena are generated by social interaction in a constant state of revision (Bryman and Bell, 2011). Bryman and Bell (2011) asserted that an epistemological issue is associated with what should be considered as acceptable knowledge in disciplines, and in particular the most central element of epistemology is whether a social world can be investigated in accordance with the same procedures, ethos and principles as natural sciences.

In general, there are two main philosophical paradigms on epistemology: positivism and interpretivism. Positivism supports the application of natural scientific methods to social reality and beyond (Bryman and Bell, 2011). Easterby-Smith *et al.* (2012) contended that a social world must be evaluated through objective ways rather than subjective methods such as reflection or intuition because positivists assume that the social world exists externally. According to Creswell (1994), positivists assume that investigation of social reality has no impact on that reality since they tend to see reality as independent from them. Positivism is concerned with quantitative research because it assumes that research can measure social phenomena (Collis and Hussey, 2009). Positivists prefer researching causal relationships by collecting observable data and developing hypotheses and using existing theory (Saunders *et al.*, 2012). In addition, positivists are likely to adopt a highly structured methodology so as to ease replication (Gill and Johnson, 2010)

In contrast, interpretivists asserted that they share a perspective that the subject matter of the social science is basically dissimilar from that of the natural sciences (Bryman and Bell, 2011). They tend to think that people do not respond to external stimuli but dynamically interpret the world. The researchers communicate with the study by isolating their own thought from what exists in the social reality (Creswell, 1994). In other words, interpretivism concentrates on investigating the complexity of social phenomena from a perspective of interpretive understanding (Collis and Hussey, 2009). Even though researchers study the same object, there will be different consequences according to each researcher because the way they recognise their roles as social actors is relatively different, so it should be noted that interpretivists are encouraged to adopt an empathetic stance (Saunders *et al.*, 2012). Therefore, instead of employing the quantitative methods adopted by positivists, interpretivists use methods that *"seek to describe, translate and otherwise come to terms with the meaning, not the frequency of certain more or less naturally occurring phenomena in the social world"* (Van Maanen, 1983, p. 9). It advocates a fact that research findings based on interpretivism are not originated from the quantitative data or statistical analysis (Strauss and Corbin, 1990)

The next important attention should be paid to research approach: deductive and inductive approach. Deductive approach refers to the research in which a theoretical structure is developed and evaluated through empirical observations (Collis and Hussey, 2009), whilst an inductive approach begins with data in hand and creates a theory from the ground up (Saunders *et al.*, 2012) The deductive approach is likely to be employed in positivism whilst the inductive approach is dominant in interpretivism. As shown in Figure 5.1, this study assumes positivism since the main constructs will be tested by a deductive approach based on extant theories. Given this, the qualitative methodology is employed because it is concerned with a deductive approach focusing on test theory. Quantitative research is basically associated with survey research (Saunders *et al.*, 2012), and closed questions are typically employed in quantitative research using large-scale surveys (Hair *et al.*, 2007). Therefore, the survey method including closed questions is chosen as the major research strategy. In terms of choosing a time horizon, the 'snapshot' time horizon means cross-sectional whilst longitudinal represents 'diary' perspective (Saunders *et al.*, 2012). This study aims at adopting cross-sectional research since the study is an attempt to find particular phenomena at a particular time. Finally, the data collection method will be a questionnaire survey. In conclusion, Figure 5.1 depicts how this study adopts to use research procedures associated with a particular philosophy in turn: philosophy, approach, methodological choice, strategy, time horizon and techniques and procedures.

Figure 5.1 The research ‘onion’ in this research



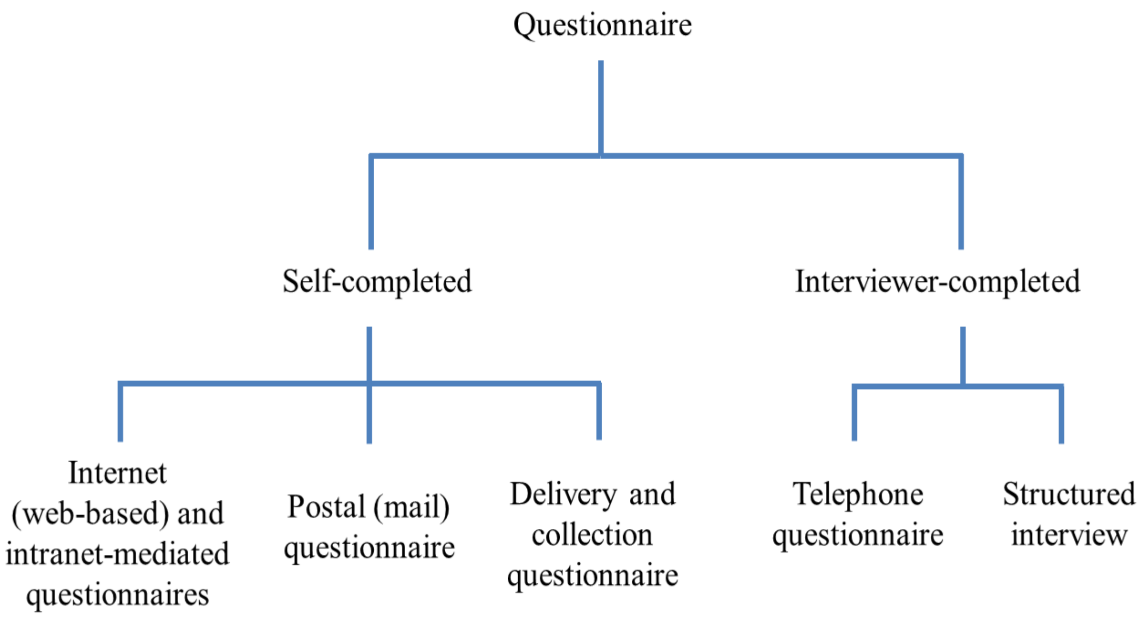
Source: adapted from Saunders *et al.* (2012, p. 128)

5.2 Data collection method

Surveys can be regarded as good methods for collecting data to measure a number of peoples’ opinion and behaviour (Easterby-Smith *et al.*, 2012). A researcher can collect data from a semi-structured interview survey by telephone or interview in person or can release a structured questionnaire by email, postal mail, fax, the Internet and a combination of these (Cooper and Schindler, 2011). This study employs a structured questionnaire survey for data collection as the main method because it can be used to identify and discern relationships between variables that might have causal relationships (Saunders *et al.*, 2012). Collis and Hussey (2009, p. 191) stated that *“a questionnaire is a list of structured questions, which have been chosen after considerable testing with a view to eliciting reliable responses from a particular group of people”.*

According to Saunders *et al.* (2012), the questionnaire design varies according to how it is administered and the amount of contacts for respondents. In general, self-administered questionnaires are undertaken by the respondents. These are conducted by the Internet (Internet-mediated questionnaires), Intranet (Intranet-mediated questionnaires), posted to respondents by mail (postal questionnaire), or delivered in person and collected soon (delivery and collection questionnaire). As a different way, interviewer-administered questionnaires are a way to record a respondent's answer by the interviewer through a telephone or a physical meeting. Figure 5.2 indicates the various types of questionnaires.

Figure 5.2 Types of questionnaire



Source: Saunders *et al.* (2012, p. 420)

A considerable growth in the number of surveys online has been detected for the last decade (Bryman and Bell, 2011). Two categories of online social surveys are email surveys (through emails) and web surveys (through a website). This study employs the web survey, since it is more advantageous than the email and paper survey in that it can utilise diverse decorations, colour and variety in the format of questions in terms of appearance (Bryman and Bell, 2011). If researchers notify potential respondents of URL (web address) by emails, texts or phone calls or in person, respondents can answer that questionnaire by visiting the website clicking URL via their personal computer. The reason this method is employed for this study is because there are a variety of advantages of it. At first, the Internet-mediated questionnaires by email provide potential respondents with greater flexibility and control, as they can respond to their own email in front of their personal computer (Saunders *et al.*, 2012). Therefore, filling out a questionnaire using this method is more convenient for respondents because they can complete it when they have free time and at the speed they want. Secondly, the cost per respondent for large samples is cheaper than other methods if samples are widely dispersed, so it is possible to cover a widespread geographical area. Thirdly, researchers can sometimes know who or which organisation completes the questionnaire. Fourthly, a researcher is able to send questionnaires regardless of the number of them in one batch without any costs. Fifthly, respondents do not need to suffer from different ways of questions, which is caused by interviewers. As a result, there will be no interviewer effects causing bias due to characteristics of interviewer's (Bryman and Bell, 2011). Finally, the online questionnaire assists researchers to save much time by automatically coding respondents' answers, so no bias issues via the coding occurs.

In contrast, the disadvantage of an online questionnaire is low response rates. First of all, it is common that a twenty per cent response rate is seen as good, since there is no encouragement for anonymous respondents to demand their cooperation (Easterby-Smith *et al.*, 2012). Secondly, this low response causes sample bias problems because there is a possibility that respondents who filled out a questionnaire might be not representative of the targeted population (Collis and Hussey, 2009). For example, a high proportion of executives might hand an online questionnaire over to their subordinates because they are normally very busy. Thirdly, there is no way to demonstrate whether respondents have a difficulty in completing a question (Sekaran and Bougie, 2009). Fourthly, researchers cannot ask a number of questions which might not be salient to respondents due to ‘respondent fatigue’ if questionnaires have a lot of questions (Bryman and Bell, 2011). Lastly, there is the possibility that people decide not to complete a questionnaire if they feel bored or it is irrelevant to them (Bryman and Bell, 2011).

In spite of these disadvantages, there are several ways to improve response rates for the questionnaires. First, closed questions and short questionnaires increase response rate (Collis and Hussey, 2009). Second, some methods such as sending follow-up letters and attaching small monetary incentives can increase the response rates (Sekaran and Bougie, 2009). Third, response rates can be boosted by an attractive layout and clear instructions (Bryman and Bell, 2011). Fourth, accompanying a good cover letter stating the reasons for the study also can increase the response rates (Bryman and Bell, 2011).

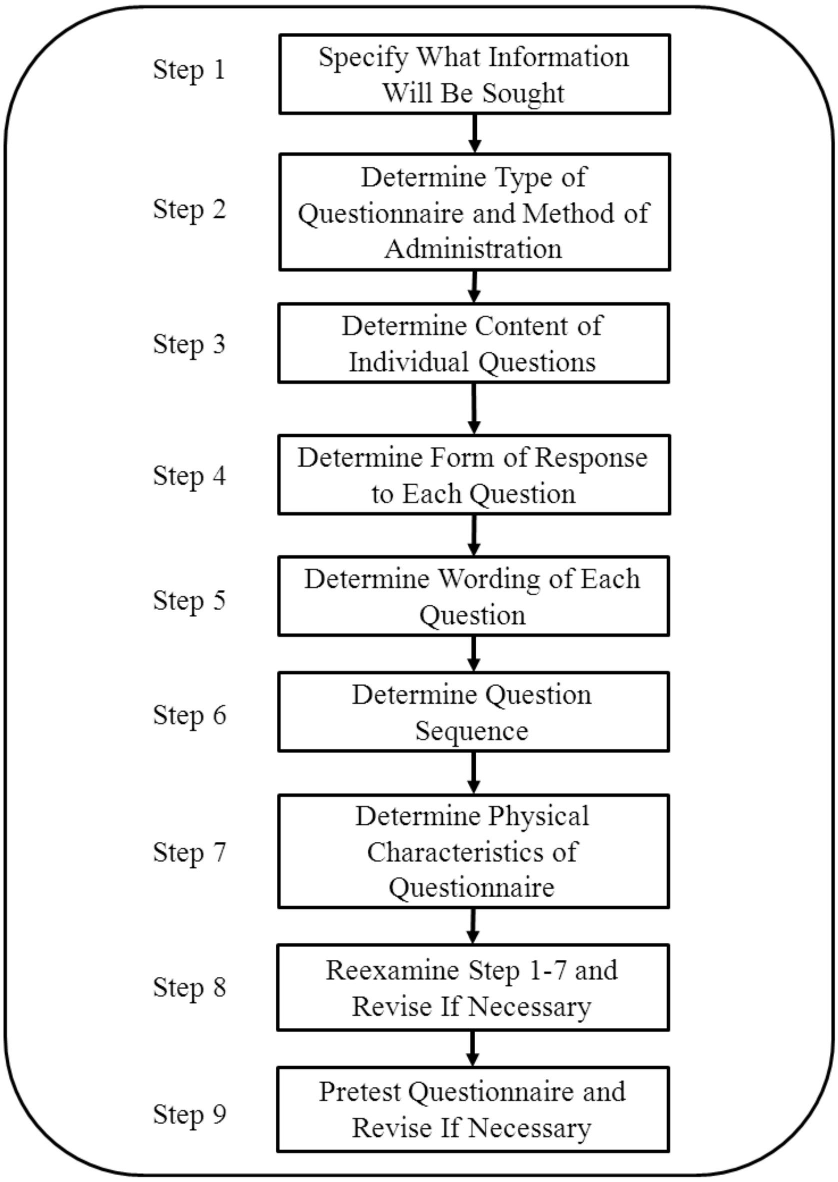
5.3 Questionnaire design

The constructs postulated in this study have been extracted explicitly from the literature review, and selected measures which have high reliability and validity. To develop and validate reliable measures of SCC, CA and PP involving container maritime logistics, subjective measures based on experienced practitioner perceptions were canvassed. A questionnaire to capture the extent to which each respondent’s organisation performs and perceive SCC, CA and

PP were designed to ensure coincidence between researchers' understanding of the meaning of each measurement scale proposed, and practitioners' understanding as suggested by scale development research (Churchill, 1979, Segars and Grover, 1998, Xia and Lee, 2005) as follows: (1) rigorous literature reviews on maritime and SCM contexts identified a pool of instruments and the domain of constructs. (2) In-depth discussions, item review and scoring as well as the Q-sorting technique with experts honed items and ensured their validity with the chosen context in order to signify ambiguity or misunderstandings with the instrument and to suggest modifications. To test for ambiguity in operationalisation, experts including one SCM academic, one maritime academic and four senior maritime practitioners were recruited to undertake the Q-sort to test each item. Experts grouped items based on their similarity, offering a powerful way of confirming the underlying structure of intricate variables and establishing their validity, which is necessary to develop new scales (Segars and Grover, 1998). (3) Potential respondents will attempt to perform a pilot test. This study has invited 22 post-graduate students who are also currently senior practitioners in containerised MLOs in South Korea. In particular, they have attempted to ensure content and face validity by scrutinising instruments, drafts of questionnaires and cover letter from the stance of domain representativeness, item specificity and readability. Some instruments were reworded according to above processes. (4) If a pilot test indicates appropriate content validity of instruments, it will be used. Item purification and development does not halt at any one of these stages, but, rather, is an iterative process.

Each variable is evaluated using a five point Likert scale, ranging from "1 = strongly disagree" to "5 = strongly agree". Questionnaire design is a demanding task, so it requires a guideline on drawing appropriate questionnaires. McDaniel and Gates (2013) put forward ten-step questionnaire design process whilst Churchill (2001) proposed nine-step procedure. Due to simplicity and academic focus, this study decides to use Churchill's (2001) procedure for developing a questionnaire as shown in Figure 5.3.

Figure 5.3 Procedure for developing a questionnaire



Source: adapted from Churchill (2001, p. 314)

Step 1: Specify What Information Will Be Sought

As a first stage in questionnaire design, researchers should have sufficient knowledge regarding research problem and hypotheses to guide the study. The hypotheses guides what information will be pursued since they elaborate what kinds of relationships between the main constructs will be explored. Therefore, the questionnaire was designed to measure answers from respondents for three main constructs: SCC, CA and PP. Besides, the questionnaire includes a cover page illustrating research objectives and author's information. Also, some questions that are related to both respondents profile and organisational profile in the maritime industry are sought.

Step 2: Determine Type of Questionnaire and Method of Administration

The second step is choosing the type of questionnaire and method of administration such as an email, postal mail, online survey, telephone and personal interviews. After carefully considering how data is collected and what level of structure and disguise is used, a researcher should decide the method of administration (Churchill, 2001). The research method normally affects the questionnaire design (McDaniel and Gates, 2013). This study employs a structured questionnaire by online (web-based survey), since this method of collecting data is inexpensive to create and maintain it as well as to eliminate the risk of missing data, and facilitates accurate assembly of a complete dataset (Froehle and Roth, 2004).

Step 3: Determine Content of Individual Questions

The observed variables which are rigorously extracted from literature review in the previous chapter are included in questionnaires after adequately revising. Given the novelty of SCC, CA and PP measures in a maritime context, the Q-sorting technique facilitates verification and enhances content validity proceeding via a construct description phase, a random item list phase, and finally a set of sorting instructions. In the construct description stage, experts receive one page of information showing a one-paragraph statement of each of the six components of SCC, four components of CA and seven components of PP. Next, second sheets randomly lists each of 30 items of SCC, 15 items of

CA and 21 items of PP offer a one-sentence description. Finally, following instructions to read the construct description thoroughly, experts are requested to group the 30, 15 and 21 items of SCC, CA and PP respectively into the sub-dimensions according to definitions in the construct definition and to highlight any unresolvable pairs, ambiguity, redundancy and lack of clarity. Experts including one SCM academic, one maritime academic and four senior maritime practitioners were recruited to undertake the Q-sort to test each item.

Item placement ratios confirmed the content validity and initial reliability of constructs (Moore and Benbasat, 1991). For each item, the number of experts who accurately matched it with its corresponding construct is recorded. All item placement ratios for SCC (IS=87%; KC=90%; CC=96%; GS=83%; DH=73%; JPM=70%) exceeded the suggested 70% threshold (Table 5.1). During this process experts noted that items DS3 and JPM4 were both similar to DS4, and thus redundant. After these were removed, scores rose significantly for JPM and DH to 87% and 91% respectively. In addition, the item placement ratios for CA and PP were all greater than 88%, which provides evidence of high content validity. Because the meanings of the remaining items were consistent across all experts offering measurement scales consistent with corresponding constructs, their content validity was assured.

Table 5.1 Item sorting results

	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Total score
IS	5	4	4	5	4	4	26 (87%)
KC	4	5	4	5	4	5	27 (90%)
CC	5	5	5	5	5	4	29 (96%)
GS	4	5	4	4	4	4	25 (83%)
DH	4	4	4	4	3	3	22 (91%)
JPM	4	3	3	4	3	4	21 (87%)
BS	4	3	4	4	3	4	22 (92%)
QL	3	4	4	3	4	3	21 (88%)

IN	3	3	3	3	2	3	17 (94%)
FL	4	4	4	3	4	4	23 (96%)
CV	2	2	2	2	1	2	11 (92%)
VAS	2	3	2	3	3	3	16 (89%)
SS	2	2	1	2	2	2	11 (92%)
EO	3	2	2	3	3	3	16 (89%)
CE	4	4	4	3	4	3	22 (92%)
RL	4	4	3	4	4	4	23 (96%)
CPU	3	3	2	3	3	2	16 (89%)

Table 5.2 presents all the multi-dimensional measurements for each construct.

Table 5.2 Measurements for constructs in this study

Construct	Latent variables	Observed variables
Supply chain collaboration	Information sharing	Our port and port supply chain partners:
	IS1	provide any information that might help within our port supply chain
	IS2	frequently exchange information within our port supply chain
	IS3	have informed each other of changing needs in advance within our port supply chain
	IS4	keep each other informed about events or changes that may affect our port supply chain
	IS5	exchange accurate information within our port supply chain
	Knowledge creation	
	KC1	search and acquire new and relevant knowledge within our port supply chain
	KC2	assimilate and apply relevant knowledge within our port supply chain
	KC3	identify customer needs for our port supply chain
	KC4	discover new technology for our port supply chain
	KC5	learn the intensions and capabilities of other port supply chains in competition
	Collaborative collaboration	
	CC1	have frequent contacts on a regular basis for our port supply chain
	CC2	have open and two way communication for our port supply chain
	CC3	have informal communication for our port supply chain
	CC4	have many different channels to communicate for our port supply chain
	CC5	have influence each other's decisions through discussion for our port supply chain
	Goal similarity	
	GS1	pursue efficient multi-modal transport of container cargoes for our port supply chain
	GS2	stress the importance of collaboration within our port supply chain
	GS3	pursue the provision of value-added logistics services for our port supply chain
	GS4	pursue cost reduction throughout our port supply chain
	GS5	pursue reduced cycle times and enhanced inventory management for our port supply chain
	Decision harmonisation	
	DH1	plan on emergent situations within our port supply chain
	DH2	plan on altering schedules and amending orders when customers demand them within our port supply chain
	DH3*	manage the flow of cargoes within port supply chain
	DH4	plan on transport planning and scheduling transport within our port supply chain
	DH5	advise each other of any potential problems in meeting the shipper's needs within our port supply chain

	Joint supply chain performance measurement	
	JPM1	develop systems to evaluate supply chain performance for our port supply chain
	JPM2	deal with security and risks that may occur for our port supply chain
	JPM3	develop systems to enable shippers to identify their cargoes' location for our port supply chain
	JPM4*	keep seamless transport flows even in a peak time for our port supply chain
	JPM5	solve the problems together (i.e. delay and accidents in transport) for our port supply chain
Collaborative advantage	Business synergy	Our port and port supply chain partners:
	BS1	have an integrated IT infrastructure.
	BS2	have integrated knowledge bases and know-how.
	BS3	have integrated marketing efforts.
	BS4	have integrated services.
	Quality	
	QL1	offer services that are highly reliable.
	QL2	offer services that are highly punctual.
	QL3	offer high quality services to our customers.
	QL4	have helped each other to improve service quality.
	Innovation	
	IN1	introduce new services to market quickly.
	IN2	have rapid new services development.
	IN3	innovate frequently (e.g., state-of-the art communication systems, latest skills for faster container transport).
	Flexibility	
	FL1	offer a variety of services efficiently.
	FL2	offer customised services with different features quickly.
	FL3	meet different customer demands efficiently.
	FL4	have good customer responsiveness.
Port performance	Connectivity	
	CV1	Capacity of inland transport services is good.
	CV2	Transportation time to hinterland is short.
	Value-added service	
	VAS1	Cargo is attracted by VAS (warehousing).
	VAS2	VA is increased from VAS.
	VAS3	We have adequate facility for VAS.

Safety and security	
SS1	Our port is compliant to security regulations.
SS2	The number of accident is low.
Efficient operation	
EO1	Terminal productivity is high.
EO2	Port turnaround time is short (ship waiting time due to congestion).
EO3	Port operating hours (24/7/365).
Cost efficiency	
CE1	Our total price is low.
CE2	Our cargo handling charge is low.
CE3	Our auxiliary service charge is low (pilotage, towage, customers).
CE4	Cost of inland transport services is low.
Reliability	
RL1	Our port handles cargo on quoted or anticipated time.
RL2	Our port handles cargo on time customers require.
RL3	Our port's service lead time is short.
RL4	Our port provides shipment information accurately.
Convenience of port users	
CPU1	Our port has information technology ability (EDI; port-MIS).
CPU2	Our port has easy and fast operation process for port users.
CPU3	Our port has convenience of custom procedures.

* deleted after Q-sorting technique

Step 4: Determine Form of Response to Each Question

After determining the content of individual questions, it is necessary for researchers to decide whether to employ questions such as open questions, closed questions and multiple choice questions. According to Wilson (2010), open questions are one in which the respondents can indicate a particular response, so it generally creates much lengthier answers.

The advantage of open questions is that respondents can offer broad views that are not limited so that new insights to develop future research ideas are possible. This method is specifically helpful when conducting exploratory study (Wilson, 2010). The answers from respondents illustrate real-world terminology based on their personal experience so that open questions may advise alternatives not recorded in closed questions (McDaniel and Gates, 2013). In fact, open questions encourage respondents to express unusual responses the researcher might not have contemplated (Bryman and Bell, 2011). It is easier for a researcher to develop questions since there is no need for specifying the answer (Hair *et al.*, 2007).

However, open questions have several disadvantages. First, it may be time-consuming to analyse and interpret a number of responses and cost a significant amount of money (Bryman and Bell, 2011). Second, comparing qualitative answers is difficult (Wilson, 2010). Third, editing responses needs to collapse many alternatives into some reasonable number (McDaniel and Gates, 2013). Finally, as it needs great endeavours from respondents, prospective respondents sometimes give up, causing low response rates (Bryman and Bell, 2011).

On the other hand, closed questions require that respondents should select from limited answers (Wilson, 2010). There are some advantages of using closed questions. First of all, closed questions are easier to analyse because the range of answers is limited (Collis and Hussey, 2009). Second, closed questions can clarify the meaning of questions for respondents due to availability of answers (Bryman and Bell, 2011). Third, this type of questions can improve the comparability of answers because it is easier to demonstrate relationships amongst constructs and to make comparisons between respondents (Bryman and Bell, 2011).

Closed questions also exhibit the following disadvantages. First, they may lose spontaneity in respondents' answers, where they may come up with fascinating ideas (Bryman and Bell, 2011). Second, it might irritate respondents if there is no category respondents would like to answer (Bryman and Bell, 2011). Third, designing closed questions is more time-consuming, expensive and difficult than open questions (Hair *et al.*, 2007).

Meanwhile, multiple choice questions are those in which the respondents are asked to choose their perspective from predetermined categories as closed questions (Collis and Hussey, 2009). Each response should be mutually exclusive of the others in order not to result in an overlap in the choice (McClelland, 1994). The disadvantage of multiple choice questions is that providing sufficient and clear categories is difficult for respondents to give an unambiguous answer (Collis and Hussey, 2009).

This study employs the five-point Likert scale measurement metric. The Likert scale is the most widely common variation of the summated rating scale (Cooper and Schindler, 2011). A Likert scale question is regarded as an attitude question that asks respondents to determine the attitude towards a specific topic (Wilson, 2010). This technique is a common way to measure a respondent's attitude in social science such as marketing, logistics, SCM and operations management. Especially, research on SCM pertaining to customer satisfaction, supply chain integration, partnerships and transport mode choice tends to depend on this technique. Five point Likert scales are adopted since it works better with smaller samples compared to seven point Likert scales (Wilson, 2010). If a respondent has no opinion on an issue, there is a neutral mid-point in five point Likert scales (Easterby-Smith *et al.*, 2012). Because the scale makes it possible to collect metric data, academics manage to undertake various multivariate techniques such as factor analysis, regression analysis and SEM for analysing data and achieving their conclusions.

Step 5: Determine Wording of Each Question

Determining wording of each question is an essential task, in that bad phrasing of a question leads respondents to refuse to answer it. The difficulty in understanding question words causes distortion in surveys (Cooper and Schindler, 2011). There are basic principles that researchers should bear in mind. These principles involve the followings (Churchill, 2001, p. 331-334):

- *Use simple words*
- *Avoid ambiguous words and questions*
- *Avoid leading questions*
- *Avoid implicit alternatives*
- *Avoid implicit assumptions*
- *Avoid generalisations and estimates*
- *Avoid double-barrelled questions*

In addition, McDaniel and Gates (2013) highlighted two different aspects from Churchill's (2001): considering the respondent's ability to answer the questions and the respondent's willingness to answer the question.

Step 6: Determine Question Sequence

In this step, a researcher should begin by putting the questions together into a questionnaire. This stage includes (Churchill, 2001, p. 335-337):

- *Use simple and interesting opening questions*
- *Use funnel approach*
- *Design branching questions with care*
- *Ask for classified information at last*
- *Place difficult or sensitive questions late in the questionnaire*

Step 7: Determine Physical Characteristics of Questionnaire

The physical characteristics of a questionnaire may have an influence on how respondents react to it and the accuracy of the replies. This encompasses the following (Churchill, 2001, p. 337-338):

- *Securing acceptance of the questionnaire (e.g. using good cover letters, introduction, giving incentive, securing confidentiality, including the name of the sponsoring organisation and name of research)*
- *Facilitate handling and control (e.g. including questionnaire size, layout and question sequencing)*

Moreover, McDaniel and Gates (2013, p. 355-358) also argued the following suggestions to establish the question flow and layout.

- *Use screening questions to identify qualified respondents*

- *Begin with a question that gets the respondent's interest*
- *Ask general questions first*
- *Ask questions that require "work" in the middle*
- *Insert "prompters" at strategic points*
- *Position sensitive, threatening and demographic questions at the end*
- *Put instructions in capital letters*
- *Use a proper introduction and closing*

Step 8: Re-examine Steps 1-7 and Revise If Necessary

Re-examination and revision play an important role in questionnaire construction. Each question should be examined to make sure that question is not ambiguous and confusing. If a potential problem is detected the question should be corrected (Churchill, 2001).

Step 9: Pre-test Questionnaire and Revise If Necessary

Before conducting an adequate pre-test of the questionnaire, data collection should never start (Churchill, 2001), since there will be no interviewer present to solve any confusion during filling out the self-completion questionnaire (Bryman and Bell, 2011). If a research topic is unfamiliar with a researcher or the questionnaire was translated into another language, pre-test must be conducted (Hair *et al.*, 2007). Hair et al. (2007) argued that at least four individuals (maximum thirty) should be involved in the pre-test as an appropriate sample size. The pre-test includes an attempt to find misinterpretations, lack of continuity and poor skip patterns (McDaniel and Gates, 2013). Cooper and Schindler (2011) commented that there are a variety of motivations for conducting the pre-test: (1) identifying ways to increase respondents interest; (2) increasing the likelihood that respondents are engaged to the survey; (3)

realising contents, wording and sequencing problems (4) noticing target groups in which training is required and (5) increasing the quality of data.

For this study, each item is reviewed by 22 practitioners in South Korea in the maritime industry who were asked to comment on the appropriateness of constructs. In accordance with the feedback from them, redundant and ambiguous questions were either deleted or revised.

5.4 Sampling design

SCC and CA focus upon relationships between the ports and port users. Therefore, this study strategically chose the ports (container terminal operators) and port users (shipping lines, inland transport companies, freight forwarders, ship management companies and third-party logistics providers) involved in only containerised maritime logistics to obtain a comprehensive and balanced view on all constructs in South Korea as a target population for the empirical research. Table 5.3 shows the container throughputs in each port between 2009 and 2012 in South Korea. In addition, Table 5.4 indicates the various characteristics of container terminal operators and in those major three ports in South Korea.

Table 5.3 Container throughputs in South Korea

(Unit: TEU)

Name of Port	Ranking in 2012	2009	2010	2011	2012	Rate of increase or decrease (%)
Sum of all ports		16,341,378	19,368,962	21,610,503	22,550,266	4.35
Busan	1	11,980,325	14,194,334	16,184,706	17,046,177	5.32
Gwangyang	2	1,830,317	2,087,890	2,085,222	2,153,818	3.29
Incheon	3	1,578,003	1,902,733	1,997,779	1,981,855	-0.8
Pyeongtack-Dangjin	4	377,511	446,550	529,509	516,999	-2.36
Ulsan	5	319,334	335,706	326,882	373,235	14.18
Pohang	6	3,057	70,948	129,202	143,480	11.05
Mokpo	7	77,438	94,152	98,816	105,196	6.46
Gunsan	8	68,160	104,320	122,385	65,302	-46.64
Daesan	9	29,031	45,233	54,591	62,681	14.82
Jeju	10	29,055	32,910	27,494	39,688	44.35
Seogwipo	11	14,489	18,274	21,872	19,853	-9.23
Wando	12	14,465	18,120	21,482	19,787	-7.89
Kyungin	13	-	-	-	10,410	-
Masan	14	13,482	12,058	7,892	8,470	7.32
Donghae-Mukho	15	2,406	3,615	2,319	2,124	-8.41
Jinhae	16	196	91	342	1,188	247.37
Okpo	17	40	0	0	3	-
Gohyun	18	0	37	10	-	-
Sokcho	19	4,069	1,991	0	-	-

Source: Incheon Regional Maritime Affairs and Port Administration (2014)

Table 5.4 Container terminal operators and facilities in South Korea

Port	Terminal	Operator(s)	Capacity for vessels	Annual handling capacity	Berth length (metre)	Opening year	Note
Busan	Jasungdae	Korea Hutchison	4,000TEUx4 / 700TEUx1	1,700,000	1,447	1978	
	Shinsundae	CJ Korea Express	4,000TEUx5	2,000,000	1,500	1991	
	Gamman	SBTC, BGCT	4,000TEUx4	1,560,000	1,400	1998	
	Singamman	Dongbu Busan	4,000TEUx2 / 400TEUx1	780,000	826	2002	
	Uam	Uam Co., Ltd	2,000TEUx1 / 400TEUx2	300,000	500	1996	
	Gamcheon			660,000	600	1998	Closed in 2009
	1-1	PNIT	4,000TEUx6	1,380,000	1,200	2006	
	1-1, 2	PNC	4,000TEUx3	2,730,000	2,000	2009	
	2-1	HJNC	4,000TEUx2 / 2,000TEUx2	1,600,000	1,100	2009	
	Multipurpose berth		2,000TEUx1	290,000			
	2-2	HPNT	4,000TEUx2 / 2,000TEUx2	1,600,000	1,150	2010	
	2-3	BNCT	4,000TEUx4	1,920,000	1,400	2012	
Gwangyang	1	-	4,000TEUx2	1,600,000	1,400	1998	Transferred to general berth in 2013
	2-1	HSGC	2,000TEUx2 / 4,000TEUx2	1,140,000	1,150	2002	
	2-2	KIT	2,000TEUx2 / 4,000TEUx2	1,140,000	1,150	2004	
	3-1	Korea Express	4,000TEUx4	1,600,000	1,400	2007	
Incheon	ICT	-	3,000TEUx2	400,000	600	2004	
	SICT	-	1,500TEUx2	240,000	407	2009	
	E1CT	-	2,000TEUx1	140,000	259	2009	
	Korea Express	-	400TEUx2	100,000	225	2009	
	HJS	-	10,000 ton x1/20,000 ton x1/50,000 ton x1/40,000 ton x1	240,000	625	1996	Multipurpose berth

Source: Ministry of Land, Transport and Maritime Affairs (2013)

This study aims to explore a relationship between SCC, CA and PP with an emphasis on the joint relationship between a port and port users. The questionnaire survey was aimed at organisations engaged in container maritime logistics in South Korea which handled the fourth largest global maritime container port throughput of twenty millions in 2011 and owned the fifth largest fleet in terms of deadweight tonnage with leading container shipping lines such as Hanjin shipping and Hyundai Merchant Marine as well as the second largest shipbuilding industry in the world (UNCTAD, 2013).

Regarding sampling design, it is well known that a random sample has to be obtained from the population of interest. However, this study deployed convenience and purposive sampling, as there is no single representative directory for identifying containerised MLOs in South Korea. Convenience sampling refers to sampling by acquiring units that are conveniently available, whilst purposive sampling refers to sampling that selects samples by experts based on their judgment about suitable characteristics required on the sample member (Zikmund *et al.*, 2013). Bryman and Bell (2011) argued that convenience is more accessible, acceptable, common and prominent, though not ideal, than sampling based on probability sampling in the field of business and management. Purposive sampling draws on the knowledge and experience of the researchers to obtain a representative sample within the experts of container ports in South Korea. Potential respondent mailing lists were compiled from the Korea Port Logistics Association (KPLA), Korea Shipowners' Association (KSA), Korea International Freight Forwarders Association (KIFFA), and Maritime and Logistics Information Directory in the Korean shipping gazette to cross-check entries in the four directories. Terminal operators, shipping lines, inland transport companies, freight forwarders, ship management companies and third-party logistics providers involved in containerised maritime logistics were selected to obtain a comprehensive and balanced view on all constructs (Martin and Thomas, 2001, Bichou, 2007, Nam and Song, 2011), in line with the principle that a comprehensive measurements should involve the interests of all various members (Tongzon *et al.*, 2009, Woo *et al.*, 2011b). All were located in the three major container ports of Busan, Gwangyang and Incheon adjacent to major shipping routes close to major markets in the hinterland and would tend to adopt SCM and provide more integrated logistics activities (Ferrari *et al.*, 2006).

To ensure accurate response to the questions, this study attempts to select the respondents in operations, strategy or marketing divisions who are anticipated to have sufficient and significant knowledge with regard to the issues investigated in this study. A single respondent in each organisation was targeted. The targeted respondents embrace senior position such as CEOs, presidents, vice presidents, general managers, managing directors, managers and operation directors. This survey focuses on at least a high level of manager as the key respondents. The limited number of senior managers may tend to possess appropriate knowledge and information rather than managers in a low or middle position. In addition, port authorities and academics in the maritime industry are excluded in the surveys.

Online links to a web-based survey were emailed to 643 potential respondents. To increase response rates, respondents were promised to be offered anonymity and an executive summary of findings. Questionnaires were distributed from April to August 2013, followed by two email reminders and one phone call generating 178 responses, a 27.68% response rate. The covariance structure preferred for subsequent analysis assumes no missing values in the data set (Anderson and Gerbing, 1988), a condition guaranteed by the design of the web-based questionnaire. In terms of sample size, there is no absolute standard. It can be considered as small (less than 100 samples), medium (between 100 and 200 samples) and large (more than 200 samples). Therefore, 178 samples are judged as the critical size (Hair *et al.*, 2010).

5.5 Validity and reliability of measurement

A number of academics have examined the issues of reliability and validity of measures in the methodological research. In general, the final step of the measure development can be carried out by the validation of measures. The following section elaborates the characteristics of validity and reliability in detail, and discusses how to maximise both validity and reliability for this study.

5.5.1 Validity

Validity is referred to as the accuracy of a measure. Hair *et al.* (2007) defined it as the extent to which a construct measures what it is supposed to measure. An instrument should be logically consistent and wholly cover all features of the abstract constructs or concepts to measure. Validity of each construct can be considered as a basic and fundamental condition in developing theory (Steenkamp and Van Trijp, 1991). Also, validity is concerned with systematic errors rather than random errors that can be the major source of reliability evaluation. Table 5.5 illustrates a short introduction to various types of validity, which are examined in the following sections.

Table 5.5 Types of validity

Validity	Description
Content validity	Does the measure adequately measure the concept?
Convergent validity	Do two instruments measuring the concept correlate highly?
Discriminant validity	Does the measure have a low correlation with a variable

that is supposed to be unrelated to this variable?

Source: Sekaran and Bougie (2009, p. 160)

5.5.1.1 Content validity

Content validity is often referred to as measurement validity, and this concept mainly applies to quantitative research (Bryman and Bell, 2011). In order to precisely measure latent variables, these have to be comprehensively defined from the extant literature as well as the author's comprehension of those (Dunn *et al.*, 1994). Li *et al.* (2006) asserted that in-depth discussions with practitioners and academics are necessary to achieve content validity. Content validity is referred to as the appropriateness with which the domain of the characteristics is seized by the measure (Churchill and Iacobucci, 2009). Churchill (1992) stated that content validity may exist when the domain of the characteristics is appropriately reflected by the scale items, but it largely relies on a researcher's subjective judgment. In addition, it is evaluated by testing the measure with a view to contending the domain being sampled. If domains are different from the domain of the variables as perceived, it can be considered as a lack of content validity (Churchill, 1992). On the other hand, if the instrument involves a representative sample of the universe of the subject concerned, content validity is good (Cooper and Schindler, 2011). If the domain or universe of the variables is measured by a large number of items, it is regarded as having greater content validity (Sekaran and Bougie, 2009). However, there are no rigorous ways to confirm content validity (Dunn *et al.*, 1994). Measuring multiple items is a typical way to thoroughly measure the constructs (Churchill, 1979). Churchill (1979, p, 70) contended that *"specifying the domain of the construct, generating items that exhaust the domain, and subsequently purifying the resulting scale should produce a measure which is content",* and that content validity depends on examining procedures which are used to develop the instrument. If convergent and discriminant validity are significant, construct validity can be supported (Dunn *et al.*, 1994).

5.5.1.2 Convergent validity

Convergent validity may be seen as the extent to which constructs have a correlation with other ways designed to measure the same construct (Churchill, 1979). Anderson and Gerbing (1988) argued that convergent validity can be evaluated from measurement models by determining whether each indicator's estimated coefficient on its posited underlying construct factors are statistically significant. This implies that it must correlate with other measures designed to measure at the same item (Churchill, 1992). In other words, convergent validity refers to the level of agreement between more than two attempts to gauge the same construct through different methods (Bagozzi *et al.*, 1991). Evaluation of convergent validity can be elucidated by a confirmatory factor analysis. To appraise convergent validity, it is necessary to check whether the single item's standardised coefficient from the measurement model is significant or not, larger than twice its standard error (Anderson and Gerbing, 1988). It exists when factor loadings are all significant, meaning that the factor loading is different from zero in accordance with the t-values.

5.5.1.3 Discriminant validity

Discriminant validity refers to "*the extent to which the measure is indeed novel and not simply a reflection of some other variable*" (Churchill, 1979, p. 70). According to Anderson and Gerbing (1988, p. 416), discriminant validity can be evaluated *"for two estimated constructs by constraining the estimated correlation parameter between them to 1.0 and performing a chi-square difference test on the values obtained for the constrained and unconstrained models".* It must not correlate highly with measures intended to assess different items (Churchill, 1992). In other words, individual items employed to measure one specific latent variable should not measure another latent variable simultaneously. Discriminant validity normally relies on the level to which a scale measures distinct constructs (Bagozzi *et al.*, 1991). It can be assessed by testing the inter-correlations amongst the constructs that are generated and purified by exploratory factor analysis and confirmatory factor analysis. If the chi-squared difference value is associated with a p-value of less than 0.05, discriminant validity exists (Jöreskog, 1971).

5.5.1.4 Unidimensionality

Some previous techniques such as Cronbach's Alpha and exploratory factor analysis have been adopted to assess unidimensionality (Anderson *et al.*, 1987) It is possible for a scale to have construct validity if it is unidimensional (Gerbing and Anderson, 1988). Having a multidimensional construct is tolerable, but scales should be unidimensional (Dunn *et al.*, 1994). Attaining unidimensionality is an essential task in theory testing and development (Anderson and Gerbing, 1988). Obtaining construct validity is infeasible without unidimensional scales, but it is insufficient to have a unidimensional scale for construct validity because unidimensionality is a necessary but not sufficient condition for construct validity (Garvin, 1987, Gerbing and Anderson, 1988). Dunn *et al.* (1994) pointed out that a scale is viewed as unidimensional if the items of a scale estimate one factor, and unidimensionality should be appraised before a reliability test. Unidimensionality is generally sought by using confirmatory factor analysis. Weakly loaded items on the hypothesised factors are deleted from the scale, leading to a unidimensional scale (Dunn *et al.*, 1994).

5.5.2 Reliability

Reliability means how consistently the measures generate the same results through multiple applications (Mentzer and Flint, 1997). Campbell and Fiske (1959, p. 83) argued that *"reliability is the agreement between two efforts to measure the same trait through maximally similar methods whilst validity is represented in the agreement between two attempts to measure the same trait through maximally different methods"*. Reliability encompasses determining the consistency of either comparable or independent measures of the same object (Churchill, 1992). According to Peter (1979), assessing the reliability consists of ascertaining how much the variation in scores is due to inconsistencies in measurement. Reliability is considered as a necessary condition, but not sufficient for validity (Churchill, 1992). After a successful unidimensionality test, the reliability of a composite score should be evaluated (Gerbing and Anderson, 1988). This implies that reliability becomes significant after examining unidimensionality because having a reliable scale, which is measuring more than one construct, satisfies a sufficient condition for absence of construct validity (Dunn *et al.*, 1994). Gerbing and Anderson (1988, p. 190) asserted that *"reliability of a scale is determined by the number of items, which define the scale and the reliabilities of those items"*. In positivist studies, reliability has a tendency to be high whilst it has little importance under interpretivism (Collis and Hussey, 2009).

Reliability is assessed by a number of methods such as test-retest split-half and Cronbach's Alpha (Bagozzi, 1984, Mentzer and Flint, 1997). Test-retest involves a high cost and causes a problem if respondents can recall their reliability answers. Split-half also has a disadvantage in that correlation results from two groups are highly dependent on how the results are split. Many academics in survey-based studies tend to use Cronbach's Alpha as a reliability test. Cronbach's Alpha coefficient can be employed to evaluate the degree of internal consistency within specific scales (Hair *et al.*, 2010).

Nonetheless, Cronbach's Alpha has drawbacks. Since it assumes that the items already shape unidimensionality and they possess equal reliabilities, it results in underestimation of the reliability for composite scores (Gerbing and Anderson, 1988). In order to solve this problem, confirmatory factor analysis is widely employed to test the composite reliability of constructs and variance extracted measures (Garver and Mentzer, 1999, Hair *et al.*, 2010). Composite reliability provides a measure of the internal consistency and homogeneity of the items comprising a scale (Churchill, 1979). In other words, a series of latent indicators of constructs are consistent with their measurement.

The composite reliability can be calculated:

$$\mathbf{CR = (\sum \text{Standardised Factor Loading})^2 \,/\, ((\sum \text{Standardised Factor Loading})^2 + \sum e_j)}$$

This formula explains that the numerator means the standardised factor loading between a latent variable and its indicators summed, squaring the summation whilst the denominator implies that summed e_j (measurement error) of each indicator plus the numerator. e_j can be calculated as 1 minus the reliability of the indicator that is the square of the indicator's standardised factor loading (Garver and Mentzer, 1999). The reliability value over 0.7 is considered to be acceptable (Hair *et al.*, 2010).

According to Medsker *et al.* (1994), the measurement of average variance extracted (AVE) can be sought by a complementary measure of construct validity. This measurement is implemented by gauging the amount of variance in the indicators accounted for by the latent variables. The AVE can be calculated with the formula:

$$\textbf{AVE} = \sum \textbf{Standardised Squared Factor Loading}^2 \, / \, (\sum \textbf{Standardised Squared Factor Loading}^2 + \sum e_j)$$

This formula elucidates that the numerator stands for standardised squared factor loading between latent constructs and its indicators squared, then summed whilst the denominator equals the summed e_j plus the numerator. The value of 0.5 or larger for AVE is widely acceptable (Garver and Mentzer, 1999, Hair *et al.*, 2010).

5.6 Data analysis technique

This thesis aims to examine the association between multiple independent and dependent variables involving SCC, CA and PP. Some viable techniques can support such an analysis. For example, both Multi-Attribute Utility Technique (MAUT) and Analytical Hierarchy Process (AHP) and SEM can be considered to test it. Amongst these, due to its advantages of flexibility and powerfulness for analysing simultaneous relationships, SEM is strongly recommended as the most effective analytical technique by the majority of academics (Byrne, 2010, Hair *et al.*, 2010, Kline, 2011, Tabachnick and Fidell, 2012). Thus, this thesis employs SEM as the main data analysis technique for empirical tests.

5.6.1 What is structural equation modelling?

SEM refers to a statistical methodology which embraces a confirmatory approach for the analysis of theory (Byrne, 2010). SEM can statistically explore hypothesised models to confirm that the proposed models are consistent with the sample data (Wisner, 2003). According to Wijanto (2008), SEM is composed of two variables. Firstly, two variables involve the latent variable and observed variable. The latent variable, which is impossible to measure directly, is an abstract construct such as collaboration and satisfaction whilst the observed variable is used to measure it. Thus, latent variables have two kinds of variables: exogenous latent variables and endogenous latent variables. Exogenous latent variables affect other latent variables, whilst endogenous latent variables are either directly or indirectly influenced by other variables within the model (Byrne, 2010). The measurement models explicitly specify how the latent variables gauged in terms of observed variables, addressing the validity and reliability of them in evaluating the latent variables or hypothetical constructs (Wisner, 2003).

SEM has two models: measurement model and structural model (Garver and Mentzer, 1999). The measurement model depicts relationships between latent variables and observed variables, whilst the structural model describes causal relationships between latent variables (Wijanto, 2008). Furthermore, SEM has two errors: measurement error and structural error. A measurement is necessary to explain why observed variables cannot perfectly measure their latent variables, whilst a structural error is added to an equation because independent variables cannot perfectly give dependent variables an influence (Wijanto, 2008).

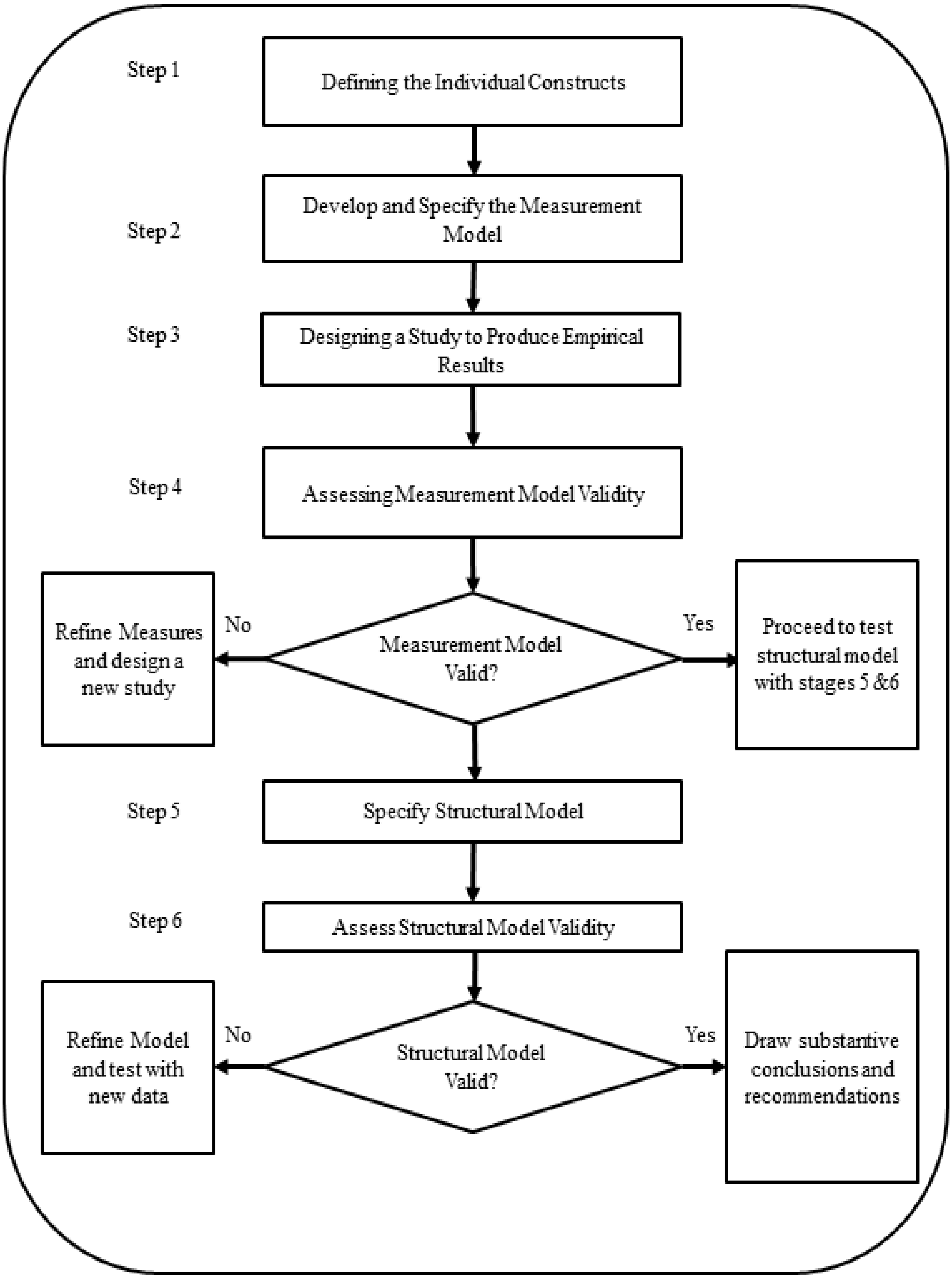
5.6.2 Advantages of SEM

The proliferation of SEM is because it has numerous advantages compared to other research tools. The main advantage is that the confirmatory methods offer a comprehensive means for evaluating and amending theoretical models to researchers (Anderson and Gerbing, 1988). Secondly, SEM allows multiple interrelated dependence relationships to estimate, whilst multiple regression analysis only sorts out one relationship (Hair *et al.*, 2010). Thirdly, measurement errors can be eliminated through the equations in the measurement model, whilst it occurs in the multiple regression analysis. Fourthly, SEM is capable of dealing with reciprocal or non-recursive relationships (Kline and Klammer, 2001). Fifthly, it offers an evaluation of predictive validity and explores the direct and indirect relationships amongst latent variables (Byrne, 2010). Sixthly, it allows researchers to test both hypothesised model and other competing models (Devaraj *et al.*, 2007). Seventhly, SEM is helpful when one dependent variable becomes an independent variable in subsequent dependence relationships (Hair *et al.*, 2010). Finally, it makes it possible to evaluate the relationships comprehensively and offers a transition from exploratory to confirmatory analysis (Hair *et al.*, 2010). As such it provides great potential to develop a further theory (Anderson and Gerbing, 1988).

5.6.3 SEM procedure steps

In this study, Hair *et al.* (2010)'s six-stage process for SEM is employed. Figure 5.4 elaborates the detailed process.

Figure 5.4 Six-stage process for SEM



Source: Hair *et al.* (2010, p. 654)

Stage 1: Defining individual constructs

In order to gain suitable results from employing SEM, a good measurement is a necessary condition. This stage focuses on what items to be employed are used as measured constructs. The way researchers choose the items to measure constructs affects the entire remainder of the SEM process. Therefore, researchers should spend significant time and endeavour on measurement quality to ensure that appropriate items are drawn for valid conclusion. This stage begins with providing a theoretical definition of each construct chosen so that a researcher can operationalise constructs by choosing its measurement scale items. In general, scales can be drawn from either prior research or new scale development (Hair *et al.*, 2010). As for this study, the model is carefully based on theoretical foundations and scales are drawn from extant literature, involving three latent constructs.

Stage 2: Developing and specifying the measurement model

In the second stage, latent variables in the model are recognised and observed variables are assigned to latent variables, and a path diagram is drawn for the measurement model. A critical consideration in deciding the number of observed variables to each latent variable should be made. Each latent variable must be measured by multiple indicators, but the exact number of indicator is abstract (Baumgartner and Homburg, 1996). A sufficient number of observed variables per construct not only allow a model to be identified but also minimise estimation problems such as non-convergence. However, the large number of indicators per factor makes it difficult to simply represent the measurement structure. Therefore, Baumgartner and Homburg (1996) recommended that each construct be evaluated with a minimum of three or four observed variables each, whilst Churchill (1979) argued that at least two observed variables are sufficient to measure the corresponding latent variable.

There are three types of relationships: measurement relationships between items and constructs, structural relationships between constructs and correlational relationships between constructs. In addition, there are two types of error terms: one related to separate indicators and the other to endogenous variables. Therefore, specification of the complete measurement model embraces (1) measurement relationships for the items and constructs, (2) correlational relationship among the constructs, and (3) error terms for the items. Although scales are well established, researchers should ensure that the validity and unidimensionality are appropriate (Hair *et al.*, 2010).

Stage 3: Designing a study to produce empirical results

In third stage, researchers should evaluate the adequacy of the sample size, choose the estimation method and find missing data. SEM needs cautious consideration of factors affecting the research design. Traditionally, research seeks metric data to measure observed variables, but due to advances in the software programmes it is possible to use nonmetric data. Specifying the type of data before using each variable makes measurement appropriate (Hair *et al.*, 2010). This study adopts metric data (interval) to measure observed items. Another element that should sensibly be considered is sample size. SEM is not only very sensitive to sample size compared to other multivariate analysis, but also hardly reliable with small samples. Previous recommendations based on sample size such as “always maximise as much as you can” and “sample sizes of 300 are needed” are no longer suitable. Nonetheless, there is no doubt that larger sample size generates stable results.

Another critical factor that should be discussed in this stage is issues in model identification. Broadly speaking, model identification investigates whether there is a unique set of parameters consistent with the data (Byrne, 2010). When specifying model parameters to estimate, researchers should decide if it is to be free or fixed. A fixed parameter is to be specified by the researcher whilst a free parameter is one in which the value is estimated in the model (Hair *et al.*, 2010). The model can be identified if a unique solution for the values of parameters is found, resulting in parameters that are estimable and the model therefore testable (Byrne, 2010). According to Byrne (2010), three types of structural model exists: just-identified, over-identified or under-identified. Just-identified model refers to the extent to which there is a one-to-one correspondence between the parameters and the data. This model has no degrees of freedom, so it is not scientifically interesting and cannot be rejected. An over-identified model means that the number of parameters is less than the number of data points (the number of distinct elements in the variance-covariance matrix of the observed variables). It leads to positive degrees of freedom which offer rejection of the model. If a model has insufficient information for parameter estimation it is regarded as an under-identified model.

There are several types available to deal with multiple relationships: LISREL, EQS, AMOS, PLS and CALIS (Hair *et al.*, 2010). This study employs AMOS because it takes a confirmatory approach whilst other multivariate procedures are descriptive (Byrne, 2010)

Stage 4: Assessing measurement model validity

Measurement model validity relies on levels of goodness-of-fit for the measurement model and specific evidence of construct validity. In general, the measurement model is used to assess convergent and discriminant validity in a confirmatory manner (Anderson and Gerbing, 1988). Goodness-of-fit shows how well the model reproduces the observed covariance matrix amongst the indicators. Model fit compares the theory to reality by evaluating the similarity of the estimated covariance matrix to the observed covariance matrix (Hair *et al.*, 2010). However, there is no single investigation of significant factors which can completely identify a correct model given the sample data (Schumacker and Lomax, 2004). Hair *et al.* (2010) recommended three main classifications for evaluating goodness-of-fit indexes: absolute fit indices, incremental fit indices and parsimony fit indices.

First of all, the absolute fit measures offer an assessment of how well a proposed model fits the sample data, involving chi-square (χ^2) statistic, goodness-of-fit index (GFI), root mean square error of approximation (RMSEA), root mean square residual (RMR), standardised root mean residual (SRMR) and normed chi-square (χ^2/df). χ^2 is the only statistically based SEM fit measure. Although χ^2 is the most general way to assess fit, this is too sensitive to sample size. When sample size is bigger than 200 there are significant differences in most models (Medsker *et al.*, 1994). When measuring goodness-of-fit, researchers find differences between matrices to support a model as representative of the data (Hair *et al.*, 2010). GFI is an indicator to measure the relative amount of variance and covariance (Byrne, 2010). RMSEA is the most informative criteria in covariance structure modelling, measuring the discrepancy between observed and estimated input matrices per degree of freedom (Byrne, 2010). RMSEA measures the discrepancy regarding the population not the sample (Hair *et al.*, 2010). It can be interpreted that the fit index value would approximate the population. RMR and SRMR are *“the square* *foot of the difference between the residuals of the sample covariance matrix and the hypothesised covariance model"* (Hooper *et al.*, 2008, p. 54). Normed chi-square is regarded as a simple ratio of χ^2 to the degrees of freedom for a model (Hair *et al.*, 2010).

Secondly, incremental fit indices show how well the estimated model fits an alternative baseline model. This embraces normed fit index (NFI), Tucker Lewis index (TLI), comparative fit index (CFI), relative non-centrality index (RNI). NFI is a ratio of the difference in χ^2 value for the fitted model (Hair *et al.*, 2010). TLI compares a planned model's fit to null model, measuring parsimony by evaluating the degrees of freedom from the model to the null model (Garver and Mentzer, 1999). CFI is a modified form of the NFI which takes into account sample size (Byrne, 2010). It was invented to overcome the limitation of sample size effects as a non-centrality parameter-based index (Bentler, 1990).

The third type of indices is parsimony fit indices that are related to the extent to which modelling amongst competing models shows the best fit considering its complexity. It includes adjusted goodness of fit index (AGFI), parsimony normed fit index (PNFI). AGFI is slightly different from goodness-of-fit in fact AGFI adjusts for the number of degrees of freedom in the model (Byrne, 2010). AFGI considers differing degrees of model complexity (Hair *et al.*, 2010). It solves the problems in parsimony by incorporating a penalty for the inclusion of additional parameters (Byrne, 2010). The value of PNFI can be used in comparing one model to another with the highest PNFI value being most supported with regards to the criteria (Hair *et al.*, 2010). PNFI also adjusts for degrees of freedom based on the NFI.

Stage 5: Specify structural model

This stage assesses the model by assigning relationships from one construct to others based on the suggested theoretical model, which involves converting a measurement model to a structural model. The researcher investigates the dependence of the relationships which are hypothesised to exist amongst the constructs. Each hypothesis stands for a particular relationship (Hair *et al.*, 2010).

Stage 6: Assess structural model validity

In this final stage, it tests the structural model validity and hypothesised theoretical relationships. For example, it evaluates goodness-of-fit, significance, direction and size of structural parameter estimates. Although acceptable overall model fit is established, alternative or competing models are encouraged to support a model's superiority. In addition, estimated parameters for the structural relationships are emphasised since they offer direct empirical evidence related to the hypothesised relationships in the model. In order to establish the validity of the structural model, the same criteria as the measurement model in stage four can be used (Hair *et al.*, 2010).

5.7 Summary

This chapter was devoted to research design and methodology of this thesis. Section 5.1 discussed research design processes including research philosophy, research paradigm, research approach and methodological approach. This thesis was positioned in the positivism applying deductive approach and mono method quantitative way through the web-based survey. Subsequently, the data collection method and questionnaire design was presented in detail. The questionnaire was designed by Churchill's (2001) procedure. Additionally, Q-sorting technique was employed to facilitate verification and improve content validity proceeding via a construction description phase, a random item list phase and a set of sorting instructions. Next, the rationale for the sample design, validity and reliability was discussed. Then, section 5.6 justified the adoption of the SEM amongst various techniques due to its advantages of flexibility and powerfulness for analysing simultaneous relationships. Finally, Hair et al. (2010)'s six-stage process for SEM was displayed.

Chapter 6. Descriptive analysis

The main aim of this study is to examine the relationships between supply chain collaboration (SCC), collaborative advantage (CA) and port performance (PP). Therefore, this study employs a questionnaire survey to obtain data designed for empirical analysis using structural equation modelling (SEM), since this technique allows researchers to deal with a large number of endogenous and exogenous variables, as well as latent variables specified as linear combinations of the observed variables. Before empirical analysis in chapter 7, this chapter undertakes an initial data analysis including the descriptive statistics of the data. Implementing initial data analysis is important not only for a general picture of the data by exploring and summarising data, but also for model formulation prior to the empirical analysis. The first section includes an overview of the survey respondent by dividing respondents into port and port user group. Descriptive statistics for SCC, CA and PP are given in section two. The statistics encompass percentage frequency, mean and standard deviation of each item in the questionnaire survey pertaining to the three constructs. Furthermore, this initial analysis incorporates a comparison between ports and ports user groups to show a difference of their view.

6.1 Response rate, non-response bias and common method variance

This section focuses on describing response rate, non-response bias and common method bias. The questionnaires were distributed and collected approximately for five months, commencing in April until the end of August 2013. As presented in Chapter 5, the questionnaire was developed following Churchill

(2001)' guidelines. As a main survey, the free online questionnaire programme offered by Google including a personalised cover letter asking for participation in the survey together with aims of the present study was sent to the 643 potential respondents including 48 terminal operators (TOs), 108 shipping lines (SLs), 79 inland transport companies (ITCs), 178 freight forwarders (FFs), 64 ship management companies (SMC), and 166 third-party logistics providers (3PLs), whose business are related to three major container ports in South Korea. The more detailed process for selecting samples is displayed in Chapter 5. Two additional waves of follow-up emails and telephone calls to those who did not respond during the targeted period were also sent. Table 6.1 illustrates the overview of the response rate of this online survey. Whether potential respondents have opened questionnaires or not was checked because the online questionnaires was distributed via email. The email was not even opened with 50 SLs, 30 ITCs, 107 FFs, 40 SMCs and 109 3PLs. It may be attributed to presumptions that respondents' email automatically filtered it as a spam mail or ignored by respondents due to their busyness. Of the emails that were opened, 8 SLs, 29 ITCs, 50 FFs, 5 SMCs, and 37 3PLs have ignored a request for the completion of the questionnaire. Finally, the total response rate was 28%. This rate appears to be adequate compared to other studies that employed a structured questionnaire and SEM.

Table 6.1 Questionnaire response

Group	Sent	Not opened	Opened but ignored	Total number	Response rate (%)
TO	48	0	0	48	100
SL	108	50	8	50	46
ITC	79	30	29	20	25
FF	178	107	50	21	12
SMC	64	40	5	19	30

3PL	166	109	37	20	12
subtotal	643	336	129	178	28

It is imperative to handle the potential problem of non-response bias. To check non-response bias, t-test was conducted to compare the last quartile respondents and first quartile respondents as recommended by Armstrong and Overton (1977). It is presumed that the first quartile of respondents is willing to participate in surveys, whilst the last quartile of respondents is akin to the non-respondents because they postponed their replies. The 178 respondents were divided into two groups, namely, early quartile (N=44, 24.7%) and late (N=44, 24.7%) quartile respondents. T-test was performed on the two groups' characteristics and perceptions of each item. Table 6.2 shows that most responses between the first and last quartile have no statistical difference at the 0.05 significance level in respect to characteristics of respondents and firms, SCC, CA and PP except for only one item from SCC (GS2) and two items from CA (FL4 and QL4). Hence, it is concluded that non-response bias is not a major concern for this study, since late quartile responses seem to reflect those of the first quartile as shown in Appendix B.

Table 6.2 Test for non-response bias

	Significant difference	Non-significant difference
SCC	1	27
CA	2	13
PP	0	21
Respondents' profile	0	7
Total	3	68

A Harman's single-factor test was undertaken to inspect common method bias because one single response per organisation at one single point in time was received (Podsakoff *et al.*, 2003). To ensure that no one general factor accounts for the majority of total variance, confirmatory factor analysis (CFA) to evaluate common method bias revealed single factor model fit indices of χ^2/df (9327.855/2416)=3.861, Comparative Fit Index (CFI)=0.565, Tucker-Lewis Index (TLI)=0.553, Root Mean Square Error of Approximation (RMSEA)=0.127 showing intolerable outcomes compared to those of the measurement model. It implies that common method bias is unlikely for this study.

6.2 Survey respondents profile

The profiles of respondents' organisation and their characteristics are displayed in Table 6.3. The sample of TOs and SLs accounted for approximately 27 and 28% respectively, whilst ITCs, FFs, SMCs and 3PLs accounted for 11, 12, 11 and 11% respectively. In terms of ports, Busan, Gwangyang and Incheon ports accounted for 47, 34 and 19 percent respectively. It would be plausible that the ports which handle more container cargo throughput involve more relevant MLOs. Therefore, it is likely that the number of respondents in Busan and Gwangyang ports is greater than that of Incheon. For further information, comprehensive categories according to each MLO in each port are shown in Appendix C for further information.

Table 6.3 Type of MLOs according to three major ports

		Type						Total
		TO (N, %)	SL	ITC	FF	SMC	3PL	
Port	Busan	31	23	7	8	8	7	84 (47)
	Gwangyang	12	20	9	10	5	4	60 (34)
	Incheon	5	7	4	3	6	9	34 (19)
Total		48 (27)	50 (28)	20 (11)	21 (12)	19 (11)	20 (11)	178

6.2.1 Detailed characteristics of respondents

This section examines detailed characteristics of respondents by dividing them into ports (TOs) and port users (SLs, ITCs, FFs, SMCs and 3PLs).

6.2.1.1 Terminal operators

At the time this study first distributed questionnaires in April 2013, the total number of TOs registered in the Korea Port Logistics Association (KPLA) was 305, and 101 TOs (33%) were registered in Busan, Gwangyang and Incheon port. 48 questionnaires were collected from TOs in those ports, indicating approximately 48% of participation amongst the total population. More than half of respondents (55%) have been working in the port industry, and 21% of them have work experience of between 10 and 12 years. On top of that, the level of positions was relatively high, showing that 68% of them held a position as a department manager, managing director and CEO within their organisation. In addition, in terms of organisation size, 71% responses came from the organisation which has less than 300 employees, whilst 29% of respondents belonged to a large organisation, which has more than 300 employees.

Table 6.4 The profile of terminal operators

The profile of terminal operator	Frequency	Percentage
Work experience in port industry		
Less than 3	2	4
4-6	3	6
7-9	6	13
10-12	10	21
13-15	6	13
16-18	10	21
Over than 19	11	23
Position		
Assistant manager	2	4
Manager	5	10
Deputy general manager	8	17
Department manager	16	33
Managing director	16	33
CEO	1	2

The number of employees		
Less than 50	4	8
50-99	4	8
100-149	6	13
150-199	6	13
200-249	6	13
250-299	8	17
Over than 300	14	29

6.2.1.2 Port users

In order to compare the perception of the degree of SCC, CA and PP between service providers (ports) and service users (port users), this study divided respondents into port service providers (TOs) and port users (SLs, ITCs, FFs, SMCs and 3PLs). This section focuses on the perceptions of port users.

Shipping line

This study obtained the population lists from Korea Shipowners' Association (KSA). Then, the samples were carefully chosen based on their ports of the calls in Busan, Gwangyang and Incheon ports. Of the respondents, 54 percent of them have been working in port industry more than thirteen years. Nearly 52 percent of them held a position higher than department manager. In addition, in terms of firm size, 30 percent of respondents were working for large firms. This may be attributed to the fact that some respondents work for world-wide shipping lines' branch in Korea. Those shipping lines tend to have a large number of vessels, employees and branches in all major shipping routes in the world.

Table 6.5 The profile of shipping line

The profile of shipping line	Frequency	Percentage
Work experience in port industry		
Less than 3	4	8
4-6	7	14
7-9	8	16
10-12	4	8
13-15	10	20
16-18	11	22
Over than 19	6	12
Position		
Assistant manager	7	14
Manager	7	14
Deputy general manager	10	20
Department manager	12	24
Managing director	12	24
CEO	2	4
The number of employees		
Less than 50	6	12
50-99	4	8
100-149	9	18
150-199	7	14
200-249	4	8
250-299	5	10
Over than 300	15	30

Inland transport companies

Inland transport companies were also selected as main port users. They are in charge of the provision of inland transport on the basis of door-to-door, contributing to smooth hinterland connections and inter-modal transport. Working experience in the port industry and position of the frequency were roughly equal. In addition, most respondents have been working for small and medium sized firm.

Table 6.6 The profile of inland transport company

The profile of inland transport company	Frequency	Percentage
Work experience in port industry		
Less than 3	2	10
4-6	2	10
7-9	2	10
10-12	5	25
13-15	4	20
16-18	2	10
Over than 19	3	15
Position		
Assistant manager	2	10
Manager	3	15
Deputy general manager	2	10
Department manager	8	40
Managing director	3	15
CEO	2	10
The number of employees		
Less than 50	2	10
50-99	2	10
100-149	4	20
150-199	3	15
200-249	4	20
250-299	1	5
Over than 300	4	20

Freight forwarder

57 % of respondents have been working for longer than 13 years in the port industry, and those who have work experience for 10 to 12 years accounted for 19 percent. The proportion of department manager, managing director and CEO were 33, 24 and 10 percent respectively. In addition, 7% of respondents were from large firms.

Table 6.7 The profile of freight forwarder

The profile of freight forwarder	Frequency	Percentage
Work experience in port industry		
Less than 3	0	0
4-6	1	5
7-9	4	19
10-12	4	19
13-15	2	10
16-18	3	14
Over than 19	7	33
Position		
Assistant manager	0	0
Manager	4	19
Deputy general manager	3	14
Department manager	7	33
Managing director	5	24
CEO	2	10
The number of employees		
Less than 50	1	5
50-99	0	0
100-149	4	19
150-199	4	19
200-249	5	24
250-299	0	0
Over than 300	7	33

Ship management companies

This study also selected ship management companies as a key port user. In particular, the ship management companies that primarily manage container ships rather than tramper ships on behalf of shipping lines were selected as a key port user. These ship management companies may act as an agent of container shipping lines, so their perception on port services might be akin to the shipping lines. 44 percent respondents have a working experience in the port industry more than 13 years. In addition, 63 % of them were from a senior position such as department managers, managing directors and CEOs. 32 percent of them were from large firms.

Table 6.8 The profile of ship management companies

The profile of ship management companies	Frequency	Percentage
Work experience in port industry		
Less than 3	3	16
4-6	1	5
7-9	2	11
10-12	5	26
13-15	2	11
16-18	4	21
Over than 19	2	11
Position		
Assistant manager	4	21
Manager	1	5
Deputy general manager	2	11
Department manager	9	47
Managing director	1	5
CEO	2	11
The number of employees		
Less than 50	4	21
50-99	2	11
100-149	1	5
150-199	1	5
200-249	2	11
250-299	3	16
Over than 300	6	32

Third-party logistics providers

The third-party logistics providers were also chosen as a chief port user. They tend to deal with cargoes on the demand of shippers and consignees, and sometimes, they handle similar tasks to freight forwarders to efficiently move cargoes for their customers. Since most of them deal with their cargoes through containerised maritime transportation, they are likely to be familiar with containerised maritime logistics. 25 % of respondents have worked in the port industry more than 13 years, and 25 and 5 % of respondents hold their position as a managing director and CEO respectively. In addition, only 15 percent of them were working in the large firms.

Table 6.9 The profile of third-party logistics provider

The profile of third-party logistics provider	Frequency	Percentage
Work experience in port industry		
Less than 3	3	15
4-6	3	15
7-9	7	35
10-12	2	10
13-15	1	5
16-18	3	15
Over than 19	1	5
Position		
Assistant manager	2	10
Manager	6	30
Deputy general manager	6	30
Department manager	0	0
Managing director	1	5
CEO	5	25
The number of employees		
Less than 50	10	50
50-99	1	5
100-149	2	10
150-199	1	5
200-249	2	10
250-299	1	5
Over than 300	3	15

6.3 Descriptive statistics

This section reports descriptive statistics concerning each item. In order for respondents to evaluate SCC, CA and PP, they were asked to indicate their perceptions pertaining to these constructs, using a five-point Likert scale. The response categories for each item were anchored by “1 = strongly disagree” and “5 = strongly agree”.

6.3.1 Descriptive statistics for SCC

The domain specifications and developing instruments of SCC were identified in Section 4.2.1. The components of SCC were developed based on existing studies. However, to ensure content validity in the containerised maritime contexts, components were modified to reflect the phenomenon in containerised maritime logistics contexts through in-depth discussions with practitioners and academics. This section focuses on identifying overall statistics and perceived differences between port service providers and port users.

6.3.1.1 Overall statistics for SCC

As displayed in Table 6.10, overall statistics show that IS2 (mean: 3.77) was perceived as the most strongly agreed items, followed by CC4 (mean: 3.74). GS4 and JPM5 were rated as relatively low (mean: 3.29 and 3.30 respectively). The respondents largely indicate neutral positions about the components of SCC, implying that they did not strongly agree or disagree with the elements of SCC.

Table 6.10 Descriptive statistics for SCC

Items	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly agree	Mean	SD
IS1	8 (4.5%)	16 (9.0%)	38 (21.3%)	72 (40.4%)	44 (24.7%)	3.72	1.073
IS2	4 (2.2%)	24 (13.5%)	27 (15.2%)	77 (43.3%)	46 (25.8%)	3.77	1.051
IS3	4 (2.2%)	19 (10.7%)	41 (23.0%)	75 (42.1%)	39 (21.9%)	3.71	0.999
IS4	2 (1.1%)	23 (12.9%)	39 (21.9%)	84 (47.2%)	30 (16.9%)	3.66	0.945
IS5	4 (2.2%)	23 (12.9%)	39 (21.9%)	78 (43.8%)	34 (19.1%)	3.65	1.005
CC1	8 (4.5%)	20 (11.2%)	37 (20.8%)	74 (41.6%)	39 (21.9%)	3.65	1.080
CC2	6 (3.4%)	19 (10.7%)	28 (15.7%)	89 (50.0%)	36 (20.2%)	3.73	1.011
CC3	8 (4.5%)	19 (10.7%)	38 (21.3%)	61 (34.3%)	52 (29.2%)	3.73	1.128
CC4	6 (3.4%)	19 (10.7%)	33 (18.5%)	78 (43.8%)	42 (23.6%)	3.74	1.043
CC5	9 (5.1%)	19 (10.7%)	40 (22.5%)	82 (46.1%)	28 (15.7%)	3.57	1.041
KC1	8 (4.5%)	15 (8.4%)	42 (23.6%)	77 (43.3%)	36 (20.2%)	3.66	1.035
KC2	7 (3.9%)	14 (7.9%)	48 (27.0%)	74 (41.6%)	35 (19.7%)	3.65	1.010
KC3	8 (4.5%)	22 (12.4%)	52 (29.2%)	64 (36.0%)	32 (18.0%)	3.51	1.064
KC4	6 (3.4%)	17 (9.6%)	48 (27.0%)	73 (41.0%)	34 (19.1%)	3.63	1.007
KC5	10 (5.6%)	18 (10.1%)	55 (30.9%)	63 (35.4%)	32 (18.0%)	3.50	1.075
DH1	6 (3.4%)	21 (11.8%)	45 (25.3%)	73 (41.0%)	33 (18.5%)	3.60	1.028
DH2	5 (2.8%)	20 (11.2%)	47 (26.4%)	68 (38.2%)	38 (21.3%)	3.64	1.028
DH4	5 (2.8%)	22 (12.4%)	58 (32.6%)	66 (37.1%)	27 (15.2%)	3.49	0.987
DH5	4 (2.2%)	16 (9.0%)	54 (30.3%)	73 (41.0%)	31 (17.4%)	3.62	0.950
GS1	5 (2.8%)	18 (10.1%)	75 (42.1%)	55 (30.9%)	25 (14.0%)	3.43	0.950
GS2	4 (2.2%)	23 (12.9%)	64 (36.0%)	64 (36.0%)	23 (12.9%)	3.44	0.951
GS3	8 (4.5%)	16 (9.0%)	67 (37.6%)	70 (39.3%)	17 (9.6%)	3.40	0.941
GS4	4 (2.2%)	27 (15.2%)	75 (42.1%)	57 (32.0%)	15 (8.4%)	3.29	0.905
GS5	5 (2.8%)	19 (10.7%)	67 (37.6%)	71 (39.9%)	15 (8.4%)	3.42	0.913
JPM1	6 (3.4%)	24 (13.5%)	63 (35.4%)	61 (34.3%)	24 (13.5%)	3.41	0.995
JPM2	7 (3.9%)	23 (12.9%)	61 (34.3%)	72 (40.4%)	15 (8.4%)	3.37	0.949
JPM3	8 (4.5%)	22 (12.4%)	57 (32.0%)	67 (37.6%)	24 (13.5%)	3.43	1.019
JPM5	6 (3.4%)	28 (15.7%)	72 (40.4%)	50 (28.1%)	22 (12.4%)	3.30	0.990

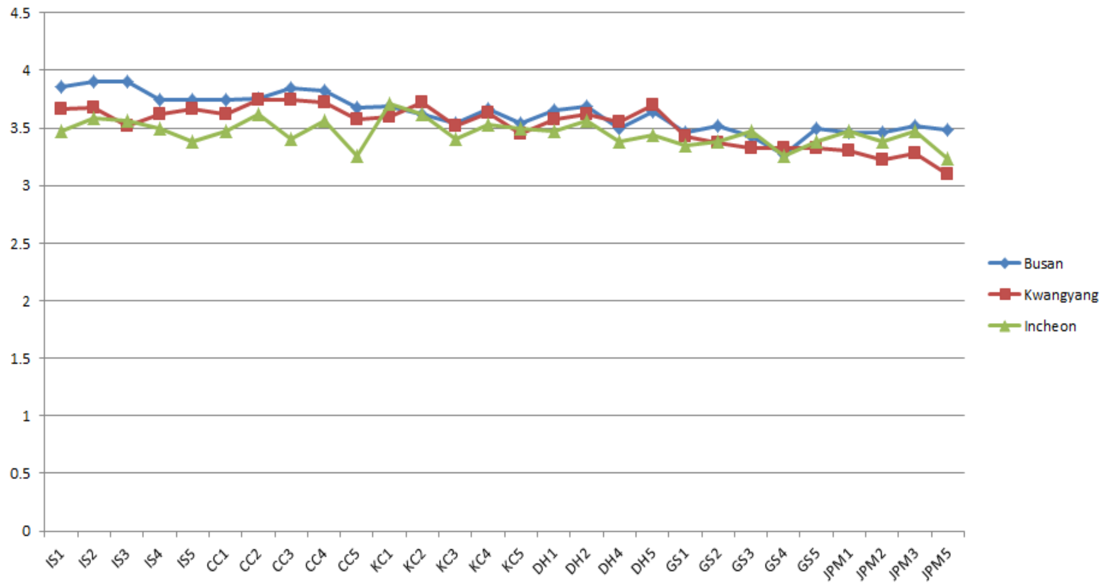
6.3.1.2 Comparisons between ports for SCC

This section compares mean values of SCC between three ports. The results indicate that respondents whose organisations were located or related to Busan port showed slightly higher perceptions on SCC than those in Gwangyang and Incheon port. Similarly, respondents in Gwangyang port displayed marginally higher mean values of SCC than Incheon port. Table 6.11 shows the comparisons of mean values between the three ports. As shown in Figure 6.1, the patterns of the mean values regarding SCC were similar.

Table 6.11 Mean values of items for SCC by ports

Items	Port		
	Busan	Gwangyang	Incheon
IS1	3.86	3.67	3.47
IS2	3.90	3.68	3.59
IS3	3.90	3.52	3.56
IS4	3.75	3.62	3.50
IS5	3.74	3.67	3.38
CC1	3.75	3.62	3.47
CC2	3.76	3.75	3.62
CC3	3.85	3.75	3.41
CC4	3.82	3.72	3.56
CC5	3.68	3.58	3.26
KC1	3.69	3.60	3.71
KC2	3.62	3.72	3.62
KC3	3.54	3.52	3.41
KC4	3.67	3.63	3.53
KC5	3.54	3.45	3.50
DH1	3.65	3.58	3.47
DH2	3.69	3.62	3.56
DH4	3.50	3.55	3.38
DH5	3.64	3.70	3.44
GS1	3.46	3.43	3.35
GS2	3.52	3.37	3.38
GS3	3.43	3.33	3.47
GS4	3.27	3.33	3.26
GS5	3.50	3.33	3.38
JPM1	3.46	3.30	3.47
JPM2	3.46	3.22	3.38
JPM3	3.52	3.28	3.47
JPM5	3.48	3.10	3.24

Figure 6.1 Comparison between three ports for SCC



6.3.1.3 Comparisons between ports and port users for SCC

The comparisons between ports and port users were conducted to investigate any differences in perception between mean values of SCC. TOs' responses were more generous than port users. All items were rated greater than 3.5 by TOs, whilst most of the port users' answers remain around 3.5.

Table 6.12 Mean values of items for SCC by each MLO

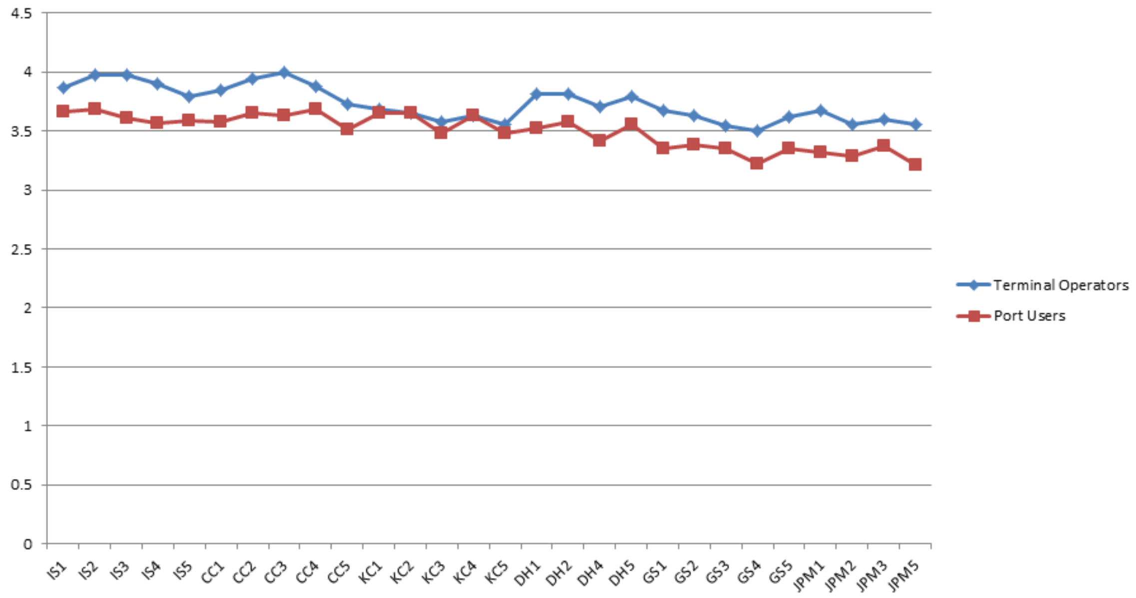
Items	Type					
	TO	SL	ITC	FF	SMC	3PL
IS1	3.88	3.64	3.60	3.57	3.79	3.75
IS2	3.98	3.68	3.65	3.57	3.89	3.70
IS3	3.98	3.60	3.65	3.43	3.74	3.65
IS4	3.90	3.56	3.55	3.33	3.79	3.65
IS5	3.79	3.64	3.60	3.33	3.74	3.60
CC1	3.85	3.48	3.65	3.48	3.58	3.85
CC2	3.94	3.56	3.80	3.52	3.74	3.80
CC3	4.00	3.64	3.65	3.62	3.74	3.50
CC4	3.88	3.58	3.85	3.62	3.79	3.75
CC5	3.73	3.46	3.60	3.38	3.58	3.60
KC1	3.69	3.62	3.80	3.43	3.68	3.80
KC2	3.65	3.74	3.50	3.48	3.63	3.80
KC3	3.58	3.52	3.50	3.24	3.47	3.60
KC4	3.63	3.70	3.55	3.48	3.58	3.75
KC5	3.56	3.56	3.45	3.19	3.37	3.70
DH1	3.81	3.62	3.60	3.24	3.47	3.50
DH2	3.81	3.70	3.65	3.19	3.58	3.60

DH4	3.71	3.46	3.55	3.24	3.42	3.35
DH5	3.79	3.74	3.55	3.14	3.47	3.65
GS1	3.67	3.38	3.65	3.10	3.16	3.40
GS2	3.63	3.40	3.60	3.24	3.42	3.20
GS3	3.54	3.38	3.60	3.24	3.32	3.20
GS4	3.50	3.18	3.40	3.14	3.26	3.15
GS5	3.63	3.44	3.55	3.05	3.26	3.30
JPM1	3.67	3.24	3.40	3.14	3.63	3.30
JPM2	3.56	3.24	3.45	3.19	3.58	3.10
JPM3	3.60	3.28	3.35	3.14	3.68	3.55
JPM5	3.56	3.16	3.30	3.00	3.37	3.30

Table 6.13 Mean values of items for SCC by ports and port users

Items	Ports	Port Users
IS1	3.87	3.66
IS2	3.98	3.69
IS3	3.98	3.61
IS4	3.90	3.57
IS5	3.79	3.59
CC1	3.85	3.58
CC2	3.94	3.65
CC3	4.00	3.63
CC4	3.88	3.68
CC5	3.73	3.51
KC1	3.69	3.65
KC2	3.65	3.65
KC3	3.58	3.48
KC4	3.63	3.63
KC5	3.56	3.48
DH1	3.81	3.52
DH2	3.81	3.58
DH4	3.71	3.42
DH5	3.79	3.56
GS1	3.67	3.35
GS2	3.63	3.38
GS3	3.54	3.35
GS4	3.50	3.22
GS5	3.62	3.35
JPM1	3.67	3.32
JPM2	3.56	3.29
JPM3	3.60	3.37
JPM5	3.56	3.21

Figure 6.2 Comparison between ports (TOs) and port users for SCC



In order to statistically examine a difference in mean values, Levene's tests for equality of variance and t-test for equality means were conducted. Notwithstanding the fact that the perception of SCC from ports is apparently higher than that of port users in Figure 6.2, most items did not indicate a wide statistical gap between ports and port users at the 5% level. Only some items (IS3, GS1, JPM1 and JPM5) show the significant gap in perceptions between port service providers and all the port users combined. The results of Levene's tests for equality of variance and t-test for equality means are displayed in Appendix D-1.

6.3.2 Descriptive statistics for CA

The instruments for CA were developed based on existing literature and in-depth discussions with academics and practitioners in containerised MLOs in South Korea as discussed in Chapter 5. To capture content validity in the containerised maritime contexts, it was modified and revised based on in-depth discussions. This section demonstrates overall statistics and perceived differences between port service providers and the port users combined.

6.3.2.1 Overall statistics for CA

Table 6.14 illustrates the descriptive statistics of CA. In general, the mean values of most items for CA remain around at 3.5. BS2 and IN3 showed the highest mean values at 3.63. The lowest mean value was QL1 (3.38). Seven items amongst 15 were rated between 3 and 3.5, whilst there were seven items between 3.5 and 4. One item (FL2) remained at 3.5. It is likely that the perceptions of respondents in CA tend to show neutral positions without strong agreement or disagreement.

Table 6.14 Descriptive statistics for CA

Items	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly agree	Mean	SD
BS1	3 (1.7%)	21 (11.8%)	47 (26.4%)	84 (47.2%)	23 (12.9%)	3.58	0.919
BS2	4 (2.2%)	20 (11.2%)	53 (29.8%)	62 (34.8%)	39 (21.9%)	3.63	1.018
BS3	3 (1.7%)	16 (9.0%)	61 (34.3%)	70 (39.3%)	28 (15.7%)	3.58	0.918
BS4	5 (2.8%)	15 (8.4%)	57 (32.0%)	73 (41.0%)	28 (15.7%)	3.58	0.948
IN1	10 (5.6%)	17 (9.6%)	47 (26.4%)	57 (32.0%)	47 (26.4%)	3.64	1.137
IN2	10 (5.6%)	17 (9.6%)	36 (20.2%)	66 (37.1%)	49 (27.5%)	3.71	1.136
IN3	7 (3.9%)	21 (11.8%)	38 (21.3%)	77 (43.3%)	35 (19.7%)	3.63	1.051
FL1	4 (2.2%)	18 (10.1%)	63 (35.4%)	77 (43.3%)	16 (9.0%)	3.47	0.878
FL2	2 (1.1%)	17 (9.6%)	72 (40.4%)	64 (36.0%)	23 (12.9%)	3.50	0.878
FL3	2 (1.1%)	25 (14.0%)	57 (32.0%)	78 (43.8%)	16 (9.0%)	3.46	0.883
FL4	6 (3.4%)	17 (9.6%)	61 (34.3%)	80 (44.9%)	14 (7.9%)	3.44	0.895
QL1	5 (2.8%)	23 (12.9%)	65 (36.5%)	69 (38.8%)	16 (9.0%)	3.38	0.921
QL2	6 (3.4%)	24 (13.5%)	62 (34.8%)	66 (37.1%)	20 (11.2%)	3.39	0.970
QL3	3 (1.7%)	22 (12.4%)	57 (32.0%)	79 (44.4%)	17 (9.6%)	3.48	0.891
QL4	6 (3.4%)	20 (11.2%)	63 (35.4%)	69 (38.8%)	20 (11.2%)	3.43	0.950

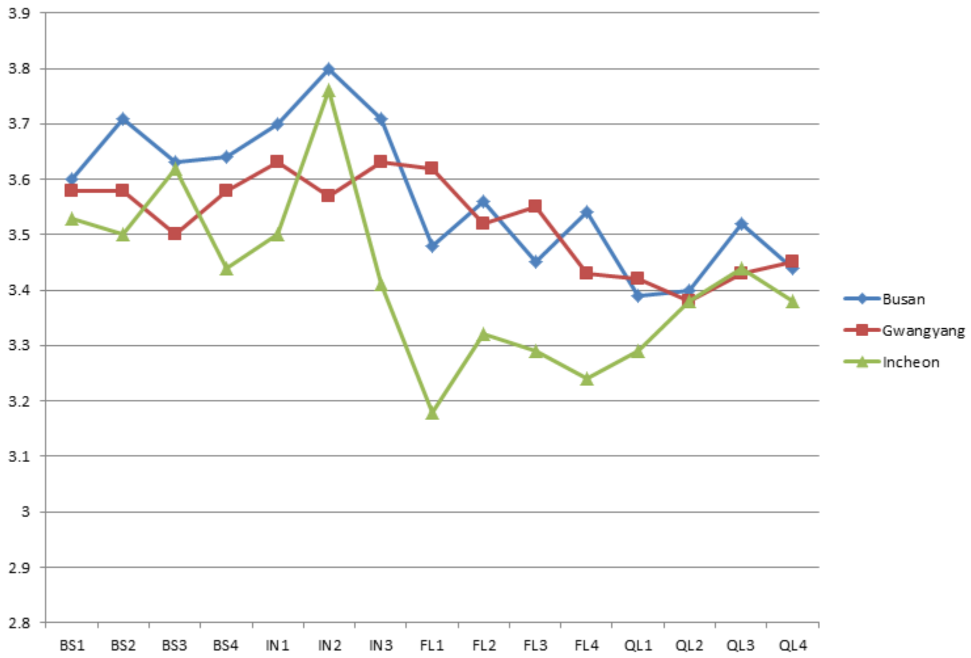
6.3.2.2 Comparison between ports for CA

The perception gap between Busan, Gwangyang and Incheon ports for CA was examined using a similar procedure to that undertaken for SCC. The pattern was akin to SCC in the earlier section. The respondents whose organisations were located or related to Busan port revealed slightly higher mean values of CA than Gwangyang and Incheon ports. Table 6.15 shows the comparisons of mean values of CA between the above ports. In addition, the patterns of the mean values of CA were similar to each other as shown in Figure 6.3.

Table 6.15 Mean values of items for CA by ports

Items	Port		
	Busan	Gwangyang	Incheon
BS1	3.60	3.58	3.53
BS2	3.71	3.58	3.50
BS3	3.63	3.50	3.62
BS4	3.64	3.58	3.44
IN1	3.70	3.63	3.50
IN2	3.80	3.57	3.76
IN3	3.71	3.63	3.41
FL1	3.48	3.62	3.18
FL2	3.56	3.52	3.32
FL3	3.45	3.55	3.29
FL4	3.54	3.43	3.24
QL1	3.39	3.42	3.29
QL2	3.40	3.38	3.38
QL3	3.52	3.43	3.44
QL4	3.44	3.45	3.38

Figure 6.3 Comparison between three ports for CA



6.3.2.3 Comparison between ports and port users for CA

In order to grasp any differences in the perceptions of CA between port service providers and the port users combined, this section has explored mean values of CA. The results were almost the same as those for SCC. It was found that port service providers' answers were slightly higher than all port users. Most answers were rated around 3.5.

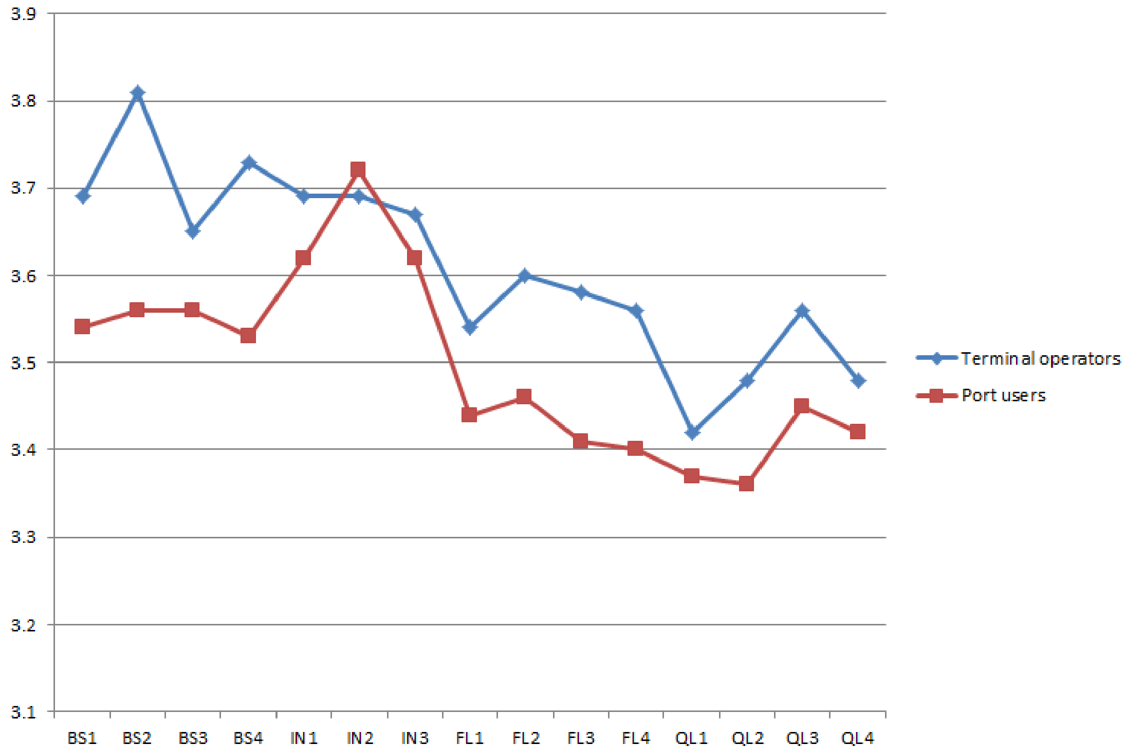
Table 6.16 Mean values of items for CA by each MLO

Items	Type					
	TO	SL	ITC	FF	SMC	3PL
BS1	3.69	3.48	3.55	3.38	3.74	3.65
BS2	3.81	3.56	3.65	3.19	3.74	3.70
BS3	3.65	3.56	3.60	3.24	3.63	3.80
BS4	3.73	3.50	3.70	3.29	3.53	3.70
IN1	3.69	3.64	3.85	3.33	3.68	3.60
IN2	3.69	3.76	3.85	3.48	3.79	3.70
IN3	3.67	3.64	3.80	3.52	3.53	3.55
FL1	3.54	3.54	3.60	3.33	3.37	3.20
FL2	3.60	3.48	3.70	3.38	3.42	3.30
FL3	3.58	3.46	3.45	3.38	3.21	3.45
FL4	3.56	3.50	3.40	3.29	3.37	3.30
QL1	3.42	3.42	3.50	3.05	3.32	3.50
QL2	3.48	3.32	3.50	3.29	3.26	3.50
QL3	3.56	3.42	3.90	3.10	3.47	3.40
QL4	3.48	3.32	3.70	3.14	3.53	3.55

Table 6.17 Mean values of items for CA by ports and port users

Items	Terminal operators	Port users
BS1	3.69	3.54
BS2	3.81	3.56
BS3	3.65	3.56
BS4	3.73	3.53
IN1	3.69	3.62
IN2	3.69	3.72
IN3	3.67	3.62
FL1	3.54	3.44
FL2	3.60	3.46
FL3	3.58	3.41
FL4	3.56	3.40
QL1	3.42	3.37
QL2	3.48	3.36
QL3	3.56	3.45
QL4	3.48	3.42

Figure 6.4 Comparison between ports (TOs) and port users for CA



To further investigate whether or not those differences of CA in mean values are statistically significant, this study conducted Levene's tests for equality of variance and t-tests for equality means. Despite a slight difference in mean values between them, no items were significantly different at the 5% level. The results of Levene's tests for equality of variance and t-test for equality means were displayed in Appendix D-2.

6.3.3 Descriptive statistics for PP

The instruments to assess port performance are also developed based on the prior research and discussions with academics and practitioners who have sufficient knowledge about port performance in diverse containerised MLOs in South Korea as presented in Chapter 5. Existing instruments were modified to ensure content validity after discussions. The instruments employed in this study were mainly focused on capturing perceptual performance. Since traditional port performance indexes barely reflect some important port performance characteristics such as effectiveness and VAS in a fast changing environment (Woo *et al.*, 2011b), those characteristics cannot be measured in an objective manner due to the abstract concepts in the measurements. This section mainly focuses on showing overall statistics and perceived gaps between port service providers and all the port users combined.

6.3.3.1 Overall statistics for PP

As shown in Table 6.18, the mean values of most items for PP remain around at 3.5. The greatest mean value was SP4 (3.74), whilst EO2 was rated at the lowest mean value (3.33). There are 16 items of mean values between 3.5 and 4, whilst 5 items out of 21 were rated between 3 and 3.5.

Table 6.18 Descriptive statistics for PP

Items	1 Strongly disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly agree	Mean	SD
CE1	8 (4.5%)	18 (10.1%)	38 (21.3%)	70 (39.3%)	44 (24.7%)	3.70	1.088
CE2	8 (4.5%)	17 (9.6%)	43 (24.2%)	59 (33.1%)	51 (28.7%)	3.72	1.115
CE3	10 (5.6%)	15 (8.4%)	35 (19.7%)	79 (44.4%)	39 (21.9%)	3.69	1.080
CE4	9 (5.1%)	15 (8.4%)	37 (20.8%)	70 (39.3%)	47 (26.4%)	3.74	1.096
RL1	7 (3.9%)	28 (15.7%)	34 (19.1%)	71 (39.9%)	38 (21.3%)	3.59	1.107
RL2	5 (2.8%)	23 (12.9%)	43 (24.2%)	66 (37.1%)	41 (23.0%)	3.65	1.060
RL3	7 (3.9%)	30 (16.9%)	34 (19.1%)	72 (40.4%)	35 (19.7%)	3.55	1.105
RL4	8 (4.5%)	19 (10.7%)	45 (25.3%)	73 (41.0%)	33 (18.5%)	3.58	1.050
CPU1	10 (5.6%)	18 (10.1%)	55 (30.9%)	62 (34.8%)	33 (18.5%)	3.51	1.080
CPU2	9 (5.1%)	23 (12.9%)	49 (27.5%)	60 (33.7%)	37 (20.8%)	3.52	1.111
CPU3	9 (5.1%)	16 (9.0%)	57 (32.0%)	63 (35.4%)	33 (18.5%)	3.53	1.053
CV1	6 (3.4%)	22 (12.4%)	41 (23.0%)	69 (38.8%)	40 (22.5%)	3.65	1.065
CV2	6 (3.4%)	22 (12.4%)	40 (22.5%)	69 (38.8%)	41 (23.0%)	3.66	1.069
VAS1	7 (3.9%)	20 (11.2%)	39 (21.9%)	66 (37.1%)	46 (25.8%)	3.70	1.093
VAS2	8 (4.5%)	17 (9.6%)	41 (23.0%)	67 (37.6%)	45 (25.3%)	3.70	1.088
VAS3	8 (4.5%)	18 (10.1%)	37 (20.8%)	72 (40.4%)	43 (24.2%)	3.70	1.083
SS1	8 (4.5%)	20 (11.2%)	59 (33.1%)	63 (35.4%)	28 (15.7%)	3.47	1.031
SS2	7 (3.9%)	22 (12.4%)	62 (34.8%)	57 (32.0%)	30 (16.9%)	3.46	1.036
EO1	6 (3.4%)	25 (14.0%)	63 (35.4%)	65 (36.5%)	19 (10.7%)	3.37	0.967
EO2	5 (2.8%)	24 (13.5%)	72 (40.4%)	62 (34.8%)	15 (8.4%)	3.33	0.912
EO3	6 (3.4%)	21 (11.8%)	68 (38.2%)	58 (32.6%)	25 (14.0%)	3.42	0.984

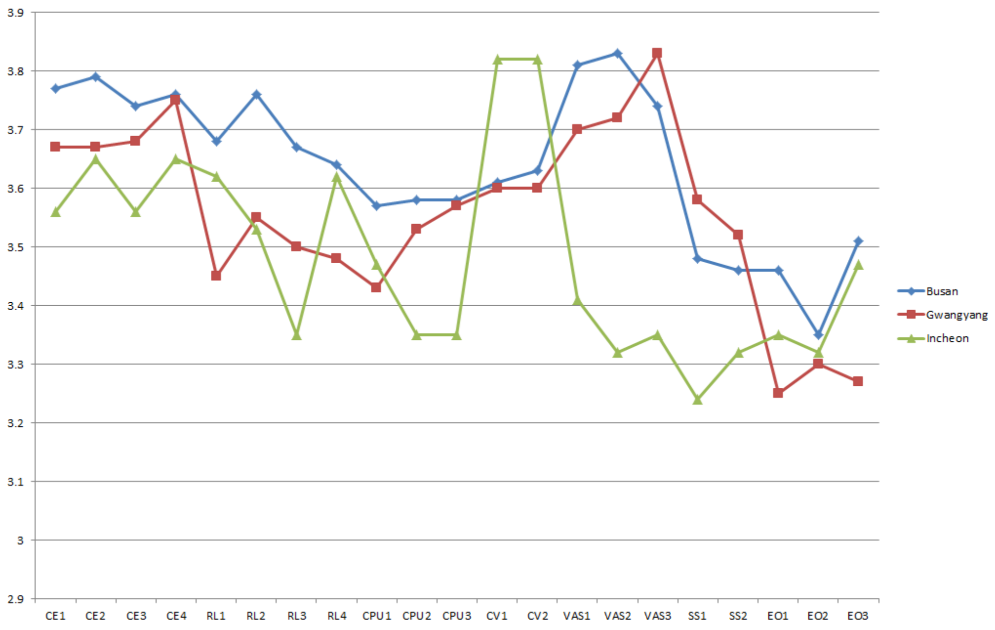
6.3.3.2 Comparison between ports for PP

The differences in mean values for PP between three ports were explored as the same process was conducted for SCC and CA. The pattern was also similar to SCC and CA in the previous section. It is found that the respondents whose organisations were located or related to Busan port showed slightly higher mean values of PP than those in the other two ports. Table 6.19 displays the comparisons of mean values of PP between the three ports. Furthermore, the patterns of mean values of PP resemble each other as shown in Figure 6.5.

Table 6.19 Mean values of items for PP by ports

Items	Port		
	Busan	Gwangyang	Incheon
CE1	3.77	3.67	3.56
CE2	3.79	3.67	3.65
CE3	3.74	3.68	3.56
CE4	3.76	3.75	3.65
RL1	3.68	3.45	3.62
RL2	3.76	3.55	3.53
RL3	3.67	3.50	3.35
RL4	3.64	3.48	3.62
CPU1	3.57	3.43	3.47
CPU2	3.58	3.53	3.35
CPU3	3.58	3.57	3.35
CV1	3.61	3.60	3.82
CV2	3.63	3.60	3.82
VAS1	3.81	3.70	3.41
VAS2	3.83	3.72	3.32
VAS3	3.74	3.83	3.35
SS1	3.48	3.58	3.24
SS2	3.46	3.52	3.32
EO1	3.46	3.25	3.35
EO2	3.35	3.30	3.32
EO3	3.51	3.27	3.47

Figure 6.5 Comparison between three ports for PP



6.3.3.3 Comparison between ports and port users for PP

Table 6.20 shows perception gaps of PP between port service providers and all the port users combined in order to identify differences. The results were akin to those of SCC and CA. It is shown that all the port users' responses were marginally higher than port service providers' responses.

Table 6.20 Mean values of items for PP by each MLO

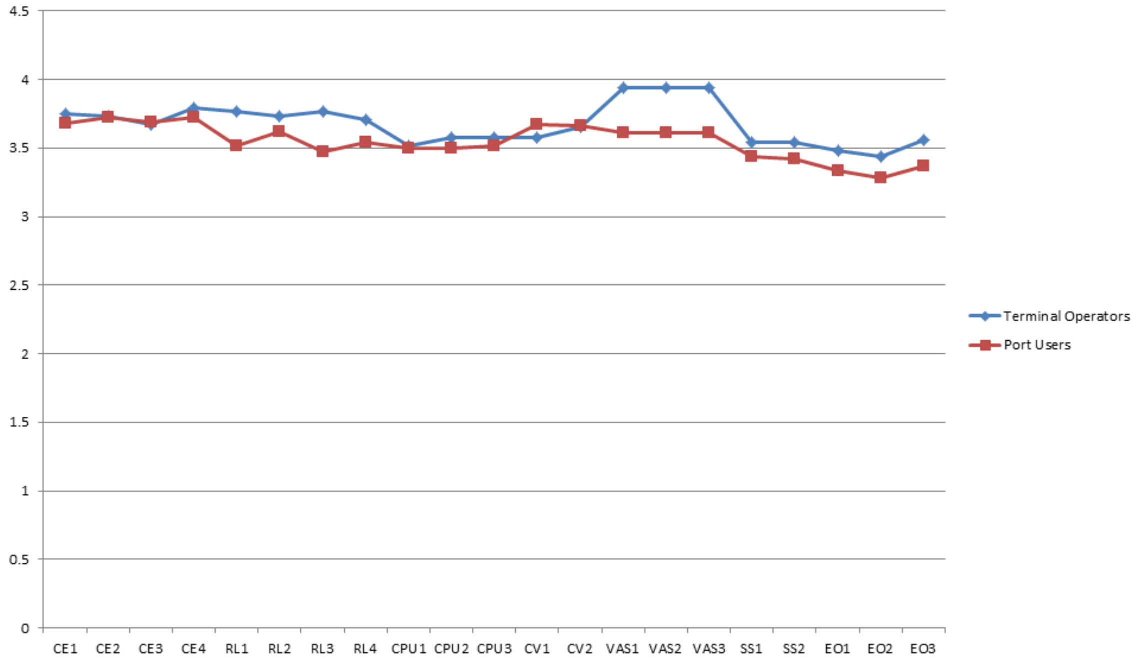
Items	Type					
	TO	SL	ITC	FF	SMC	3PL
CE1	3.75	3.70	3.90	3.48	3.48	3.65
CE2	3.73	3.74	3.85	3.48	3.48	3.70
CE3	3.67	3.76	3.95	3.52	3.52	3.45
CE4	3.79	3.74	4.10	3.52	3.52	3.55
RL1	3.77	3.40	3.80	3.38	3.38	3.50
RL2	3.73	3.48	3.90	3.62	3.62	3.50
RL3	3.77	3.38	3.70	3.43	3.43	3.40
RL4	3.71	3.30	4.00	3.48	3.48	3.45
CPU1	3.52	3.64	3.90	2.95	2.95	3.40
CPU2	3.58	3.60	3.95	3.10	3.10	3.30
CPU3	3.58	3.60	3.90	3.05	3.05	3.45
CV1	3.58	3.66	3.50	3.67	3.67	3.75
CV2	3.65	3.74	3.55	3.43	3.43	3.70
VAS1	3.94	3.58	3.65	3.67	3.67	3.55
VAS2	3.94	3.50	3.65	3.76	3.76	3.75
VAS3	3.94	3.52	3.80	3.67	3.67	3.60
SS1	3.54	3.40	3.80	3.67	3.67	3.35

SS2	3.54	3.36	3.70	3.57	3.57	3.35
EO1	3.48	3.36	3.40	3.29	3.29	3.25
EO2	3.44	3.26	3.40	3.24	3.24	3.25
EO3	3.56	3.42	3.35	3.38	3.38	3.25

Table 6.21 Mean values of items for PP by ports and port users

Items	Terminal operators	Port users
CE1	3.75	3.68
CE2	3.73	3.72
CE3	3.67	3.69
CE4	3.79	3.72
RL1	3.77	3.52
RL2	3.73	3.62
RL3	3.77	3.47
RL4	3.71	3.54
CPU1	3.52	3.50
CPU2	3.58	3.50
CPU3	3.58	3.52
CV1	3.58	3.67
CV2	3.65	3.66
VAS1	3.94	3.61
VAS2	3.94	3.61
VAS3	3.94	3.61
SS1	3.54	3.44
SS2	3.54	3.42
EO1	3.48	3.33
EO2	3.44	3.28
EO3	3.56	3.37

Figure 6.6 Comparison between ports (TOs) and port users for PP



Levene's tests for equality of variance and t-test for equality mean were undertaken to find out whether differences in mean values for PP statistically exist or not. Notwithstanding obvious differences in mean values in Figure 6.6, there were no statistical differences at the 5% level. The results of Levene's tests for equality of variance and t-test for equality means are displayed in Appendix D-3.

6.4 Summary

This chapter provided descriptive analysis of the data collected from the web-based survey as an initial data analysis. It is very important not only for a general picture of the data of the data collected by exploring and summarising data, but also for model formulation prior to the empirical analysis. Section 6.1 presents response rate, non-response bias and common method variance. Total 178 usable responses were obtained. The total response rate was 28%. The result of non-response bias through t-test indicated that non-response bias is unlikely to occur in this study. Subsequently, the result of a Harman's single-factor test showed that common method bias is not a concern for this study.

The descriptive analysis revealed that the mean of the respondents' perception on the SCC, CA and PP. Respondents whose organisations were located or related to Busan port showed slightly higher perceptions on SCC, CA and PP than those in Gwangyang and Incheon port. Similarly, respondents in Gwangyang port displayed marginally higher mean values of SCC, CA and PP than Incheon port. Furthermore, ports' responses were more generous than port users in assessing all constructs. In order to statistically examine a difference in mean values, t-test was conducted. Despite the fact that the perception of SCC, CA and PP from ports is apparently higher than that of port users, most items did not indicate a wide statistical gap between ports and port users at the 5% level.

Chapter 7. Empirical analysis

Chapter 6 concentrated on elaborating the descriptive statistics from the questionnaire survey. This chapter tests a research model and hypotheses, which is suggested in Chapter 5. Here, the causal relationship between supply chain collaboration (SCC), collaborative advantage (CA) and port performance (PP) will be evaluated. After exploratory factor analysis (EFA) for item and scale purification, this study is dedicated to using a two-step approach proposed by Anderson and Gerbing (1988). Firstly, CFA is carried out to assess the validity of the constructs in the research model. It focuses on testing construct validity by testing unidimensionality, reliability, convergent validity and discriminate validity. Once these are validated, secondly, it is necessary to estimate the structural model between the latent variables. After testing the proposed model, for further testing, this study also tests the mediating effect of CA on a relationship between SCC and PP. All analyses were performed by using SPSS 21.00 for Windows and AMOS 21.00 statistical packages.

7.1 Data preparation

Data examination is required as an initial and necessary step, but is time-consuming, and many researchers tend to overlook it (Hair *et al.*, 2010). The issues of data preparation and screening are important as the estimation methods of SEM require assumptions regarding the distributional characteristics of the data (Kline, 2011). Data-related problems lead SEM's failure to produce a logical solution or 'crash' (Kline, 2011). Consequently, this section is devoted to addressing the issues of multivariate normality, outliers and missing data prior to the test of measurement models.

7.1.1 Multivariate normality

This study attempts to analysis data using AMOS 21.00 version with Maximum Likelihood (ML) method as a default estimation technique. To conduct multivariate analysis, it is necessary to ensure the assessment of the normality of the data. Hair *et al.* (2010, p. 71) defined normality *"as the shape of the data distribution or an individual metric variable and its correspondence to the normal distribution, which is the benchmark for statistical methods".* The important presumption in the use of AMOS is that the data are multivariate normal, because this condition is embedded in large sample theory from which the SEM methodology was initiated (Byrne, 2010). Kline (2011) explained that multivariate normality means that (1) all the univariate distributions are normal; (2) the joint distribution of any pair of the variables is bivariate normal; (3) all bivariate scatterplots are linear and homoscedastic. Multivariate C.R. value over 5.00 suggests that data are not normally distributed (Byrne, 2010). Many instances of multivariate normality can be detected by inspecting univariate distributions (Kline, 2011). If researchers delete outliers, it may be a way to retain multivariate normality.

Appendix E displays the assessment of multivariate normality of the collected data for SCC, CA and PP by using AMOS 21.00 program. Overall, the observed variables were largely negatively skewed with negative kurtosis. The 22 items of SCC were significantly negatively skewed and multivariate kurtosis is also significant (13.996; C.R.=2.278). As for CA, 10 items have significant negative skewness and no observed variables have significant negative kurtosis (3.885; C.R.=1.148). PP has 17 items that were significantly negatively skewed and multivariate kurtosis is also significant (19.441; C.R.=4.173). These results indicate that the data collected for this study is non-normally disturbed, but non-normality is not a serious problem. When a multivariate distribution is violated, an alternative estimation seems more appropriate than ML estimation. One possible approach is to analysis data by Asymptotic Distribution Free (ADF) estimation, but unless sample sizes are over 1,000, ADF accomplishes very poorly and shows distorted values and standard errors (Kline, 2011). This study has adopted bootstrapping as a remedy for non-normality problems, as the data set was generally negatively skewed as Byrne (2010) recommended.

7.1.2 Outliers

Outliers refer to the cases where scores are considerably different from all the other scores in a particular set of data (Byrne, 2010). A univariate outlier holds an extreme score on a single variable, whilst a multivariate outlier contains extreme scores on two or more variables, or its pattern of scores is atypical (Kline, 2011). SEM is concerned with multivariate outliers that have an uncommon combination of scores on two or more variables rather than univariate ones (Hair *et al.*, 2010). Mahalanobis distance (D^2) is mostly used to detect multivariate outliers as this statistic enables us to measure the distance in standard deviation units between a set of scores for one case and the sample means for all variables (Byrne, 2010, Tabachnick and Fidell, 2012). In other words, an outlier tends to have a distinct D^2 value compared to all the other D^2 values. According to Hair *et al.* (2010, p. 66), Mahalanobis distance is "*a measure of each observation's distance in multidimensional space from the mean centre of all observations, providing a single value for each observation no matter how many variables are considered*". This study examines Mahalanobis distance by using AMOS programme as a part of the normality check command.

The criteria on deciding outliers for this study is Mahalanobis distance at $p<0.001$ as the threshold suggested by Tabachnick and Fidell (2012) and Hair *et al.* (2010). Appendix F shows that few outliers exist according to the conservative criterion ($p<0.001$): response 96 for CA and response 35 for PP amongst 178 respondents.

All outliers are determined to be retained without discarding outliers from the data set with the following arguments. First, the existence of some outliers within a large sample size should be of minor concern (Kline, 2011). Second, strong proof is required if those outliers are not part of the population (Tabachnick and Fidell, 2012). Third, there is a risk of improving the multivariate analysis but limiting its generalizability, unless outliers are retained (Hair *et al.*, 2010).

7.1.3 Missing data

Missing data inevitably occur in social science studies (Byrne, 2010). It is typically caused by errors in data collection or data coding, or the omission of answers by respondents (Hair *et al.*, 2010). A few missing data in a very large sample may be of little concern, but when there are many missing scores it may pose a serious challenge (Kline, 2011). Because missing data cause serious biased parameter estimation and decreased statistical, researchers should address this issue (Byrne, 2010, Hair *et al.*, 2010). Byrne (2010) suggested common approaches to deal with incomplete data: (1) list-wise deletion; (2) pairwise deletion; (3) single imputation. However, both list-wise and pairwise deletions entail some problems. List-wise deletion eliminating any observation that have missing data results in decreasing sample size and reducing the statistical power, whilst pairwise delete, which only ignores missing variables, may cause an inconsistent sample size from different analyses (Arbuckle, 2011).

The imputation method replaces the incomplete data with the valid values of other observations in the dataset by some techniques such as a simple regression analysis or estimate means (Hair *et al.*, 2010, Arbuckle, 2011).

The covariance structure preferred for subsequent analysis assumes no missing values in the data set (Anderson and Gerbing, 1988). This condition is guaranteed by the structure of the online questionnaire (Web-based survey) adopted as a main survey tool, because web-based surveys are an effective tool for eliminating the possibility of missing data (Froehle and Roth, 2004). By using this, there were no missing data. The main reasons for this are that the nature of the online survey compels respondents to complete every item. Unless they fill in items in order, they are not allowed to move to the next page and finish questionnaires.

7.2 Item and scale purification: exploratory factor analysis

This section conducts exploratory factor analysis (EFA) to determine to what extent the observed variables are linked to their latent variables: (1) 28 observed variables for supply chain collaboration (SCC); (2) 15 observed variables for collaborative advantage (CA); (3) and 21 items representing port performance (PP). As the scales are used with a new sample, which is in the containerised maritime logistics industry, the items are subject to EFA in SPSS 21.00. EFA is carried out using principal component analysis with VARIMAX rotation to identify the minimal number of factors that underlie co-variation amongst the observed variables. An eigenvalue higher than one is adopted to determine the number of factors. This study only considered items that that had a factor loading higher than 0.4 and did not have significant cross-loadings (items with a loading on a second factor with a difference lower than 0.2) as recommended by Hair *et al.* (2010).

7.2.1 Identifying the factor structure

In terms of SCC, six latent variables were identified as expected in the literature review. Each item loading is larger than the cut-off criteria 0.4 and shows no cross-loadings. There were no deleted items in EFA procedures, although some items were deleted in Q-sorting in chapter 5. Six factors for SCC account for approximately 85% of total variances extracted and are thus viewed to indicate all the SCC attributes. The KMO measure of sampling adequacy is 0.957 and Bartlett’s test of sphericity is highly significant at the 1% level. Therefore, EFA for SCC data is appropriate.

Table 7.1 Exploratory factor analysis of supply chain collaboration

Items		Factor					
		1	2	3	4	5	6
Information sharing (IS)	IS5	.805					
	IS1	.802					
	IS4	.777					
	IS2	.743					
	IS3	.729					
Goal similarity (GS)	GC1		.798				
	GC3		.752				
	GC2		.746				
	GC4		.739				
	GC5		.727				
Knowledge creation (KC)	KC2			.786			
	KC3			.758			
	KC4			.753			
	KC5			.753			
	KC1			.696			
Collaborative communication (CC)	CC4				.789		
	CC2				.756		
	CC5				.719		
	CC3				.712		
	CC1				.697		
Joint supply chain performance measurement	JPM5					.793	
	JPM3					.772	
	JPM2					.761	
	JPM1					.717	

(JPM)							
Decision harmonisation (DH)	DH2						.749
	DH4						.741
	DH5						.739
	DH1						.714
Eigenvalues		17.590	1.734	1.418	1.137	1.066	1.003
% of Variance		62.822	6.192	5.065	4.060	3.808	3.581
Cumulative %		62.822	69.015	74.080	78.139	81.947	85.529

Note: Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.957, Bartlett's Test of Sphericity: $\chi^2 = 5983.489$ ($p= .000$), df = 378

Fifteen variables chosen for CA were identified including four latent variables: business synergy (BS), flexibility (FL), quality (QL) and innovation (IN), which account for roughly 84% of total variance extracted. Likewise, all factor loadings are larger than 0.4 and have no cross-loadings. In addition, the KMO measure of sampling adequacy is 0.935 and the Chi-square for Bartlett's test of sphericity is highly significant at the 1% level. Hence, it is concluded that EFA of CA is adequate.

Table 7.2 Exploratory factor analysis of collaborative advantage

Items		Factor			
		1	2	3	4
Business synergy (BS)	BS3	.852			
	BS1	.834			
	BS2	.824			
	BS4	.802			
Flexibility (FL)	FL2		.833		
	FL3		.808		
	FL1		.805		
	FL4		.764		
Quality (QL)	QL2			.818	
	QL3			.797	
	QL4			.787	
	QL1			.773	
Innovation (IN)	IN1				.838
	IN2				.826
	IN3				.822
Eigenvalues		8.895	1.528	1.185	1.049
% of Variance		59.299	10.185	7.902	6.994
Cumulative %		59.299	69.484	77.386	84.380

Note: Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.935, Bartlett's Test of Sphericity: χ^2 = 2524.844 (p= .000), df = 105

Finally, EFA of items for PP was conducted. Table 7.3 indicates the structure matrix for PP based on twenty one observed variables. Seven factors were identified that have eigenvalues larger than 1 and the total of variances of all factors account for nearly 90 %. Moreover, the value of KMO and Bartlett's test of sphericity are found to be appropriate for EFA. All factor loadings were over 0.4 and had no cross-loading on each other.

Table 7.3 Exploratory factor analysis of port performance

Items		Factor 1	2	3	4	5	6	7
Reliability (RL)	RL2	.857						
	RL1	.852						
	RL3	.849						
	RL4	.833						
Cost efficiency (CE)	SP2		.857					
	SP3		.820					
	SP4		.815					
	SP1		.810					
Value-added service (VAS)	VAS1			.851				
	VAS3			.841				
	VAS2			.828				
Convenience of port users (CPU)	CPU2				.843			
	CPU1				.832			
	CPU3				.831			
Efficient operation (EO)	EO3					.839		
	EO2					.833		
	EO1					.807		
Connectivity (CV)	CV1						.912	
	CV2						.905	
Safety and security (SS)	SS1							.885
	SS2							.877
Eigenvalues		10.958	1.866	1.458	1.374	1.282	1.131	1.011
% of Variance		52.183	8.887	6.942	6.542	6.103	5.386	4.812
Cumulative %		52.183	61.069	68.011	74.553	80.656	86.042	90.854

Note: Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.908, Bartlett's Test of Sphericity: χ^2 = 4273.725 (p= .000), df = 210

7.3 Measurement model

SEM is employed as a main statistical tool to purify the measurement items. SEM is a dominant technique that syndicates the measurement model (CFA) and the structural model (path analysis) into a simultaneous statistical test (Garver and Mentzer, 1999). The Maximum Likelihood (ML) method is undertaken in CFA to check unidimensionality, reliability, convergent validity, discriminant validity and second-order construct validity. The measurement model determines that each item is linked to its corresponding constructs. The major concern in the measurement model is the extent to which the observed variables are linked to their latent variables. The measurement model is regarded as a suitable instrument to assess construct validity by specifying indicators that represent the corresponding latent variable (Garver and Mentzer, 1999). Being theory driven, construct validation within the analytical framework of CFA using AMOS 21.00 sufficed to evaluate the efficacy of scales amongst constructs rather than EFA (Anderson and Gerbing, 1988, Segars and Grover, 1998, Lai *et al.*, 2002, Woo *et al.*, 2011b). Hence, this section focuses on validating proposed constructs.

7.3.1 Criteria for assessing measurement model

This section is dedicated to explain overall model fit, unidimensionality, scale reliability, convergent validity and discriminant validity so as to appropriately establish the criteria to assess the measurement model because those are major concerns in the measurement model.

7.3.1.1 Overall model fit and unidimensionality

Various goodness-of-fit indices suggested by researchers are used to evaluate the fit and unidimensionality of the measurement model (Kline, 2011). Unidimensionality involves the existence of a single concept underlying a group of measures, and can be tested for to evaluate how well measurement items represent their corresponding constructs using CFA with overall acceptable goodness-of-fit indices (Anderson *et al.*, 1987). As Hair *et al.* (2010) suggested, it is not required to report all indices due to redundancy amongst them, but researchers should report at least one absolute index, one incremental index as well as the chi-square value and the degrees of freedom. Hence, this study adopts at least one absolute fit index (RMSEA and SRMR), one incremental fit index (CFI and TLI) and the normed chi-square (χ^2/df) index.

The criteria for ideal fit indices should be (1) relative independence of sample size; (2) precision and consistency to evaluate different models and (3) easy interpretation supported by a well-defined continuum or pre-set range (Marsh *et* *al.*, 1988). As sample size adversely influences fit indices, Garver and Mentzer (1999) recommended (1) TLI; (2) CFI and (3) RMSEA. The normed chi-square values less than five are recommended for model parsimony (Marsh and Hocevar, 1985, Segars and Grover, 1998). A rule of thumb for CFI and TLI is that higher than approximately 0.9 signifies reasonably good fit (Garver and Mentzer, 1999, Hu and Bentler, 1999). As for RMSEA, a rule of thumb is that RMSEA less than 0.05 represents close approximate fit, values between 0.05 and 0.08 indicate reasonable error of approximation, and value over 0.10 imply poor fit (Browne and Cudeck, 1993).

Table 7.4 Criteria of measurement model for this study

Validity	Criteria	Reference
Overall model fit	χ^2/df < 5	Marsh and Hocevar 1985
	CFI>0.9	Garver and Mentzer 1999
	TLI>0.9	Garver and Mentzer 1999
	SRMR<0.08	Hair *et al.* 2010
	RMSEA<0.08	Hair *et al.* 2010
Reliability	Composite reliability>0.7	Garver and Mentzer 1999
	AVE >0.5	Garver and Mentzer 1999
	Cronbach's alpha>0.7	Nunally 1978
Convergent validity	Factor loadings>0.5	Hair *et al.* 2010
	R^2 > 0.3	Hair *et al.* 2010
	AVE>0.5	Fornell and Larcker 1981
	Standardised estimates > twice their standard errors	Anderson and Gerbing 1988
Discriminant validty	Inter-construct correlations < 0.85	Kline 2011
	Square-root of the AVEs > correlations	Fornell and Larcker 1981
	Chi-square differences between constructs of fixed and free solutions (p<0.05)	Bagozzi *et al.* 1991

Source: complied by author

7.3.1.2 Scale reliability

Reliability is an evaluation of the level of consistency between multiple measurements of variables, indicating that the measurements consistently represent the same latent variables (Hair *et al.*, 2010). To check scale reliability, this study uses three criteria: composite reliability (CR), average variance extracted (AVE) and Cronbach's Alpha. The generally agreed upon lower limit for CR and Cronbach's alpha is 0.70 (Nunnally, 1978, Fornell and Larker, 1981, Hair *et al.*, 2010). Besides, AVE of 0.5 or higher is a good rule of thumb suggesting that measurement errors are low (Garver and Mentzer, 1999).

7.3.1.3 Convergent validity

Convergent validity refers to the extent to which the construct correlated to items intended to measure that same construct (Dunn *et al.*, 1994). In other words, items that measure certain constructs should statistically converge together (Garver and Mentzer, 1999). Convergent validity is confirmed by verifying whether the items in a scale converge or load together on a single construct in the measurement model (Steenkamp and Van Trijp, 1991). There is convergent validity if the factor loadings are statistically significant (Hair *et al.*, 2010). A reasonable value of the parameter estimating representing convergent validity is 0.50 (Hair *et al.*, 2010). Besides, R^2 (item reliability) can be used to measure the reliability of a specific observed variable or item (Koufteros, 1999). R^2 values greater than 0.3 provide evidence of convergent validity (Hair *et al.*, 2010). In addition, if the standardised estimates for all items are greater than twice their standard errors, it indicates strong convergent validity (Anderson and Gerbing, 1988). Finally, if AVEs exceed the minimum threshold of 0.5, it provides strong convergent validity (Fornell and Larker, 1981).

7.3.1.4 Discriminant validity

Discriminant validity refers to the extent to which the items representing a construct discriminate that construct from other items representing other constructs (Mentzer and Flint, 1997). This validity should be concerned with the situations in which constructs are highly correlated and similar in nature since too high correlation between different latent variables may mean measuring the same construct rather than different ones (Dunn *et al.*, 1994). In other words, it can be seen that discriminant validity exists when there is a relatively low correlation between constructs. Discriminant validity is ensured when any two dimensions of correlations are significantly different from unity (Bagozzi *et al.*, 1991)

To evaluate discriminant validity, this study verifies several stages. Firstly, the square-root of the AVEs exceeds each possible pairwise correlation between latent variables, indicating discriminant validity (Fornell and Larker, 1981). Secondly, inter-correlation between latent variables should be less than 0.85 (Kline, 2011). In a further test, χ^2 differences were compared in terms of values of all viable pairs of constructs between constrained (=1.0) models and unconstrained models as Bagozzi *et al.* (1991) suggested. Significant χ^2 differences suggested that the unconstrained model fits the data better, indicating the existence of discriminant validity. If all χ^2 differences between the unconstrained and constrained model were significant at the 0.05 level, it indicates good discriminant validity.

7.3.2 Measurement model for supply chain collaboration

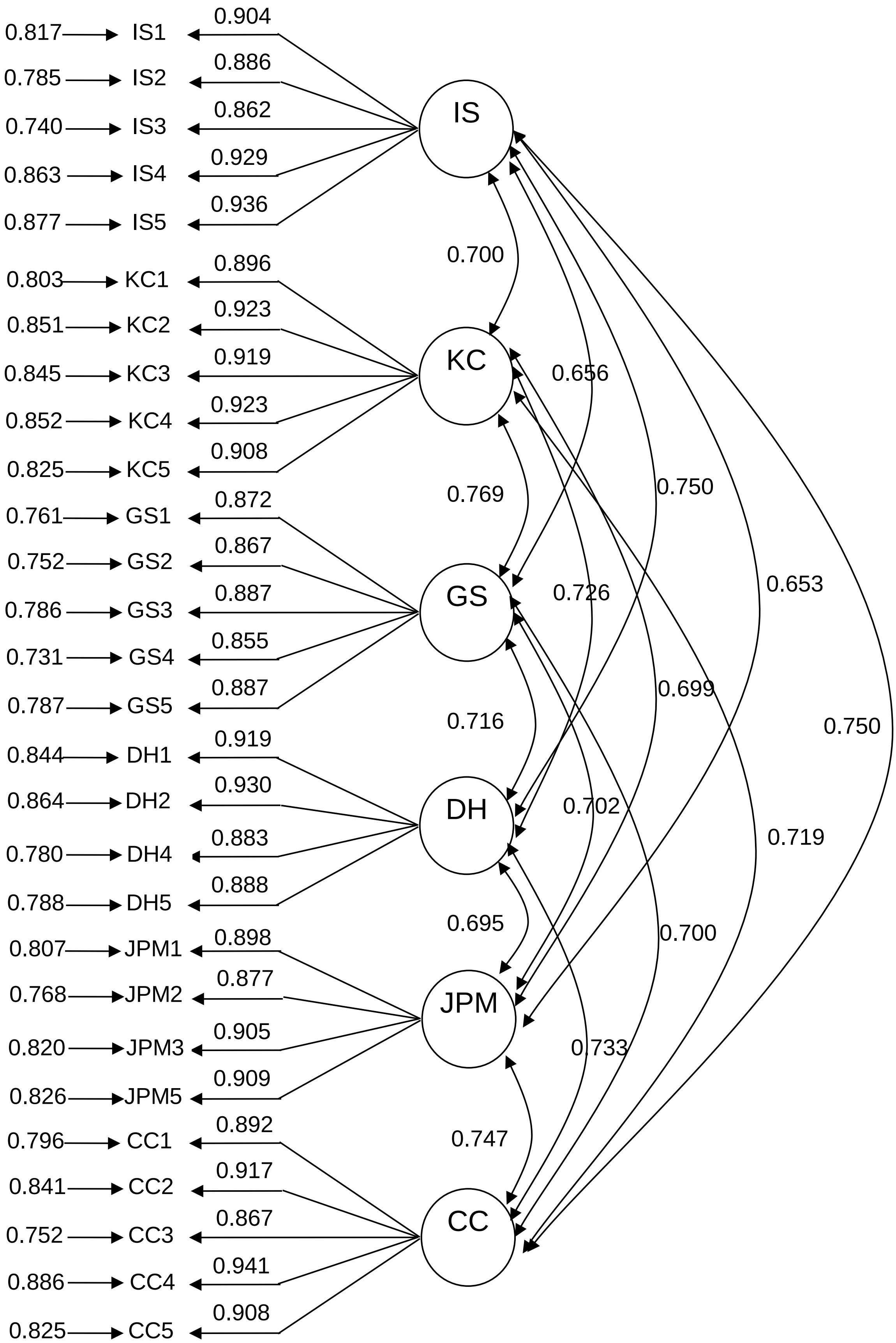
In order to examine whether SCC is a multidimensional construct, which is composed of six sub-factors as well as reliability and validity, five models were compared to investigate model fit using CFA as Xia and Lee (2005) suggested after analysing first-order and second-order measurement models separately.

7.3.2.1 First-order measurement model for SCC

It is assumed that the six constructs for SCC in the measurement model are inter-related, as indicated by the two-headed arrows. First-order measurements for SCC yield a chi-square value of 503.896, with 335 degrees of freedom and probability of less than 0.001 ($p<0.001$), thereby suggesting the fit of the data to the hypothesised model is not entirely adequate. Interpreted literally, these statistics suggests that the hypothesised bearing on SCC relations represents an unlikely event (occurring less than one time in 1,000 under the null hypothesis), so it is rejected (Byrne, 2010). However, depending solely on chi-square value causes some problems since hypothesis tested by chi-square is likely to be implausible (Kline, 2011). The sensitivity to sample size, difference in covariance matrices and model complexity, chi-square value approximates the degrees of freedom is unrealistic in SEM research, so many researchers have addressed the chi-square limitations by developing goodness-of-fit indices for a more pragmatic approach (Byrne, 2010).

The overall fit of the measurement model was excellent ($\chi^2/df=1.504$; CFI= 0.972; TLI= 0.968; RMSEA=0.052; SRMR=0.030), showing all criteria satisfying the suggested thresholds in Table 7.4 in section 7.3.3.1. Table 7.5 shows that the reliability of each construct and instrument, assessed using Cronbach's alpha and composite reliability, exceeded the approved limit of 0.7 (Nunnally, 1978, Fornell and Larker, 1981, Hair *et al.*, 2010), indicating internal consistency and reliability.

Figure 7.1 First-order factors of SCC



All specified factor loadings are highly significant, which shows good convergent validity amongst the measurements of each latent variable (Hair *et al.*, 2010). All standardised regression weights to their latent variables are significant at $p<0.001$. Moreover, all R^2 values over 0.3 provide evidence of convergent validity (Hair *et al.*, 2010). In addition, the standardised estimates for all items are greater than twice their standard errors, indicating strong convergent validity (Anderson and Gerbing, 1988). All AVEs values greater than 0.5 provide strong convergent validity (Fornell and Larker, 1981).

Table 7.5 CFA results of first-order SCC

Construct		Standardised regression Weight	t-value	Square multiple correlations (R2)	Standard error	Composite reliability	AVE	Cronbach's alpha (α)
Information sharing (IS)	IS1	.904	-	.817	-	0.957	0.816	0.956
	IS2	.886	18.350***	.785	.052			
	IS3	.862	17.107***	.740	.052			
	IS4	.929	20.828***	.863	.043			
	IS5	.936	21.334***	.877	.045			
Knowledge creation (KC)	JKC1	.896	20.002***	.803	.050	0.962	0.835	0.962
	JKC2	.923	-	.851	-			
	JKC3	.919	21.587***	.845	0.49			
	JKC4	.923	21.885***	.852	.046			
	JKC5	.908	20.799***	.825	.050			
Collaborative communication (CC)	CC1	.892	20.830***	.796	.047	0.958	0.820	0.957
	CC2	.917	22.833***	.841	.041			
	CC3	.867	19.115***	.752	.052			
	CC4	.941	-	.886	-			
	CC5	.908	22.061***	.825	.044			
Goal similarity (GS)	GS1	.872	-	.761	-	0.942	0.763	0.942
	GS2	.867	15.934***	.752	.062			
	GS3	.887	16.670***	.786	.060			
	GS4	.855	15.491***	.731	.060			
	GS5	.887	16.695***	.787	.058			
Decision harmonisation (DH)	DH1	.919	21.633***	.844	.046	0.948	0.819	0.947
	DH2	.930	-	.864	-			
	DH4	.883	19.241***	.780	0.47			
	DH5	.888	19.544***	.788	.045			
Joint supply chain performance measurement (JPM)	JPM1	.898	18.870***	807	.053	0.943	0.805	0.943
	JPM2	.877	17.764***	.768	.052			
	JPM3	.905	19.246***	.820	.053			
	JPM5	.909	-	.826	-			

Overall goodness-of-fit indices
$\chi^2/df=1.504$ (503.896/355); CFI= 0.972; TLI= 0.968; RMSEA=0.052; SRMR=0.030

Note: *** p<0.001

To certify discriminant validity, the correlations of constructs were examined. All correlations were less than 0.85 and all are significant at a 0.001 level, providing evidence of discriminant validity (Kline, 2011). In addition, Table 7.6 shows that the square root of the AVEs are greater than each possible pairwise correlation between latent variables, indicating discriminant validity (Fornell and Larker, 1981)

Table 7.6 Discriminant validity test for SCC

	JPM	IS	GS	KC	CC	DH
JPM	0.897					
IS	0.653***	0.903				
GS	0.702***	0.656***	0.874			
KC	0.699***	0.700***	0.769***	0.914		
CC	0.747***	0.750***	0.700***	0.719***	0.905	
DH	0.695***	0.750***	0.716***	0.726***	0.733***	0.905

Note: ***p<0.001; Square root of AVE is on the diagonal.

A chi-square difference test was also employed to ensure discriminant validity as suggested by Bagozzi *et al.* (1991). Significant χ^2 differences between all pairs of constructs suggest evidence for discriminant validity (Bagozzi *et al.*, 1991). After setting a fixed constrained model, which fixed correlation parameters between constructs at 1.0., an unconstrained model makes the correlation parameter free. A chi-square difference test between the two models was conducted. If the chi-square difference between the two models are significant (above 3.85 at $p<0.05$, above 6.63 at $p<0.01$ and above 10.83 at $p<0.001$), discriminant validity is certified. The results show that all χ^2 differences between the constrained and unconstrained model are significant at a 95% significance level, indicating evidence of discriminant validity between constructs. Table 7.7 summarised the χ^2 between fixed and unfixed models. As such, discriminant validity of the six first-order variables of SCC is verified by the above evidence.

Table 7.7 Pairwise comparison of χ^2 values for SCC

Construct pairs	constrained		unconstrained		$\Delta\chi^2$
	χ^2	df	χ^2	df	
IS-GS	79.674	35	61.312	34	18.362***
IS-KC	79.328	35	68.731	34	10.597**
IS-CC	59.758	35	53.662	34	6.096*
IS-JPM	67.086	27	52.792	26	14.294***
IS-DH	47.475	27	40.290	26	7.185**
GS-KC	116.811	35	102.431	34	14.38***
GS-CC	70.157	35	54.868	34	15.289***
GS-JPM	61.800	27	42.271	26	19.529***
GS-DH	56.638	27	41.014	26	15.624***
KC-CC	76.768	35	67.406	34	9.362**
KC-JPM	62.597	27	47.924	26	14.673***
KC-DH	58.597	27	47.717	26	10.88***
CC-JPM	30.512	27	21.231	26	9.281**
CC-DH	44.707	27	36.978	26	7.729**
JPM-DH	33.346	20	18.810	19	14.536***

Note: ***$p<0.001$; **$p<0.01$; *$p<0.05$.

7.3.2.2 Second-order measurement model for SCC

Second-order factors are higher in abstraction and have various first-order factors embedded within the second-order factor, whereas a first order factor is a unidimensional factor determined directly from its indicators (Anderson *et al.*, 1987). The second-order model explains the covariances amongst the first-order in a more parsimonious way, which implies that it uses fewer degrees of freedom (Hair *et al.*, 2010). The variations accumulated by the first-order factors cannot be totally explained by the single second-order factor.

The model fit is superb. The normed chi-square is 1.512 far less than 5, and CFI (0.971) and TLI (0.968) are acceptably outstanding compared to suggested criteria. Moreover the value for RMSEA and SRMR are 0.054 and 0.035 each, which satisfies the criteria value (less than 0.08). All factor loadings of items to corresponding constructs are significant at $p<0.001$ and higher than 0.8.

Figure 7.2 Second-order factors of SCC

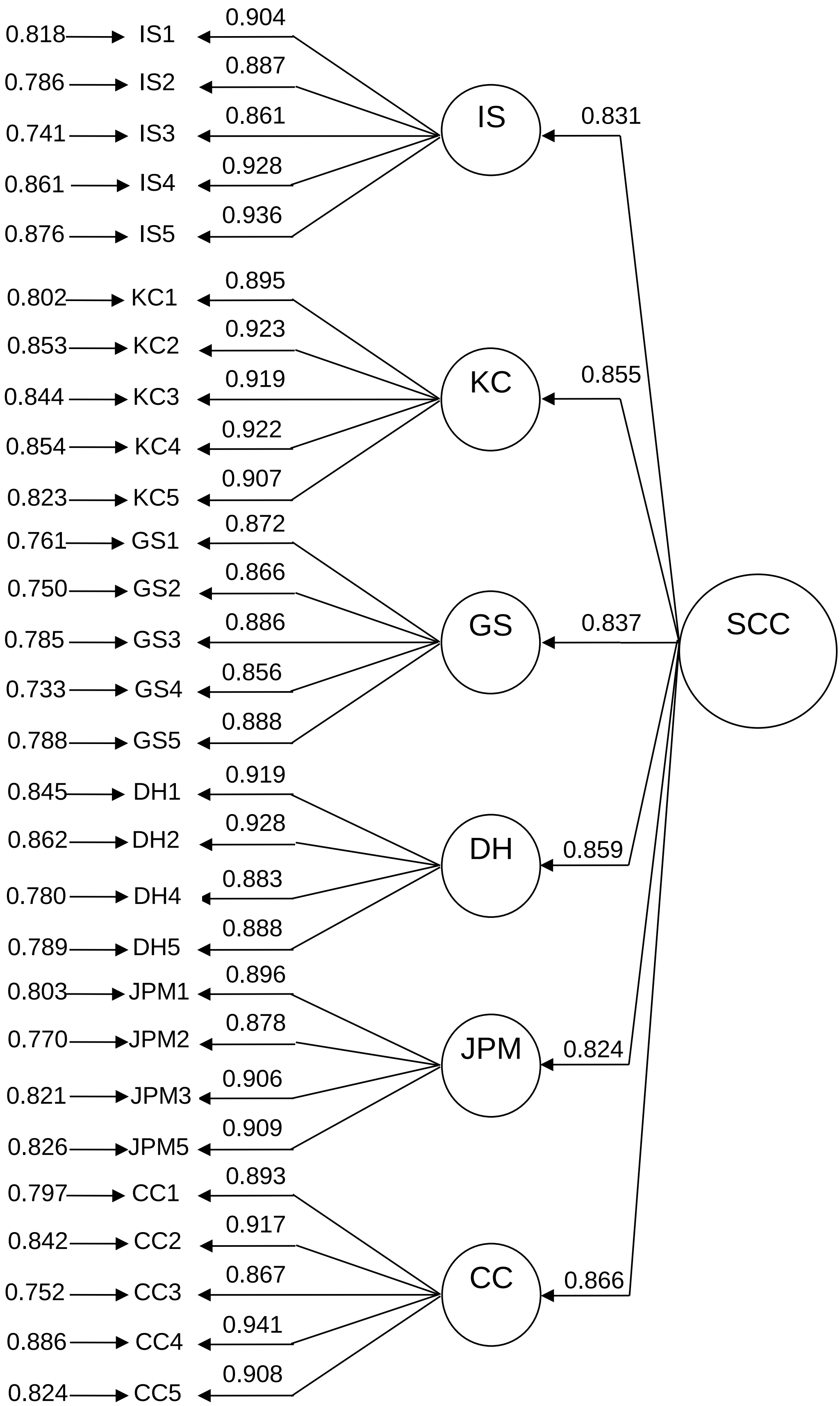


Table 7.8 CFA results of second-order SCC

	Construct	Standardised regression weight	t-value	Square multiple correlations (R^2)	Standard error
SCC	IS	.831	11.364***	.691	.089
	GS	.837	11.005***	.701	.079
	KC	.855	-	.731	-
	CC	.866	12.425***	.750	.086
	JPM	.824	11.242***	.679	.083
	DH	.859	12.078***	.737	.085
Overall goodness-of-fit indices χ^2/df=1.512 (520.009/344); CFI=0.971; TLI=0.968; RMSEA=0.054; SRMR=0.035					

Note: *** p<0.001.

Validation of the second-order model is an important element in terms of construct validity. The comparison between the second-order model and the first-order model in terms of model fit is conducted to show the rationale for the high-order model. The fit indices of the higher-order model always have worse fit than the corresponding first-order model in absolute terms, since the first-order uses more paths to capture the same amount of covariance (Hair *et al.*, 2010). The Target coefficient (T coefficient) is employed to justify the existence of the second-order construct (Marsh and Hocevar, 1985). The T coefficient is the ratio of χ^2 of the first-order model to the χ^2 of the second-order model (first-order χ^2/second-order χ^2). The value over 0.8 represents evidence of the existence of a second-order construct (Doll *et al.*, 1995). In this case, chi-square of the first model was 503.896 and of the second model was 520.009. The target coefficient is 96.90%, showing a strong evidence of existence of a higher-order SCC construct. The second-order model does not considerably increase χ^2, implying no severe negative effect on the model fit. The second-order model includes more information regarding the association between the common latent factor and each construct in the provision of path coefficients compared to the first-order model in the provision of correlations. It is accepted that SCC is conceptualised as a second-order multidimensional construct comprising IS, KC, CC, GS, DH and JPM.

7.3.2.3 Five models in the confirmatory factor analysis for SCC

To obtain a valid and reliable measurement model, five models were compared to investigate model fit using CFA as Xia and Lee (2005) suggested. Model I is a null model in which all items are uncorrelated; in Model II all items are connected on a single first-order factor; in Model III all items are connected on five uncorrelated first-order factors; in Model IV all items are connected on five correlated first-order factors; in Model V, five first-order factors were loaded onto a second-order factor of SCC (Figure 7.3). In terms of goodness-of-fit indices the first three models indicated unacceptable results, since most of goodness-of-fit indices failed to meet the threshold criteria. In contrast, the latter two showed acceptable fit indices (Table 7.9). As a whole, the six proposed factors fit the dataset well. Model V does not considerable increase increase χ^2, implying no severe negative effect on the model fit. Model V includes more information regarding the association between the common latent factor and each construct in the provision of path coefficients compared to Model IV in the provision of correlations. Therefore, it is acceptable that the six-factor second-order model offers an adequate representation of the model structure of the SCC scale.

Figure 7.3 Five models for SCC

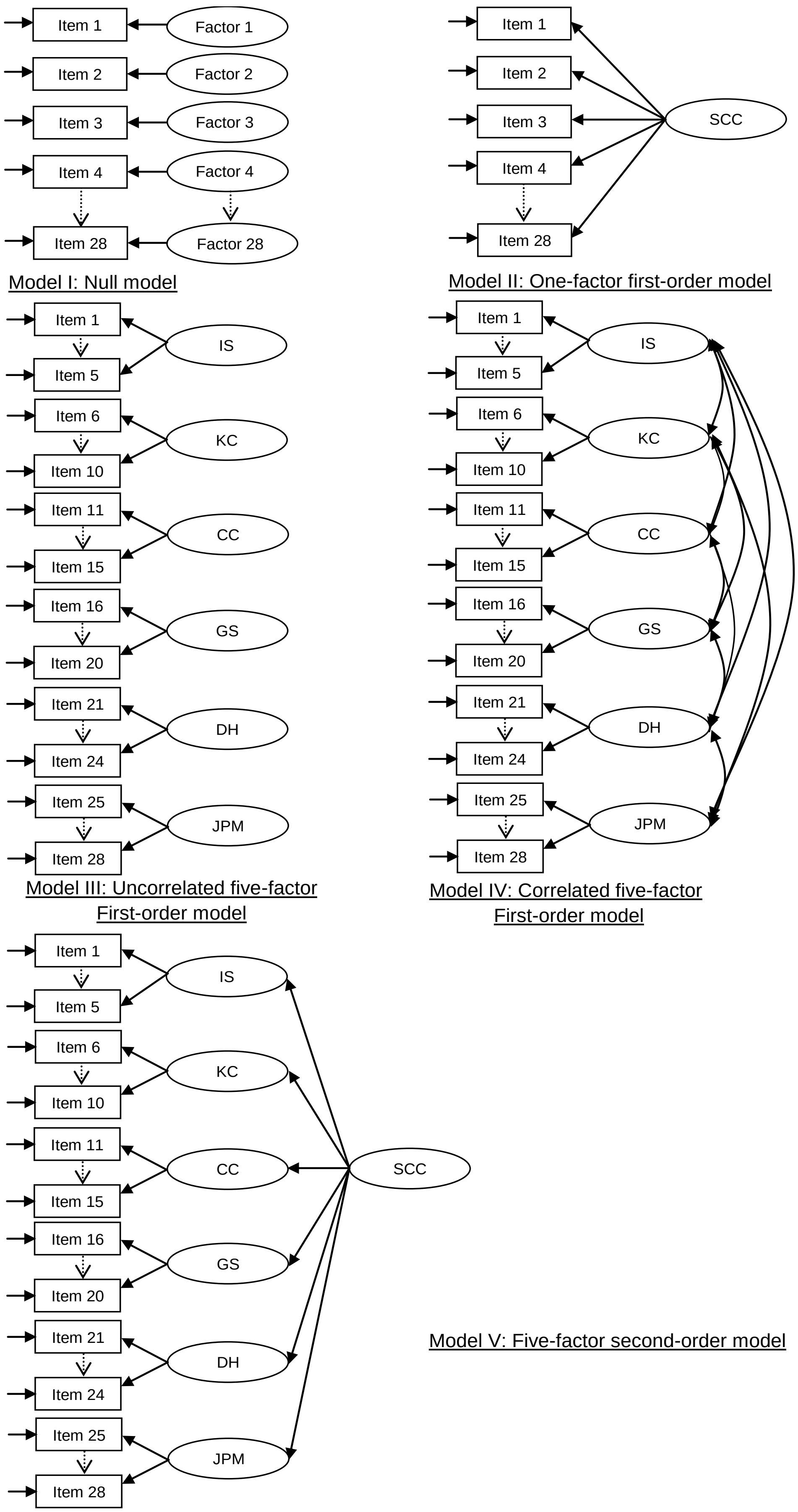


Table 7.9 Five model fit tests for SCC

Criteria	Threshold	Model I	Model II	Model III	Model IV	Model V
χ^2/df	<5	-	6.490	3.628	1.504	1.512
CFI	>0.9	1.000	0.678	0.846	0.972	0.971
TLI	>0.9	-	0.652	0.834	0.968	0.968
SRMR	<0.08	-	0.0810	0.523	0.030	0.035
RMSEA	<0.08	0.299	0.176	0.122	0.052	0.054

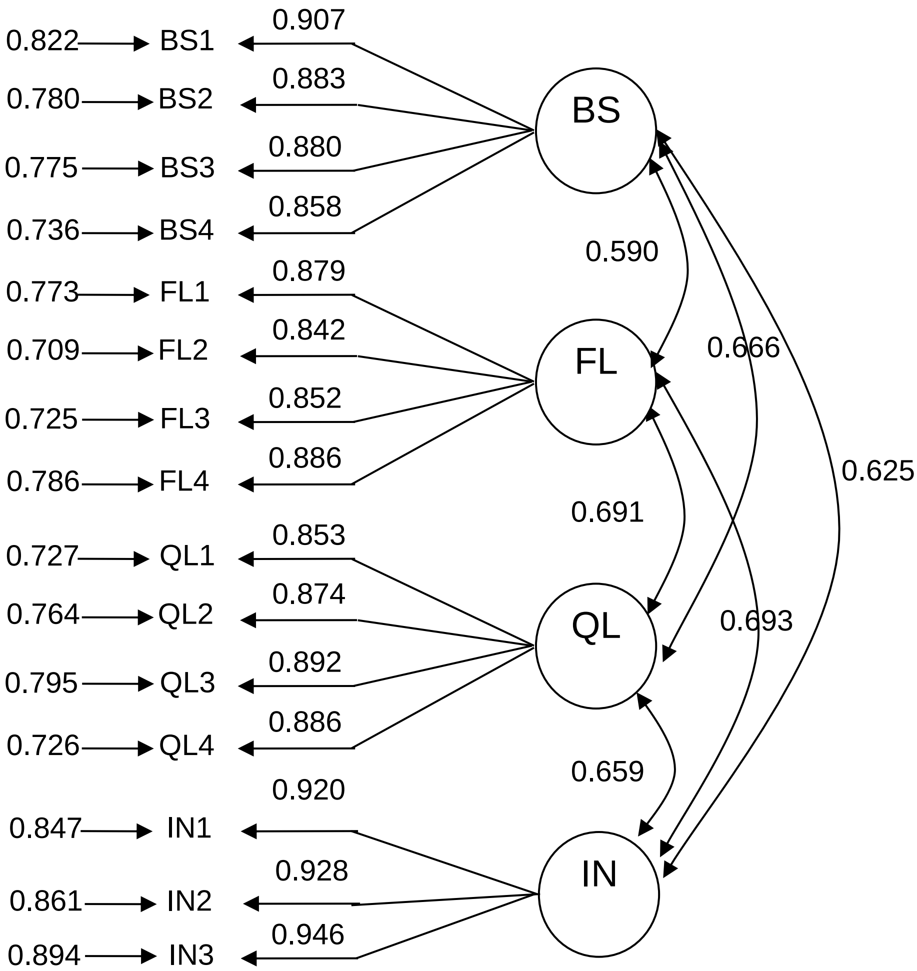
7.3.3 Measurement model for collaborative advantage

This section attempts to investigate the measurement model of CA as a multidimensional construct by dividing CA into the first-order model and second-order model. It also includes five models to examine model fit.

7.3.3.1 First-order measurement model for CA

It is presumed that the four latent variables for CA in the measurement model are correlated, as displayed by the two-headed arrows. The first-order model for CA was examined by CFA. No items were deleted from CA. The model fit indices of normed χ^2/df (1.164), CFI (0.994), TLI (0.993), RMSEA (0.030) and SRMR (0.030) all met the recommended threshold in Table 7.4 in section 7.3.3.1., as shown in Table 7.10, supporting good unidimensionality. The estimates of AVEs for BS, QL, IN and FL are 0.778, 0.753, 0.868 and 0.748 respectively, much larger than the critical value of 0.5. Moreover, composite reliability for four constructs ranged from 0.922 to 0.952, above the critical value of 0.70. The results suggest that the hypothesised model is adequate and has superb reliability. In terms of reliability, Cronbach's alpha and composite reliability were greater than the recommended threshold of 0.7, providing the evidence for consistency and reliability (Nunnally, 1978, Fornell and Larker, 1981, Hair *et al.*, 2010)

Figure 7.4 First-order factors of CA



All standardised estimates were statistically significant at the 0.001 level, providing strong convergent validity amongst the measurement of each construct (Hair *et al.*, 2010). Besides, all square multiple correlations exceeded 0.3 of the suggested threshold, indicating convergent validity (Hair *et al.*, 2010). All the standardised estimates for all items were greater than twice their standard errors, which indicates convergent validity (Anderson and Gerbing, 1988). Finally, each AVE value were larger than 0.5, showing strong convergent validity (Fornell and Larker, 1981).

Table 7.10 CFA results of first-order CA

Construct		Standardised regression weight	t-value	Square multiple correlations (R^2)	Standard error	Composite reliability	AVE	Chronbach's alpha (α)
Business synergy (BS)	BS1	.907	17.630**	.822	.059	0.933	0.778	0.933
	BS2	.883	16.659**	.780	.067			
	BS3	.880	-	.775	-			
	BS4	.858	15.550**	.736	.064			
Quality (QL)	QL1	.853	15.055**	.727	.061	0.924	0.753	0.924
	QL2	.874	-	.764	-			
	QL3	.892	16.414**	.795	.057			
	QL4	.852	15.286**	.726	.063			
Innovation (IN)	IN1	.920	-	.847	-	0.952	0.868	0.951
	IN2	.928	21.670**	.861	.047			
	IN3	.946	22.839**	.894	.042			
Flexibility (FL)	FL1	.879	15.056**	.773	.070	0.922	0.748	0.923
	FL2	.842	-	.709	-			
	FL3	.852	14.151**	.725	.072			
	FL4	.886	14.932**	.786	.071			

Overall goodness-of-fit indices
χ^2/df=1.164 (97.804/84); CFI= 0.994; TLI= 0.993; RMSEA=0.030; SRMR=0.030

Note: *** p<0.001

In order to confirm discriminant validity, the correlations and square root of AVEs were examined. Each correlation between the constructs were not greater than 0.85 and all significant at the 0.001 level, which indicates discriminant validity as shown in Table 7.11 (Kline, 2011). Furthermore, the square root of AVEs all exceeded each possible pair of correlation between the constructs, providing strong evidence for discriminant validity (Fornell and Larker, 1981).

Table 7.11 Discriminant validity test for CA

	QL	BS	FL	IN
QL	0.868			
BS	0.666***	0.882		
FL	0.691***	0.590***	0.865	
IN	0.659***	0.625***	0.693***	0.931

Note: *** $p<0.001$; Square root of AVE is on the diagonal.

In order to further ensure discriminant validity, all Chi-square differences between the fixed and free solutions were significant at a level of $p<0.01$ (Table 7.12), indicating strong evidence for discriminant validity

Table 7.12 Pairwise comparison of χ^2 values for CA

Construct pairs	constrained		unconstrained		$\Delta\chi^2$
	χ^2	df	χ^2	df	
BS-FL	20.16	19	61.783	20	41.623***
BS-QL	22.587	19	49.897	20	27.31***
BS-IN	14.677	13	31.974	14	17.297***
FL-QL	18.202	19	48.401	20	30.199***
FL-IN	22.167	13	40.057	14	17.89***
QL-IN	12.942	13	26.069	14	13.127***

Note: ***$p<0.001$.

7.3.3.2 Second-order measurement model for CA

In terms of overall model fit, the ratio of chi-square to degrees of freedom is 1.175, which infers an excellent fit. Other model fit indices CFI=0.994; TLI=0.993; RMSEA=0.031; SRMR=0.030 are also very good, satisfying all suggested thresholds. All factor loadings of items to the corresponding constructs are greater than 0.7 and significant at a 0.001 level. In addition, all R^2 values were ranged between 0.580 and 0.701, which are over than 0.3, providing evidence of appropriateness of second-order measurement model for CA.

Figure 7.5 Second-order factors of CA

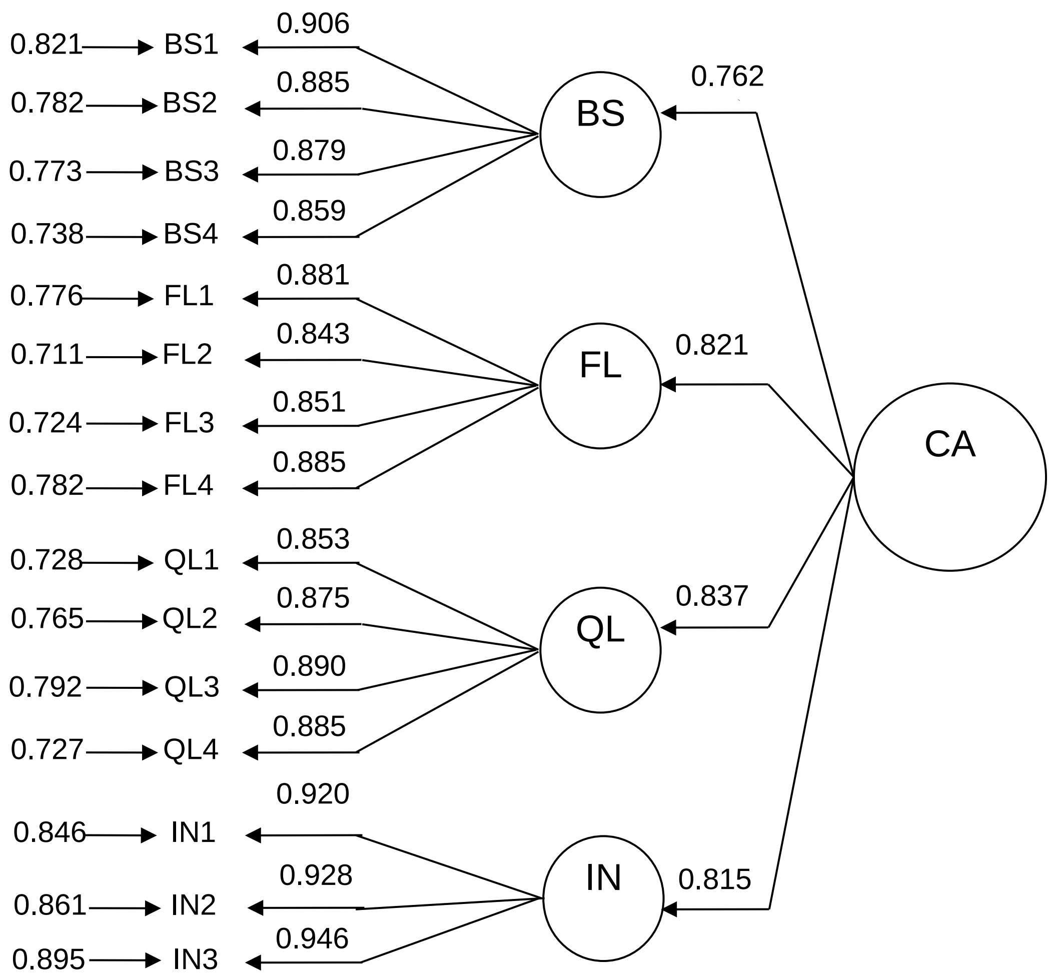


Table 7.13 CFA results of second-order CA

	Construct	Standardised regression weight	t-value	Square multiple correlations (R^2)	Standard error
CA	BS	.762	8.473***	.580	.119
	QL	.837	9.054***	.701	.129
	IN	.815	9.215***	.665	.152
	FL	.821	-	.675	-

Overall goodness-of-fit indices
χ^2/df=1.175 (101.020/86); CFI=0.994; TLI=0.993; RMSEA=0.031; SRMR=0.033

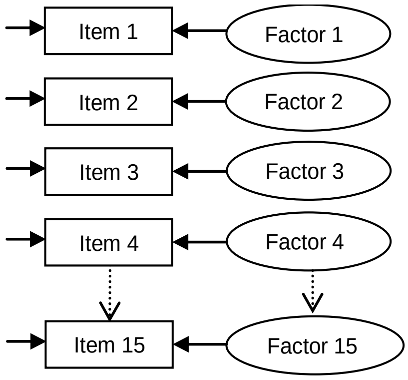
Note: *** p<0.001

The efficacy of second-order models is sought by calculating the T coefficient. The chi-square of the first-order model was 97.804 and of the second-order model was 101.020. The T coefficient for CA was 96.81%, which suggested that the second-order model is acceptable as a more precise representation of model structure over the corresponding first-order model since the second-order models show more parsimonious explanation of covariances between variables (Doll *et al.*, 1995). Therefore, it is evident that CA is conceptualised as a second-order multidimensional construct comprising BS, QL, IN and FL.

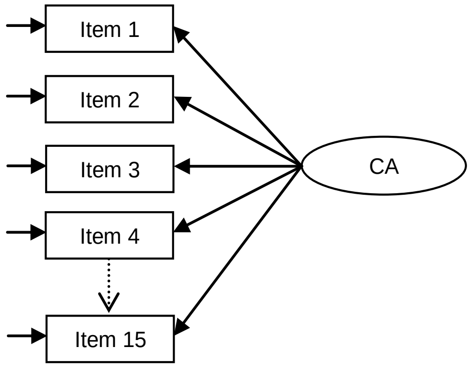
7.3.3.3 Five models in the confirmatory factor analysis for CA

As discussed in section 7.3.2.3, this section also compares five models by using CFA. In terms of goodness-of-fit indices the first three models indicated unacceptable results, since most goodness-of-fit indices failed to meet the threshold criteria. In contrast, the latter two showed acceptable fit indices (Table 7.14). As a whole, the six proposed factors fit the dataset well. Model V does not considerable increase χ^2, implying no severe negative effect on the model fit. Model V includes more information regarding the association between the common latent factor and each construct in the provision of path coefficients compared to Model IV in the provision of correlations. Therefore, it is acceptable that the four-factor second-order model is an adequate representation of the model structure of the CA scale.

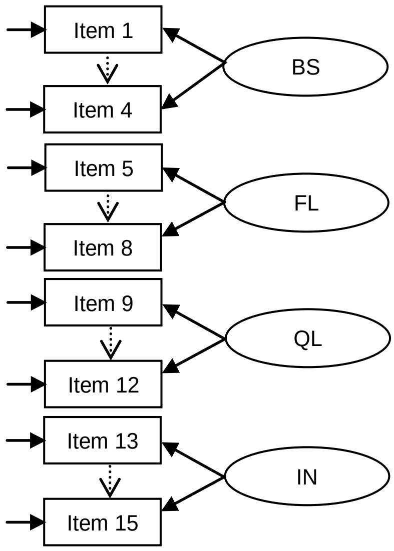
Figure 7.6 Five models for CA



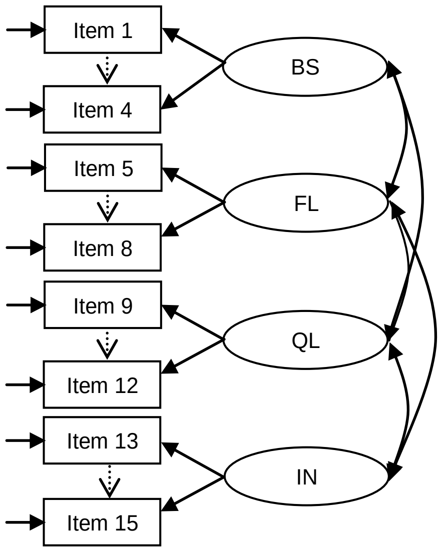
Model I: Null model



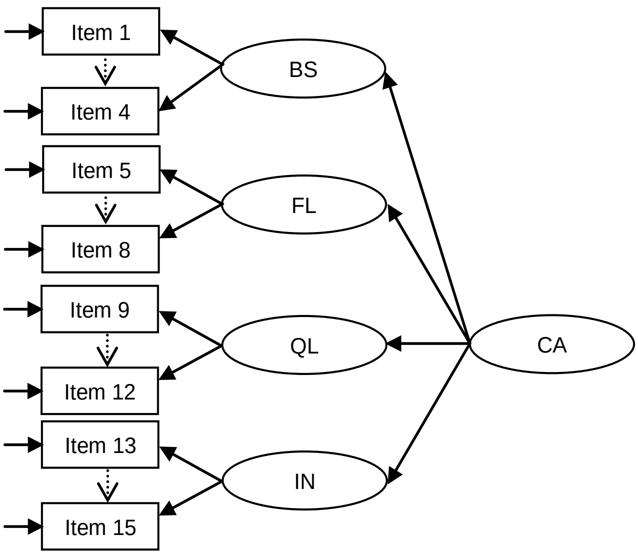
Model II: One-factor first-order model



Model III: Uncorrelated five-factor
First-order model



Model IV: Correlated five-factor
First-order model



Model V: Five-factor second-order model

Table 7.14 Five model fit tests for CA

Criteria	Threshold	Model I	Model II	Model III	Model IV	Model V
χ^2/df	<5	-	10.333	4.665	1.164	1.175
CFI	>0.9	1.000	0.665	0.868	0.994	0.994
TLI	>0.9	-	0.609	0.846	0.993	0.993
SRMR	<0.08	-	0.1063	0.429	0.030	0.033
RMSEA	<0.08	0.367	0.230	0.144	0.030	0.031

7.3.4 Measurement model for port performance

This study conceptualises seven dimensions of PP: connectivity (CV), value-added service (VAS), safety and security (SS), efficient operation (EO), cost efficiency (CE), reliability (RL) and convenience of port users (CPU). As a multidimensional construct, this study captures the measurement of PP to ensure its unidimensionality, reliability, convergent validity, discriminant validity and second-order construct validity prior to the examination of five-alternative models

7.3.4.1 First-order measurement model for PP

The seven latent variables for PP in the measurement model are correlated, as presented by the two-headed arrows. The first-order measurement model for PP is supported by a number of statistical fit indices as shown in Table 7.15: Chi-square/df=1.195, CFI=0.992, TLI=0.990, RMSEA=0.033, and SRMR=0.023. Additionally, each of the standardised loadings for the model paths was highly significant ($p<0.001$).

Composite reliability of CV, VAS, SS, EO, CE, RL and CPU was 0.977, 0.948, 0.968, 0.955, 0.943, 0.916 and 0,965 respectively above the critical values of 0.7, whilst Cronbach's alphas are greater than the approved threshold of 0.7. Consequently, all constructs have measures with satisfactory reliability.

The t-values associated with the latent variables are significant at the 0.001 level, representing good convergent validity. Furthermore, each item's R^2 value was far greater than 0.3, while all the standardised estimates for all items were greater than twice their standard errors, showing evidence of convergent validity. The higher values of AVE over 0.5 also provide the evidence for convergent validity.

Figure 7.7 First-order factors of PP

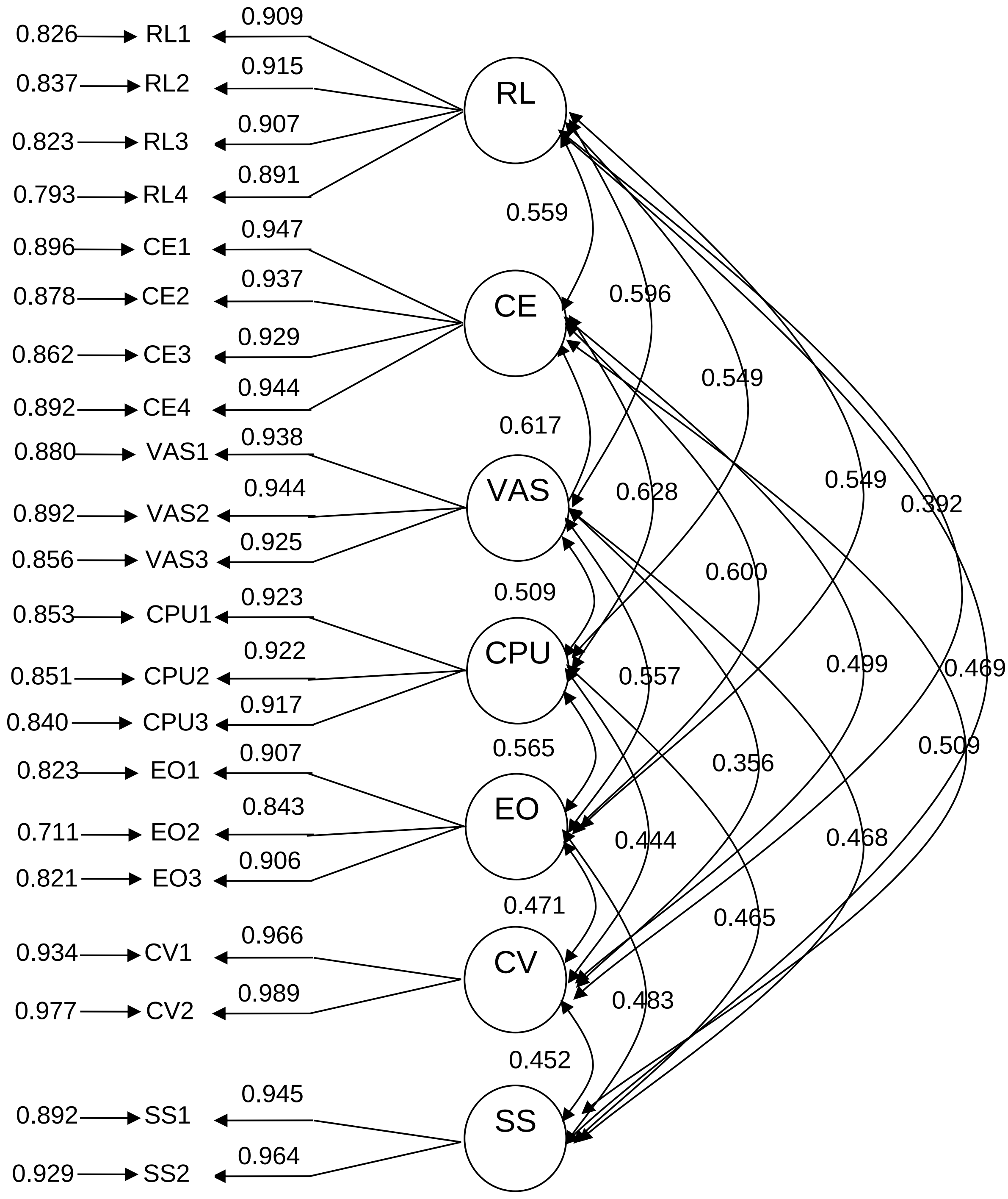


Table 7.15 CFA results of first-order PP

Construct		Standardised regression weight	t-value	Square multiple correlation (R^2)	Standard error	Composite reliability	AVE	Chronbach's alpha (α)
Connectivity (CV)	CV1	.966	-	.934	-	0.977	0.956	0.977
	CV2	.989	24.694***	.977	.041			
Value-added service (VAS)	VAS1	.938	-	.880	-	0.955	0.820	0.955
	VAS2	.944	24.485***	.892	.041			
	VAS3	.925	22.959***	.856	.043			
Safety and security (SS)	SS1	.945	-	.892	-	0.954	0.882	0.953
	SS2	964	17.292***	.929	.056			
Efficient operation (EO)	EO1	.907	17.643***	.823	.055	0.916	0.876	0.916
	EO2	.843	15.599***	.711	.056			
	EO3	.906	-	.821	-			
Cost efficiency (CE)	CE1	.947	25.440***	.896	.039	0.968	0.848	0.968
	CE2	.937	-	.878	-			
	CE3	.929	23.886***	.862	.040			
	CE4	.944	25.157***	.892	.039			
Reliability (RL)	RL1	.909	19.898***	.826	.052	0.948	0.785	0.948
	RL2	.915	-	.837	-			
	RL3	.907	19.741***	.823	0.52			
	RL4	.891	18.844***	.793	.051			
Convenience of port users (CPU)	CPU1	.923	20.912***	.853	.047	0.943	0.911	0.943
	CPU2	.922	-	.851	-			
	CPU3	.917	20.532***	.840	.046			

Overall goodness-of-fit indices
χ^2/df=1.195 (200.799/168); CFI= 0.992; TLI= 0.990; RMSEA=0.033; SRMR=0.023

Note: *** p<0.001.

To strictly test discriminant validity, the square root of the AVEs and correlation estimates are thoroughly inspected. The square root of AVE values on the diagonal line is sufficiently greater than each pair of correlation estimates. Further, all correlation estimates were less than 0.85 and all significant at the 0.001 level. As a result, discriminant validity is certified in an objective manner.

Table 7.16 Discriminant validity test for PP

	CV	RL	CE	VAS	CPU	EO	SS
CV	0.978						
RL	0.392***	0.906					
CE	0.499***	0.559***	0.939				
VAS	0.356***	0.596***	0.617***	0.936			
CPU	0.444***	0.549***	0.628***	0.509***	0.921		
EO	0.471***	0.477***	0.600***	0.557***	0.565***	0.886	
SS	0.452***	0.469***	0.509***	0.468***	0.465***	0.483***	0.955

Note: *** $p<0.001$; Square root of AVE is on the diagonal.

Measurement models were created for all possible pairs of the theoretical constructs. Those models are tested on all pairs by testing for correlation between the two constructs, and fixing the correlation between the constructs at 1.0. A significant difference in chi-square values for the fixed and free solutions indicates the discriminant validity (Bagozzi *et al.*, 1991). As seen in Table 7.17, all the differences between the fixed and free solutions in Chi-square are significant at a 0.01 level.

Table 7.17 Pairwise comparison of χ^2 values for PP

Construct pairs	constrained		unconstrained		$\Delta\ \chi^2$
	χ^2	df	χ^2	df	
RL-CE	19.214	19	32.317	20	13.103***
RL-VAS	16.875	13	28.76	14	11.885***
RL-CPU	8.285	13	22.538	14	14.253***
RL-EO	6.017	13	32.725	14	26.708***
RL-CV	7.607	8	33.069	9	25.462***
RL-SS	5.666	8	29.55	9	23.884***
CE-VAS	27.544	13	35.419	14	7.875**
CE-CPU	23.901	13	31.204	14	7.303**
CE-EO	19.899	13	34.398	14	14.499***
CE-CV	15.813	8	30.68	9	14.867***

CE-SS	25.332	8	40.028	9	14.696***
VAS-CPU	4.069	8	18.383	9	14.314***
VAS-EO	5.827	8	23.907	9	18.08***
VAS-CV	3.293	4	28.008	5	24.715***
VAS-SS	4.232	4	22.413	5	18.181***
CPU-EO	6.903	8	23.858	9	16.955***
CPU-CV	2.385	4	21.554	5	19.169***
CPU-SS	2.394	4	23.276	5	20.882***
EO-CV	0.841	4	24.177	5	23.336***
EO-SS	4.04	4	30.576	5	26.536***
CV-SS	1.137	1	20.91	2	19.773***

Note: ***p<0.001; **p<0.01.

7.3.4.2 Second-order measurement model for PP

The ratio of χ^2 to degrees of freedom (1.185) is less than the recommended value of 5 for satisfactory fit of a model to data. Further, other fit indices CFI=0.992, TLI= 0.991, RMSEA=0.032 and SRMR=0.034 are deemed acceptable. Each standardised regression weight to the associated constructs is very high ranged between 0.646 and 0.819 at p<0.001. In addition, all R^2 values were ranged between 0.351 and 0.670, which are over 0.3, providing evidence of appropriateness of the second-order measurement model for PP.

Figure 7.8 Second-order factors of PP

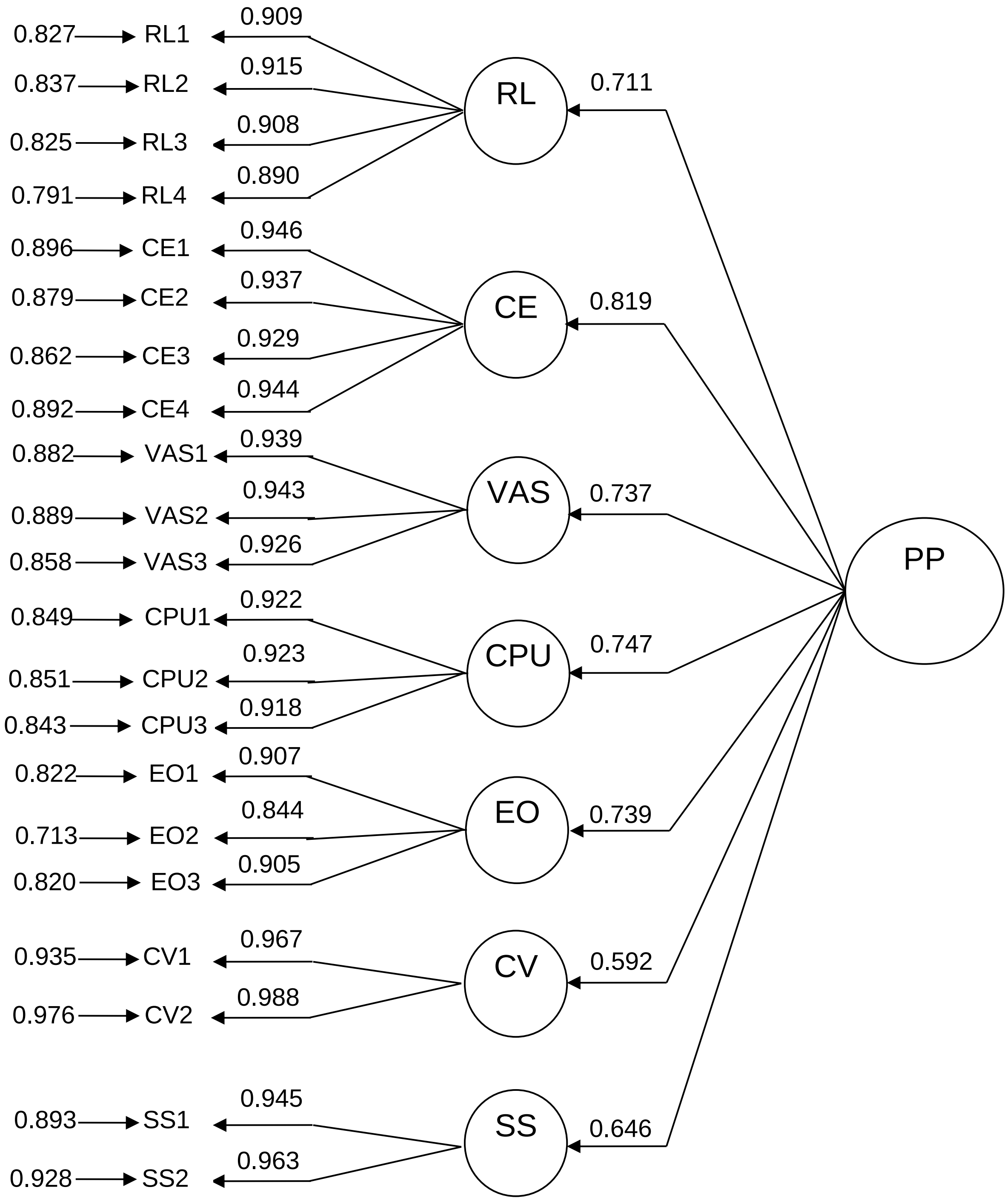


Table 7.18 CFA results of second-order PP

	Construct	Standardised regression weight	t-value	Square multiple correlations (R^2)	Standard error
PP	CV	.592	7.420***	.351	.096
	VAS	.737	9.251***	.543	.094
	SS	.646	8.048***	.418	.092
	EO	.739	9.011***	.546	.085
	CE	.819	-	.670	-
	RL	.711	8.693***	.505	.091
	CPU	.747	9.340***	.558	.096
Overall goodness-of-fit indices χ^2/df=1.185 (215.640/182); CFI=0.992; TLI=0.991; RMSEA=0.032; SRMR=0.034					

Note: *** $p<0.001$.

To judge whether or not the second-order model for PP is adequate, the T coefficient is calculated by the ratio of first-order model's chi-square to second-order model's chi-square. T coefficient (93.11 %) for PP is deemed highly acceptable as suggested threshold of 80%.

7.3.4.3 Five models in the confirmatory factor analysis for PP

This section attempts to compare five models by using CFA. In terms of goodness-of-fit indices the first three models indicated unacceptable results, since most of goodness-of-fit indices failed to meet the threshold criteria. Interestingly, model III did not show relevant goodness-of-fit indices because this was an over-identified model, which is one in which the number of estimable parameters is less than the number of data points (Byrne, 2010). If this model imposes two additional constraints, the AMOS programme shows all relevant goodness-of-fit indices. In contrast, the latter two showed acceptable fit indices (Table 7.19). As a whole, the seven proposed factors fit the dataset well. Model V does not considerable increase χ^2, implying no severe negative effect on the model fit. Model V includes more information regarding the association between the common latent factor and each construct in the provision of path coefficients compared to Model IV in the provision of correlations. Therefore, it is acceptable that the four-factor second-order model is an adequate representation of the model structure of the PP scale.

Figure 7.9 Five models for PP

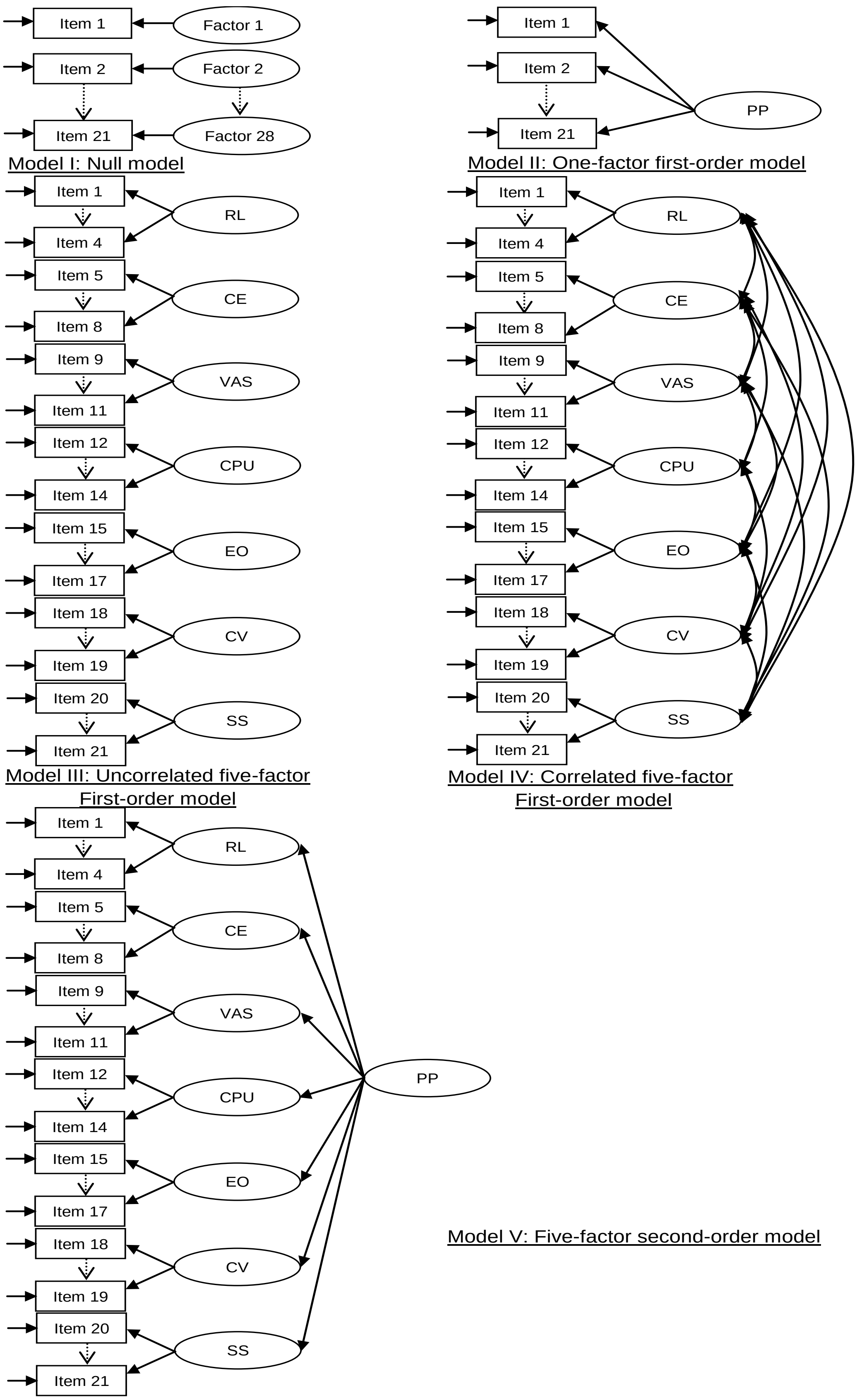


Table 7.19 Five model fit tests for PP

Criteria	Threshold	Model I	Model II	Model III	Model IV	Model V
χ^2/df	<5	-	12.493	-	1.195	1.185
CFI	>0.9	1.000	0.490	1.000	0.992	0.992
TLI	>0.9	-	0.434	-	0.990	0.991
SRMR	<0.08	-	0.124	-	0.023	0.034
RMSEA	<0.08	0.339	0.255	0.339	0.033	0.032

7.4 Structural model

Since a good model fit for the measurement model is confirmed and established in the previous sections, this study proceeds to evaluate the proposed structural model and examine the hypothesised relationships.

7.4.1 Structural equation modelling

SEM with maximum likelihood estimation (ML) was employed to test the direct effect of SCC on CA and PP in the relationship since it is a reasonably scale- and distribution-free procedure. First, model fit indices were satisfactory with χ^2/df=1.435 (2772.238/1932); CFI=0.940; TLI=0.937; RMSEA=0.050; SRMR=0.051 as a basis for assessing the proposed hypotheses. All the factor loadings of first-order factors on the high-order factors were significant at $p<0.001$. Besides, the factor loadings did not indicate significant differences in the measurement models, providing adequate validity and stability (Hair *et al.*, 2010).

The standardised regression weight from SCC to CA was 0.969, significant at 0.001. Therefore, H1 was accepted, implying that SCC positively influences CA in Korean containerised MLOs.

Hypothesis 1: Supply chain collaboration has a positive influence on collaborative advantage

Furthermore, the structural path from CA to PP was significant at the 0.05 level (γ=1.022). Therefore, the second hypothesis was supported.

Hypothesis 2: Collaborative advantage has a positive influence on port performance.

Finally, the third hypothesis was examined. The standardised coefficient from SCC to PP (γ=0.022) was not significant. Hence, the third hypothesis was rejected.

Hypothesis 3: Supply chain collaboration has a positive influence on PP

Figure 7.10 Structural model with second-order factors

Note: *** p<0.001; * p<0.05.

Table 7.20 Structural model results with second-order factors

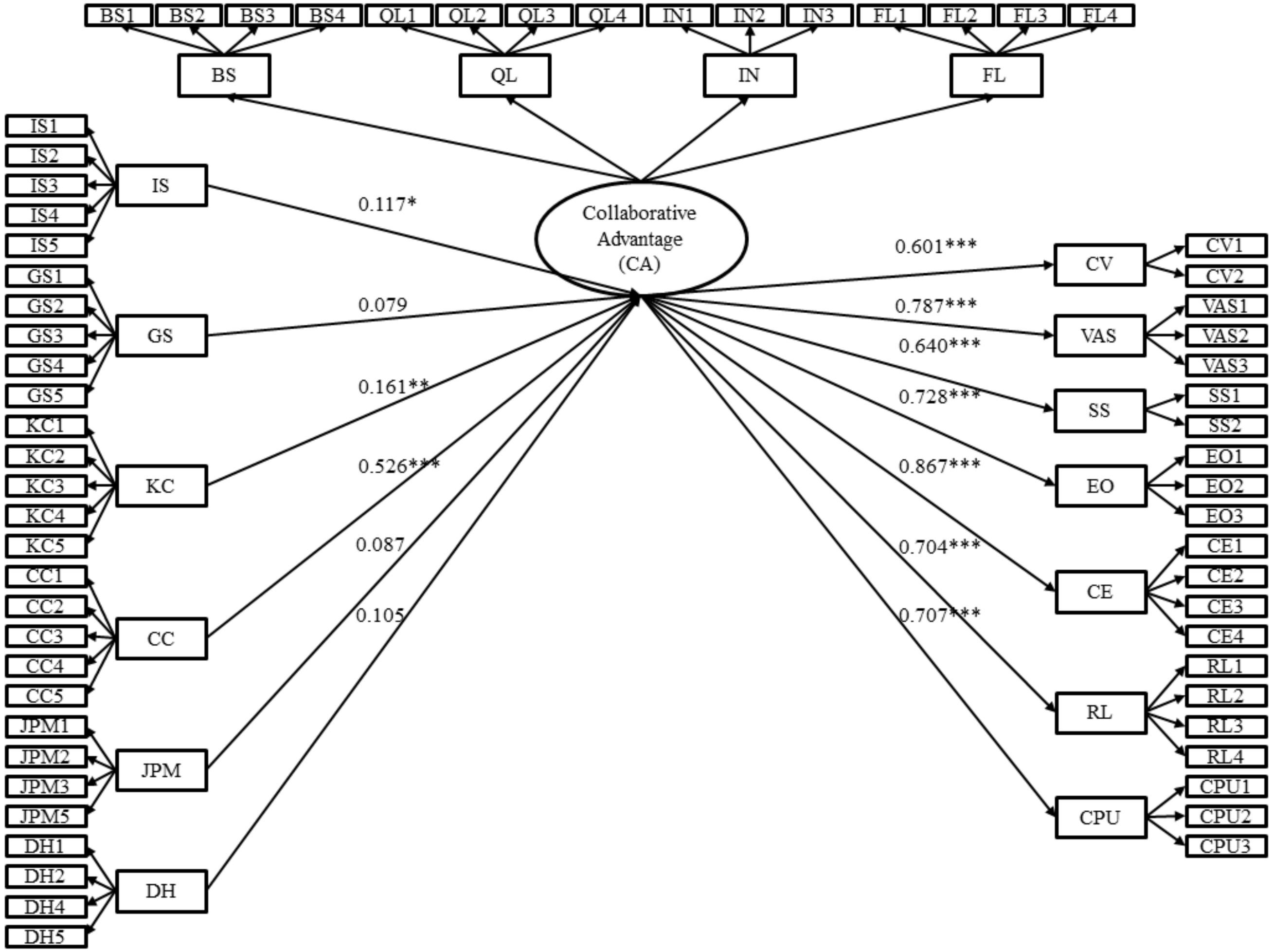
Path	Standardised regression weight	t-value	Accept/Reject
SCC → CA	0.969	9.043***	Accept
CA → PP	1.022	2.527*	Accept
SCC → PP	0.022	0.058	Reject
SCC → IS	0.821	10.735***	
SCC → CC	0.913	11.676***	
SCC →KC	0.834	10.673***	
SCC → DH	0.837	10.850***	
SCC → GS	0.814	-	
SCC → JPM	0.827	10.478***	
CA → BS	0.750	8.729***	
CA → QL	0.764	-	
CA → IN	0.890	10.225***	
CA → FL	0.795	8.968***	
PP → CV	0.593	7.765***	
PP → VAS	0.758	-	
PP → SS	0.630	8.203***	
PP → EO	0.713	8.987***	
PP → CE	0.875	11.505***	
PP → RL	0.679	8.703***	
PP → CPU	0.678	8.737***	
Overall goodness-of-fit indices χ^2/df=1.435 (2772.238/1932); CFI=0.940; TLI=0.937; RMSEA=0.050; SRMR=0.051			

Note: ***p<0.001; *p<0.05

7.4.2 Further structural models with first-order SCC and PP

In order to further investigate which first-order factors relatively have a positive impact on other variables, this section is dedicated to examining the causal relationships between each first-order factor of SCC and PP without considering the direct effect of SCC on PP. Therefore, those relationships are regarded as the antecedents and consequences of CA. Figure 7.11 illustrates the aforementioned relationships.

Figure 7.11 Structural model with first-order factors of SCC and PP



Note: ***p<0.001; **p<0.01; *p<0.05.

The overall model fit was acceptably good. The normed chi-square (1.434), CFI (0.940), TLI (0.937), RMSEA (0.049), SRMR (0.048) were all acceptable. The causal paths IS-CA, KC-CA and CC-CA are all significant at a 0.05 level with standardised regression weight ranged from 0.117 to 0.526, whereas other paths GS-CA, JPM-CA and DH-CA are not statistically supported. The effect of CC on CA was the most significant element amongst all relationships with the t-value 7.792. In addition, amongst the relationships between CA and PP, All paths (CA-CPU, CA-CE, CA-EO, CA-VAS, CA-SS, CA-CV and CA-RL) were significant at p<0.001 level.

Table 7.21 Structural model results with first-order factors of SCC and PP

Path	Standardised regression weight	t-value	Accept/Reject
IS → CA	.117	2.136*	Accept
GS → CA	.079	1.397	Reject
KC → CA	.161	2.780**	Accept
CC → CA	.526	7.792***	Accept
JPM → CA	.087	1.607	Reject
DH → CA	.105	1.809	Reject
CA → CV	.601	8.197***	Accept
CA → VAS	.787	11.246***	Accept
CA → SS	.640	8.704***	Accept
CA → EO	.728	-	Accept
CA → CE	.867	12.918***	Accept
CA → RL	.704	9.580***	Accept
CA → CPU	.707	9.693***	Accept
CA → BS	.763	10.406***	
CA → QL	.794	-	
CA → IN	.865	12.418***	
CA → FL	.806	10.787	

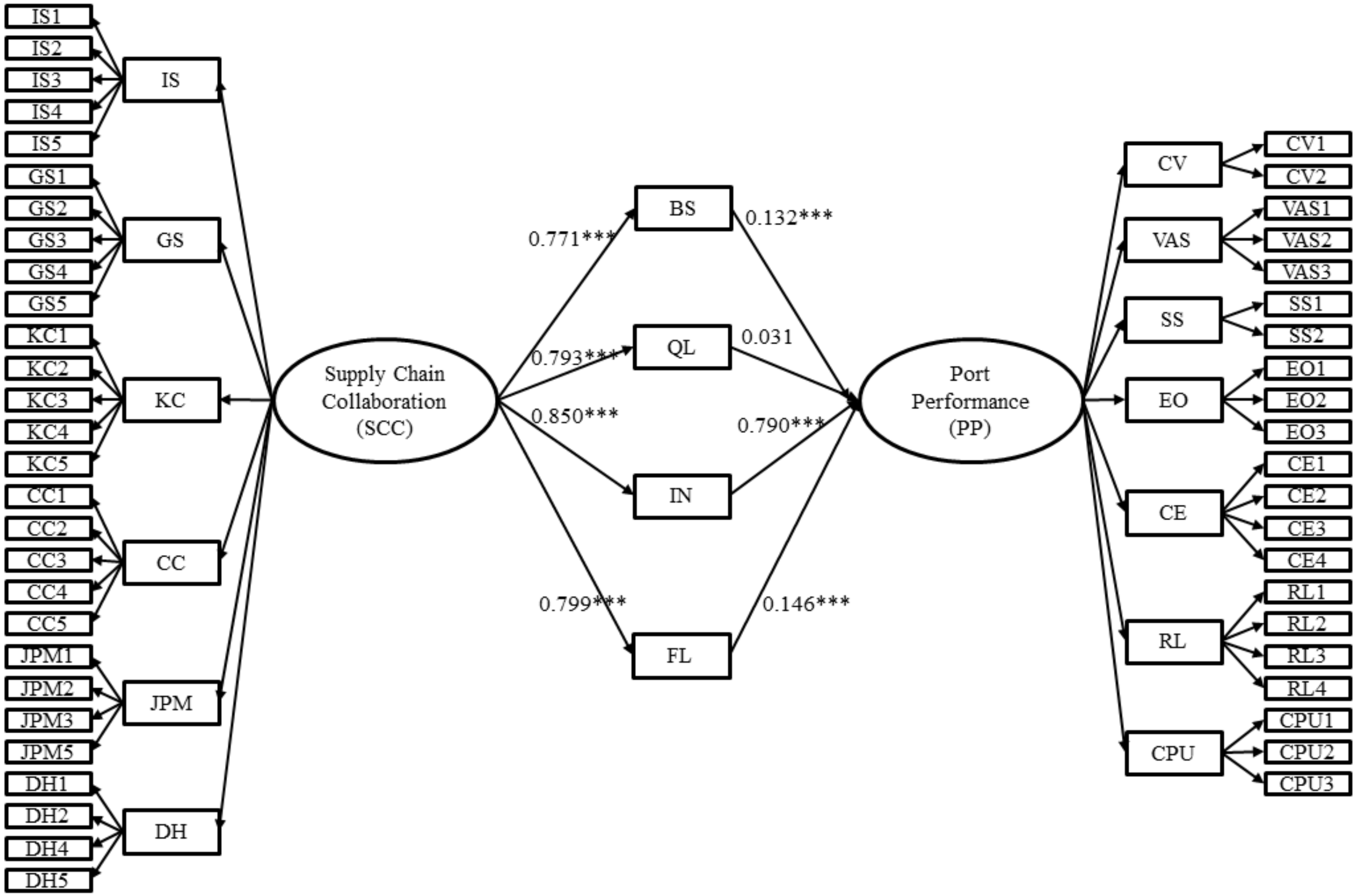
Overall goodness-of-fit indices
χ^2/df=1.434 (2754.010/1921); CFI=0.940; TLI=0.937; RMSEA=0.049; SRMR=0.048

Note: ***p<0.001; ** p<0.01; * p<0.05.

7.4.3 Further structural models with first-order of CA

For confirmatory purposes, this study also examined the structural model by dividing CA into BS, QL, IN and FL to accurately and simultaneously identify which sub-dimensions of CA do not have positive impact on PP and which sub-dimensions of CA are not positively affected by SCC without considering the direct impact of SCC on PP. The fitness indices (normed χ^2=1.439; TLI=0.937; CFI=0.939; RMSEA=0.050; SRMR=0.071) suggest that the structural model appears to be acceptable. All relationships were statistically significant except for the relationships between QL and PP. Interestingly, the non-significant impact of QL on PP appears to defy intuition.

Figure 7.12 Structural model with first-order factors of CC



Note: ***p<0.001.

Table 7.22 Structural model results with first-order factors of CC

Path	Standardised regression weight	t-value	Accept/Reject
SCC → BS	0.771	9.679***	Accept
SCC → QL	0.793	9.499***	Accept
SCC → IN	0.850	10.945***	Accept
SCC → FL	0.799	9.785***	Accept
BS → PP	0.132	3.389***	Accept
QL → PP	0.031	0.794	Reject
IN → PP	0.790	9.583***	Accept
FL → PP	0.146	3.524***	Accept
Overall goodness-of-fit indices χ^2/df=1.439 (2779.066/1931); CFI=0.939; TLI=0.937; RMSEA=0.050; SRMR=0.071			

Note: ***p<0.001.

7.4.4 Structural model with second-order factors focusing on mediation

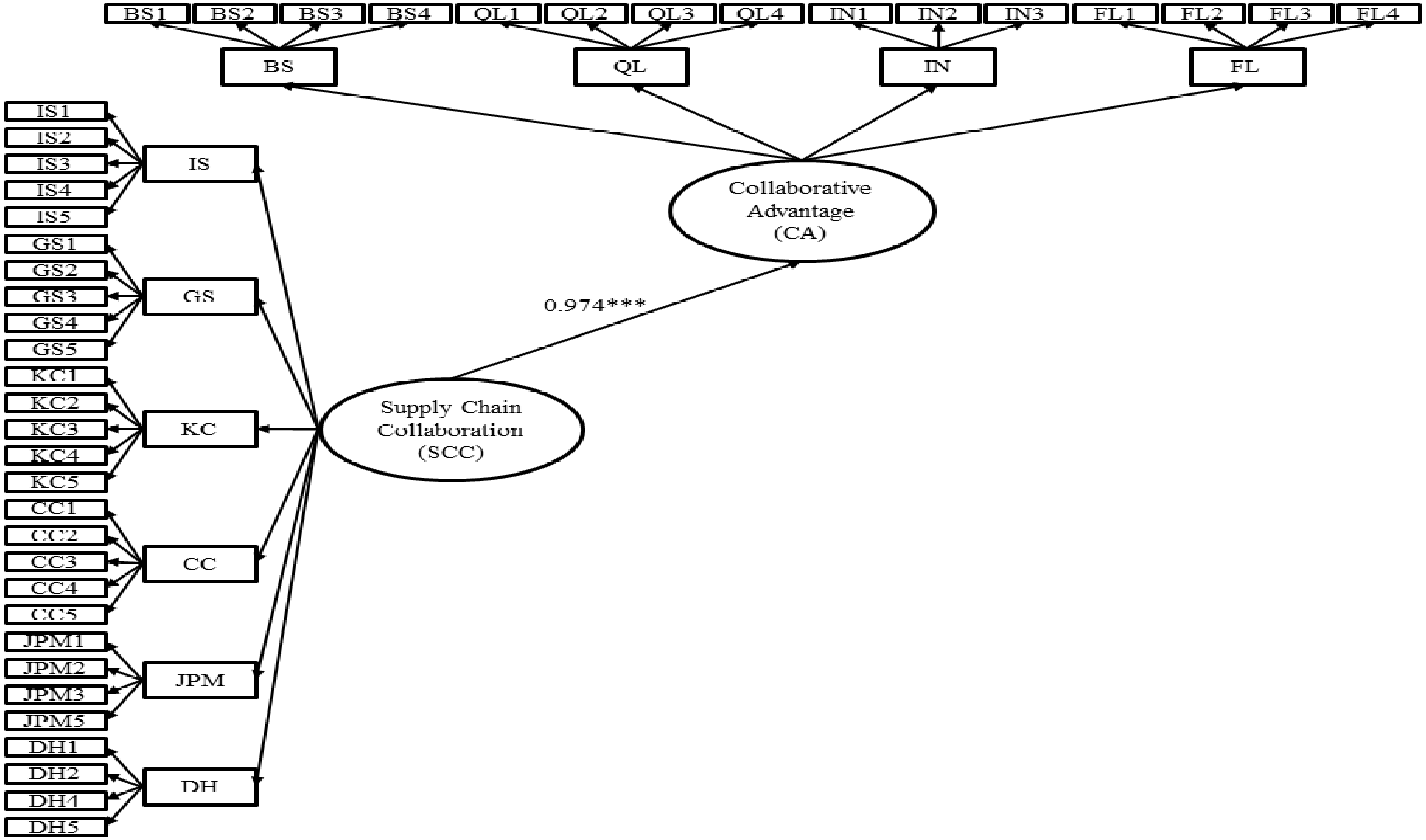
For confirmatory purposes, this study tests the mediation effect of CA on the relationship between SCC and PP. A mediating effect occurs when a third variable intervenes the relationship between two other related variables (Hair *et al.*, 2010). A mediation test can be implemented by correlation statistics and various methods of regression (i.e. hierarchical regression). However, investigating mediation effects by regression analysis may involve some problems in regard to measurement error of mediator scores, causing difficulty in modelling causation and viable reverse causation (Hopwood, 2007). SEM can reduce possible problems by decreasing measurement error via the introduction of latent variables. Using SEM is regarded as the most efficient way to test mediation effects rather than regression (Baron and Kenny, 1986), since SEM can estimate multiple equations simultaneously together by controlling measurement error.

To test the mediation effect, this study applied a hierarchical approach with the following three conditions suggested by Baron and Kenny (1986): (1) the independent variable must be significantly related to the mediating variable; (2)

the independent variable must influence the dependent variable; (3) the dependent variable must be significantly influenced by the mediator, and (4) after the mediator is introduced, the association between the independent variable and dependent variable must be decreased. If a relationship between independent variables and dependent variables is no longer significant due to the presence of the mediator, the mediator fully mediates this relationship. On the other hand, if there is a significant effect between them in the presence of the mediator, then the partial mediation is supported. In order to remain mediators, all of the above conditions must be fulfilled (Baron and Kenny, 1986, Hair *et al.*, 2010).

First, the direct impact of SCC on CA (Direct model 1) is tested whether or not pre-conditions for mediations are satisfied. The critical ratio of 9.485 with a 0.001 significant level shows a strong relationship between the independent variable (SCC) and mediator (CA). The standardised regression weight of SCC-CA (0.974) was also very strong. All factor loadings of each first-order factor on the corresponding second-order factors were sufficiently significant. The χ^2/df (1.357) represents an acceptable level for good indices. The value for CFI (0.966) and TLI (0.964) all exceed the recommended 0.9. The RMSEA (0.045) and SRMR (0.041) fall below the recommended 0.08 level.

Figure 7.13 Direct model 1



Note: ***p<0.001.

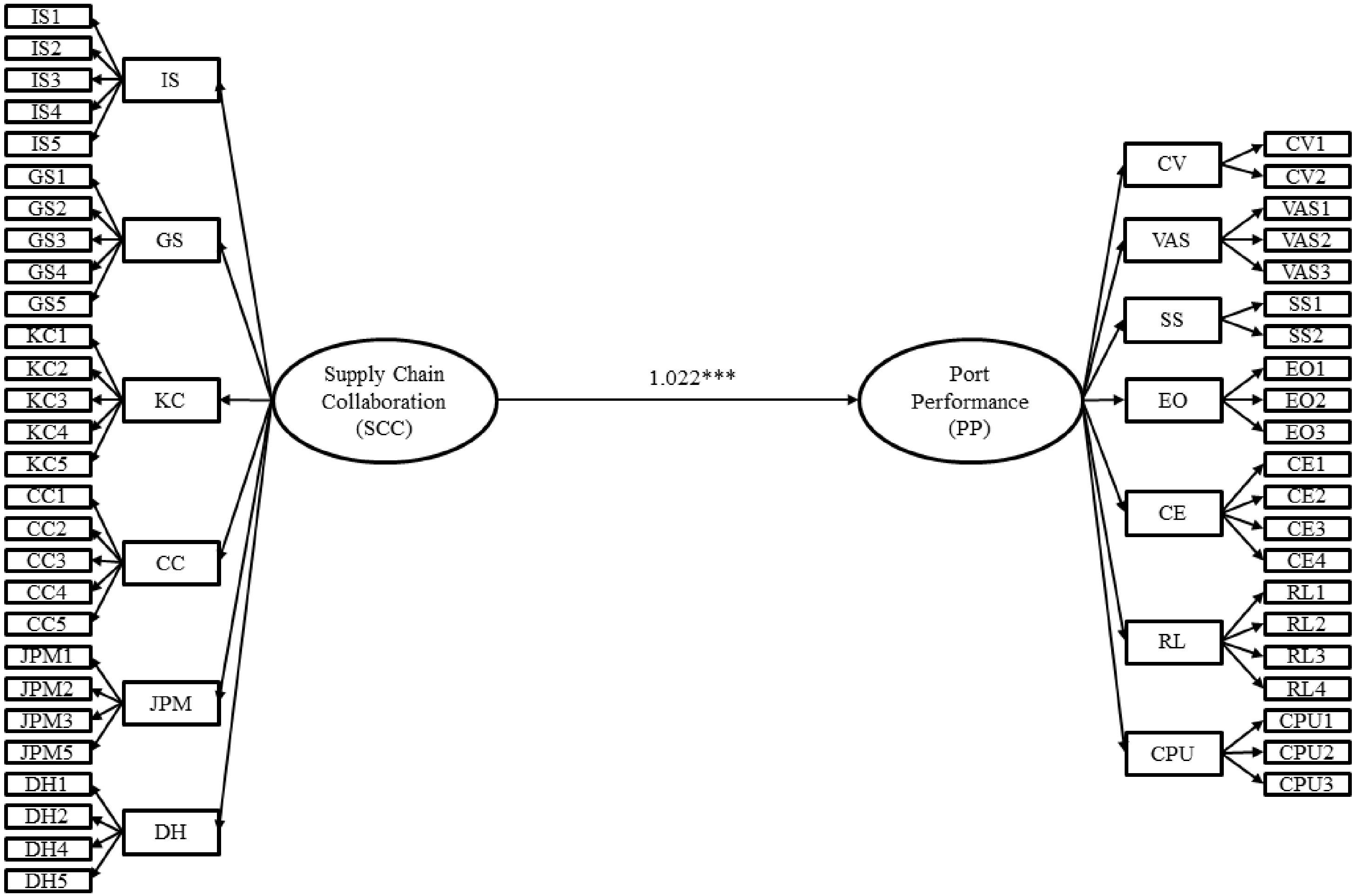
Table 7.23 Structural model results with direct model 1

Path	Standardised regression weight	t-value
SCC → CA	0.974	9.485***
SCC → IS	0.841	10.992***
SCC → GS	0.817	-
SCC → KC	0.850	10.842***
SCC → CC	0.895	11.422***
SCC → JPM	0.804	10.179***
SCC → DH	0.848	10.992***
CA → BS	0.777	9.267***
CA → QL	0.810	-
CA → IN	0.839	10.091***
CA → FL	0.808	9.397***
Overall goodness-of-fit indices χ^2/df=1.357 (1152.118/849); CFI=0.966; TLI=0.964; RMSEA=0.045; SRMR=0.041		

Note: ***p<0.001.

Second, the direct effect of SCC on PP (Direct model 2) is explored as shown in Figure 7.14. SCC are found to have significant relationships with PP (estimate= 1.022, p<0.001). All fit indices of direct model 2 are excellent. The normed chi-square at 1.378 is below the threshold level of 5, which suggests the differences in anticipated and actual matrices are insignificant and strongly proves the model's fitness to the data collected. CFI (0.959) and TLI (0.959) are much higher than the suggested threshold (0.9). RMSEA (0.046) and SRMR (0.047) are also far below the suggested standard (0.8). All factor loadings of each first-order factors on the corresponding second-order factors are statistically significant at the 0.001 level.

Figure 7.14 Direct model 2



Note: ***p<0.001.

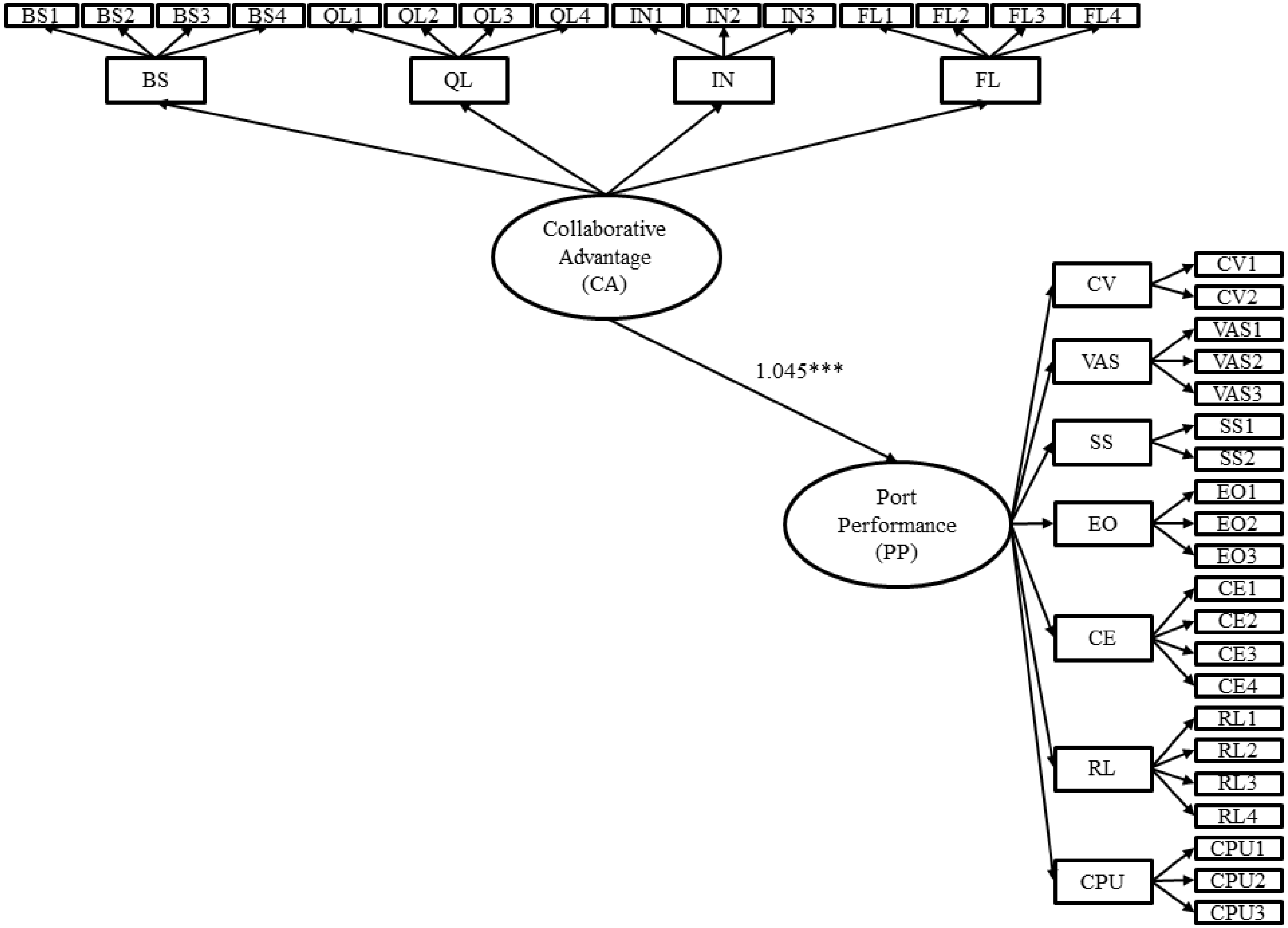
Table 7.24 Structural model results with direct model 2

Path	Standardised regression weight	t-value
SCC → PP	1.022	10.203***
SCC → IS	0.811	10.588***
SCC → GS	0.814	-
SCC → KC	0.829	10.617***
SCC → CC	0.912	11.653***
SCC → JPM	0.847	10.725***
SCC → DH	0.831	10.761***
PP → CV	0.591	7.676***
PP → VAS	0.770	-
PP → SS	0.641	8.186***
PP → EO	0.769	9.643***
PP → CE	0.816	10.740***
PP → RL	0.697	8.860***
PP → CPU	0.690	8.817***
Overall goodness-of-fit indices χ^2/df=1.378; CFI= 0.961; TLI= 0.959; RMSEA=0.046; SRMR=0.047		

Note: ***p<0.001.

Third, the relationship between mediator (CA) and dependent variable (PP) (Direct model 3) was examined to test direct effect without the presence of independent variable. Path CA-PP was statistically significant at $p<0.001$ with the critical ratio of 8.080. The standardised regression weight was 1.045, suggesting that the direct effect of mediator (CA) on dependent variable (PP) is strong. All factor loadings of first-order factors on the corresponding second-order factors were also very strong (0.601-0.942). The overall model fit of indices was highly acceptable: χ^2/df=1.391; CFI=0.969; TLI=0.966; RMSEA=0.047; SRMR=0.066.

Figure 7.15 Direct model 3



Note: ***p<0.001.

Table 7.25 Structural model results with direct model 3

Path	Standardised regression weight	t-value
CA → PP	1.045	9.200***
CA → BS	0.711	10.427***
CA → QL	0.716	9.988***
CA → IN	0.941	-
CA → FL	0.762	11.037***
PP → CV	0.573	6.508***
PP → VAS	0.693	7.545***
PP → SS	0.601	6.813***
PP → EO	0.647	-
PP → CE	0.942	9.180***
PP → RL	0.640	6.964***
PP → CPU	0.668	7.271***
Overall goodness-of-fit indices χ^2/df=1.391 (809.411/582); CFI=0.969; TLI=0.966; RMSEA=0.047; SRMR=0.064		

Note: *** p<0.001.

Fourth, testing for mediation needs to consider the original direct impact associations between the independent (SCC) and dependent variables (CA). The effect of full mediation structural model (Model 4) is tested by adding mediator (CA) in the relationship between independent variables (SCC) and dependent variables (PP). All fit indices are sufficiently supported. Normed chi-square was 1.435. CFI and TLI were 0.940 and 0.937 respectively. RMSEA (0.050) and SRMR (0.051) were also far lower than the threshold 0.08. To test whether mediation exists or not, four conditions should be met suggested by Baron and Kenny (1986). The condition (1) was supported in direct model 1 whilst condition (2) was certified by direct model 2. Direct model 3 was dedicated to showing an evidence for condition (3). Once confirmed these conditions, identifying the path from independent variable SCC to dependent variable PP is required. Model 4 shows that the significant direct association of SCC to PP (t-value: 10.230) now become statistically insignificant (t-value: 0.058) compared to direct model 2. In other words, the significant coefficients are decreased to zero in the presence of mediator CA. Hence, this result indicates strong evidence of full mediation the relationship between SCC and PP.

Figure 7.16 Model 4

Note: ***p<0.001; *p<0.05.

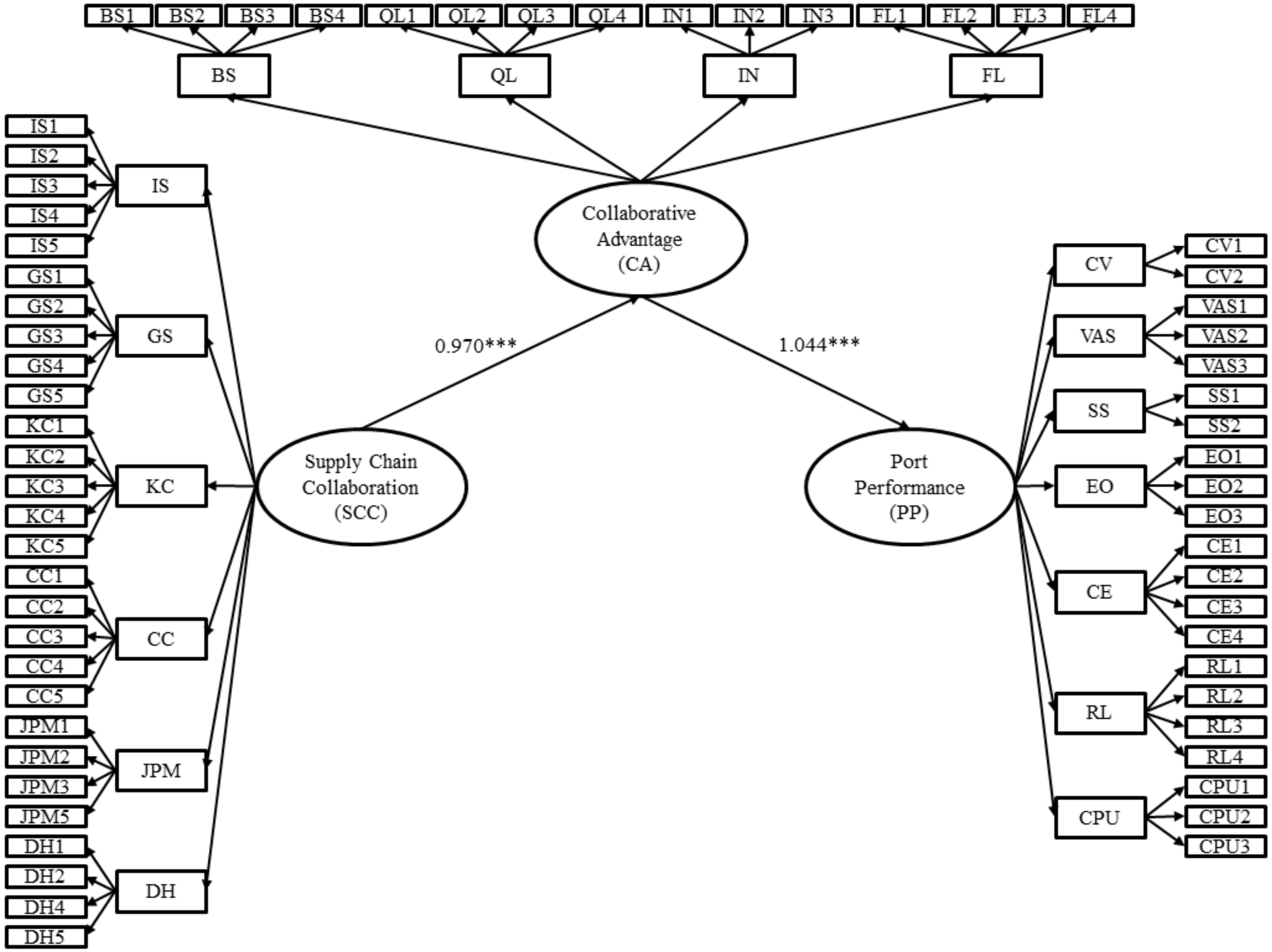
Table 7.26 Structural model results with model 4

Path	Standardised regression weight	t-value
SCC → CA	0.969	9.043***
CA → PP	1.022	2.527*
SCC → PP	0.022	0.058
SCC → IS	0.821	10.735***
SCC → CC	0.913	11.676***
SCC →KC	0.834	10.673***
SCC → DH	0.837	10.850***
SCC → GS	0.814	-
SCC → JPM	0.827	10.478***
CA → BS	0.750	8.729***
CA → QL	0.764	-
CA → IN	0.890	10.225***
CA → FL	0.795	8.968***
PP → CV	0.593	7.765***
PP → VAS	0.758	-
PP → SS	0.630	8.203***
PP → EO	0.713	8.987***
PP → CE	0.875	11.505***
PP → RL	0.679	8.703***
PP → CPU	0.678	8.737***
Overall goodness-of-fit indices χ^2/df=1.435 (2772.238/1932); CFI=0.940; TLI=0.937; RMSEA=0.050; SRMR=0.051		

Note: *** p<0.001; * p<0.05.

Finally, this study attempts to test full mediation of the structural model (model 5) to grasp the difference from Model 4. All fit of indices and chi-square difference ($\Delta\chi^2$=0.003; Δdf=1) between partial and full mediation is not statistically significant at the 95 percent level. Therefore, this shows strong evidence of full mediation.

Figure 7.17 Model 5



Note: ***p<0.001.

Table 7.27 Structural model results with model 5

Path	Standardised regression weight	t-value
SCC → CA	0.970	9.054***
CA → PP	1.044	9.303***
SCC → IS	0.821	10.736***
SCC → GS	0.814	-
SCC → KC	0.834	10.674***
SCC → CC	0.913	11.675***
SCC → JPM	0.827	10.476***
SCC → DH	0.837	10.851***
CA → BS	0.750	8.724***
CA → QL	0.764	-
CA → IN	0.890	10.219***
CA → FL	0.795	8.962***
PP → CV	0.593	7.764***
PP → VAS	0.757	-
PP → SS	0.630	8.202***
PP → EO	0.713	8.983***
PP → CE	0.875	11.506***
PP → RL	0.679	8.701***
PP → CPU	0.679	8.736***
Overall goodness-of-fit indices χ^2/df=1.434 (2772.241/1933); CFI=0.940; TLI=0.937; RMSEA=0.050; SRMR=0.051		

Note: ***p<0.001.

Via comparisons between Model 1-5, the full mediation effect of CA is certified. Table 7.28 shows that Model 1-5 consistently has good fit indices, suggesting that the model appropriately fits the data. The causal path SCC-CA was positive and significant at p<0.001, which met condition (1), whilst condition (2) is also satisfied by showing that the causal relationship between SCC-PP is positively significant at a 0.001 level. In addition, because Model 3 verified a positive association between CA and PP with significant standardised regression weight (1.045) at p<0.001, it proves the condition (3). Finally, after the introduction of a mediator (CA) in the relationship between the independent (SCC) and dependant variable (PP), the direct impact of SCC on PP is no longer significant (the standardised parameter estimates decreased from 1.022 to 0.022).

Consequently, these results conclude that the association between SCC and PP is fully mediated by CA.

Table 7.28 Comparison between model 1-5

Model element	Direct model 1 (SCC → CA)	Direct model 2 (SCC → PP)	Direct model 3 (CA → PP)	Model 4 (partial mediation)	Model 5 (full mediation)
Model fit					
χ^2/df	1.357	1.378	1.391	1.435	1.434
CFI	0.966	0.961	0.969	0.940	0.940
TLI	0.964	0.959	0.966	0.937	0.937
RMSEA	0.045	0.046	0.047	0.050	0.050
SRMR	0.041	0.047	0.066	0051	0.051
Standardised regression weight					
SCC → PP	NE	1.022***	NE	0.022	NE
SCC → CA	0.974***	NE	NE	0.969***	0.970***
CA → PP	NE	NE	1.045***	1.022*	1.044***

Note: ***p<0.001; **p<0.01; *p<0.05; NE: not estimated

To identify whether a moderating effect of CA on the relationship between SCC and PP exists or not, this study has applied a hierarchical approach recommended by Baron and Kenny (1986). However, to accurately and thoroughly establish a mediation relationship, this study also conducts a bootstrapping test to examine an indirect relationship, since a bootstrapping test is a non-parametric method based on resampling with replacement for estimation and hypothesis testing (Preacher *et al.*, 2007). It is believed that the bootstrapping test is more reliable than Baron and Kenny (1986)' tests and Sobel (1982)'s test in accurately identifying the mediating relationship (Zhao *et al.*, 2010). Therefore, this study tested 2000 bootstrapped samples at a 90 percent confidence level as Qrunfleh and Tarafdar (2013) suggested.

The first step in assessing the hypotheses is to check the direct effect of SCC on PP aside from a mediating variable (CA). The estimate of the regression weight from SCC to PP is 1.022, which is significant at a 0.001 level. Besides, the beta value from SCC to CA is 0.974, which is significant at the 0.001 level. As a next step, the direct effect of SCC on PP with presence of the mediating variable (CA) is investigated. Standardised direct effect value of SCC on PP is 0.022. Then, the focus goes to the bootstrap confidence (bias-corrected percentile method) to identify whether the value is significant. It turns out that the standardised direct effect is not significant at the 0.05 level. Subsequently, the indirect effect of CA on PP with the attendance of the mediating variable (CA) is observed. The standardised indirect effect of this value is 0.990, which is significant at the 0.01 level. The result implies that CA fully mediates the relationship between SCC and PP, which is consistent with the hierarchy approach suggested by Baron and Kenny (1986). All abovementioned results are summarised in Table 7.29.

Table 7.29 Bootstrapping test

Hypothesis	Direct beta w/o Med	Direct beta w/Med	Indirect beta	Mediation type	Significant
SCC→CA	0.976***	NE	NE	NE	Yes
SCC→PP	1.032***	NE	NE	NE	Yes
CA→PP	1.045***	NE	NE	NE	Yes
CA mediates SCC→PP	1.032***	0.022 (NS)	0.990**	Full mediation	Yes

Note: ***p<0.001; NE: not estimated; NS: not significant.

7.5 Summary

This chapter conducted the empirical analysis. After screening multivariate normality, outliers and missing data, EFA was undertaken to determine to what extent the observed variables are linked to their corresponding constructs. Before implementing the structural model, the measurement model was examined. At the measurement stage, all constructs were successfully validated with proper goodness-of-fits, reliability and validity. In addition, five models of all constructs provided an adequate representation of the model structure of their scales. By checking T coefficient, the second-order model of all constructs was statistically justified.

Subsequently, the structural model was evaluated because a good model fit for the measurement model is confirmed and established. Amongst three hypotheses, H1 and H2 were accepted, whilst H3 was rejected. In order to further examine which first-order factors relatively have a positive impact on other variables, the more detailed structural model between each first-order factor of SCC and PP without considering the direct effect of SCC on PP was examined. Additionally, this study tested the structural model by dividing CA into BS, QL, IN and FL to accurately and simultaneously identify which sub-dimensions of CA do not have positive impact on PP and which dimensions of

CA are not positively affected by SCC without considering the direct impact of SCC on PP. Finally, two kinds of mediation test were undertaken as Baron and Kenny (1986) and Qrunfleh and Tarafdar (2013) suggested. The result suggested that the association between SCC and PP is fully mediated by CA.

Chapter 8. Discussion and conclusion

The primary objective of this study is to examine the causal relationships between supply chain collaboration (SCC), collaborative advantage (CA) and port performance (PP) in containerised maritime logistics organisations (MLOs). In order to fill research gap, this study proposed conceptual models and developed hypotheses. Subsequently, this study empirically examined the proposed hypotheses. The rigorous literature reviews aimed to develop the conceptual model (chapter 3 and 4), operationalise constructs (chapter 4) and provide a theoretical foundation. The research model of this study was developed both from literature review in the maritime and SCM context and in-depth discussions in South Korea (chapter 4 and 5), proposing research hypotheses tested in the empirical study. Chapter 6 provided a descriptive analysis based survey responses. Next, the proposed research model and hypotheses were tested by structural equation modelling (SEM). Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to examine unidimensionality, reliability and validity of each measurement, and causal relationships between constructs were assessed (chapter 7).

8.1 Research findings

The main research questions of this study displayed in chapter 1 are as follows.

Research Question 1. What are the major activities and dimensions of supply chain collaboration in the containerised maritime context?

Research Question 2. What are the dimensions of collaborative advantage and port performance in the containerised maritime context?

Research Question 3. How and to what extent does supply chain collaboration influence collaborative advantage in the containerised maritime context?

Research Question 4. How and to what extent does collaborative advantage influence port performance in the containerised maritime context?

Research Question 5. How and to what extent does supply chain collaboration influence port performance in the containerised maritime context?

Research questions 1 and 2 were addressed in the literature reviews and model development process in chapter 3 and 4. In addition, SCC, CA and PP constructs were operationalised in those chapters. Then, chapter 6 was devoted to conduct a descriptive analysis in order to capture the respondents' profile and perception gaps between port service providers and port users. Subsequently, this study tested a measurement models for reliability and validity of SCC, CA and PP constructs by employing both EFA and CFA in chapter 7. The rest of research questions 3, 4, and 5 were addressed in chapter 7 by using structural equation modelling. The proposed hypotheses for this study were as follows:

Hypothesis 1: Supply chain collaboration has a positive influence on collaborative advantage.

Hypothesis 2: Collaborative advantage has a positive influence on port performance.

Hypothesis 3: Supply chain collaboration has a positive influence on port performance.

Research questions 3, 4 and 5 were converted into hypotheses 1, 2 and 3 respectively. All research hypotheses were empirically tested in chapter 7.

8.1.1 Research question 1: major activities and dimensions of SCC

SCC is defined as a multifaceted concept which defines the extent to which ports collaborate with port users in the six dimensions identified in this study. SCC involves management of multiple collaboration processes and relationships whereby ports and port users jointly work to ensure the provision of reliability, punctuality, value-added services, productivity and high supply chain performance in an effort to satisfy final customers' needs by creating synergies that are greater than organisations would gain individually. The measurement of SCC in maritime logistics requires inclusion of collaboration which recognises mutual interests between ports and port users and also reflects the nature of the maritime industry. The parameters identified in the current SCC and maritime literature to develop the concept of SCC in containerised maritime logistics include 'information sharing (IS)', 'knowledge creation (KC)', 'collaborative communication (CC)', 'goal similarity (GS)', 'decision harmonisation (DH)', 'joint supply chain performance measurement (JPM)' as well as using comprehensive, rigorous and systematic procedures such as item review, sorting, Q-sorting techniques and pilot test. The CFA results suggest that SCC is a multidimensional construct which cannot be measured by one dimension. In other words, SCC has six dimensions that exist independently but are highly correlated in the same direction. The great coefficient paths from SCC to first-order factors indicate the rationalisation of six sub-dimension of SCC.

Consequently, a terminal operator with a high level of SCC should (1) share information in performing maritime transport services with port users, contributing to supply chain visibility and sharing frequent, relevant and accurate information that may assist supply chain partners; (2) develop and create knowledge that may be useful for their port supply chain by working together; (3) have frequent and two-way communication to help relevant port users to formulate their strategy and decision-making; (4) pursue a similar goal that helps to enhance the efficiency and effectiveness of whole port supply chains; (5) synchronise decisions in arranging transport plans and operations in an attempt to optimise port supply chains; and (6) jointly measure and manage supply chain performance in common with port supply chain partners.

First of all, the specific activities of the information sharing as a sub-dimension of SCC between ports and port users includes (1) the provision of information that might help both of them within their port supply chain; (2) frequent information exchange within their port supply chain; (3) the provision of information about each other of changing needs in advance within their port supply chain; (4) the provision of information about events or changes that may affect the other within their port supply chain; and (5) accurate information exchange within their port supply chain.

As a second sub-component of SCC between the ports and port users, the particular activities of knowledge creation encompass (1) searching and acquiring new and relevant knowledge within their port supply chain; (2) assimilating and applying relevant knowledge within their port supply chain; (3) identifying customer needs for their port supply chain; (4) discovering new technology for their port supply chain; and (5) learning the intensions and capabilities of other port supply chains in competition.

The collaborative communication is selected as the third facet of the SCC construct. The underlying actions incorporate (1) frequent contacts on a regular basis for their port supply chain; (2) open and two way communications for their port supply chain; (3) informal communication for their port supply chain; (4) many different channels to communicate for their port supply chain; and (5) influence on each other's decisions through discussion for their port supply chain.

The fourth element of the SCC activity is goal similarity. The five factors of the goal similarity represent (1) the pursuit of efficient multi-modal transport of container cargoes for their port supply chain; (2) the emphasis on the importance of collaboration within their port supply chain; (3) the pursuit of the provision of value-added logistics services for their port supply chain; (4) the pursuit of cost reduction through their port supply chain; and (5) the pursuit of reduced cycle times and enhanced inventory management for their port supply chain.

Fifth, the sub-component of SCC in the containerised maritime context is decision harmonisation that deals with (1) planning on emergent situations within their port supply chain; (2) planning on altering schedules and amending orders when customers demand them within their port supply chain; (3) planning on transport planning and scheduling transport within their port supply chain; and (4) advising each other of any potential problems in meeting the shipper's needs within their port supply chain.

Finally, the joint supply chain performance measurement is categorised as a last element of SCC between ports and port users. It embraces (1) developing systems to evaluate supply chain performance for their port supply chain; (2) dealing with security and risks that may occur for their port supply chain; (3) developing systems to enable shippers to identify their cargoes' location for their port supply chain; and (4) solving the problems together (e.g. delay and accidents in transport) for their port supply chain.

8.1.2 Research question 2: dimensions of CA and PP in the containerised maritime context

Collaborative advantage in this study is defined as a relational view of joint competitive advantage resulting from collaborative activities between ports and port users. Four dimensions of collaborative advantage in the containerised maritime context were identified in chapter 4. The parameters captured for this study to develop and validate the collaborative advantage concept encompass ‘business synergy (BS)’, ‘quality (QL)’, ‘innovation (IN)’, and ‘flexibility (FL)’ through comprehensive, rigorous and systematic processes such as literature review, item review, sorting, Q-sorting techniques and pilot test. The result of CFA suggests that collaborative advantage is a multi-faceted construct that cannot be reflected by one dimension. Collaborative advantage has four dimensions that exist independently but are highly correlated in the same direction. The high standardised regression weights from collaborative advantage to each first-order factor provide the evidence of four sub-dimension of collaborative advantage. Therefore, a containerised MLO can achieve higher collaborative advantage by having business synergy, quality, innovation and flexibility.

Firstly, business synergy is defined as the extent to which ports and port users combine complementary and relevant activities and efforts to gain supernormal benefits. The detailed characteristics of business synergy as a sub-dimension of collaborative advantage between ports and port users encompass having (1) an integrated IT infrastructure for their port supply chain; (2) integrated knowledge bases and know-how for their port supply chain; (3) integrated marketing efforts for their port supply chain; and (4) integrated services for their port supply chain.

As a second sub-component of collaborative advantage, quality is defined as the extent to which ports and port users provide service quality that builds the higher value for the shippers. The particular traits of quality include (1) the provision of highly reliable services for their port supply chain; (2) the provision of highly punctual services for their port supply chain; (3) the provision of high quality services to the customers for their port supply chain; and helping each other to improve service quality for their port supply chain for their port supply chain.

The third element of the collaborative advantage is innovation, which refers to the extent to which a port works jointly with port users in quickly initiating and boosting new services and processes. The three factors of innovation between ports and port users represent (1) the introduction of new services to market quickly for their port supply chain; (2) having rapid new services development for their port supply chain; (3) innovating frequently (e.g. state-of-the art communication systems, latest skills for faster container transport) for their port supply chain.

Flexibility is categorised as a last element of collaborative advantage between ports and port users. Flexibility refers to the extent to which the port and port users supports the provision of diverse services in response to changes of the final customer’s needs. It embraces (1) the provision of a variety of services efficiently for their port supply chain; (2) the provision of customised services with different features quickly for their port supply chain; (3) meeting different customer demands efficiently for their port supply chain; and (4) having good customer responsiveness for their supply chain for their port supply chain.

As for port performance, this study also assumes that the measurements of port performance are multidimensional variables that both reflect diverse factors and involve the interests of various port users. A total of seven dimensions of port performance were derived and developed from the prior literature followed by in-depth discussions with academics and practitioners in containerised MLOs in South Korea. The CFA result suggests that port performance is a multi-dimensional construct that cannot be grasped by one dimension. In other words, port performance has seven dimensions that exist independently but are highly correlated in the same direction. The high standardised coefficients from port performance to first-order factors provide evidence for seven sub-dimensions of port performance. Therefore, ports can increase port performance by retaining connectivity, value-added service, safety and security, efficient operation, cost efficiency, reliability and convenience of port users.

Firstly, the detailed characteristics of connectivity (CV) as a sub-dimension of port performance include (1) good capacity of inland transport services; and (2) short transport time to hinterland. As a second sub-component of port performance, the indicators of value-added service (VAS) include (1) the cargo attraction by VAS (warehousing); (2) increased VA by VAS; and (3) adequate facility for VAS. The third element of the port performance is safety and security (SS). Two factors of safety and security (SS) represent (1) compliance with security regulations; and (2) the small number of accidents. Efficient operation (EO) is categorised as a fourth element of port performance. It embraces (1) high terminal productivity; (2) short port turnaround time (ship waiting time due to congestion); and (3) long port operating hours (24/7/365). As a fifth component of port performance, cost efficiency (CE) incorporates (1) low total price; (2) low cargo handling charge; (3) low auxiliary service charge (pilotage, towage and customers); and (4) low cost of inland transport services. The sixth factor of port performance is reliability (RL), which is measured by (1) handling cargo on quoted or anticipated time; (2) handling cargo on time customers require; (3) short port service lead time; and (4) the provision of accurate shipment information. The final sub-component of port performance is convenience of port users (CPU), which can be evaluated by (1) good information technology ability (EDI; port-MIS); (2) easy and fast operation process for port users; and (3) convenience of custom procedures.

8.1.3 Hypotheses testing

As for research question 3, 4 and 5, those relationships were empirically examined in chapter 7. The findings are presented in this section.

8.1.3.1 Impact of SCC on CA: research question 3

The proposed hypothesis was accepted, as the structural model indicated that SCC has a positive influence on collaborative advantage. The level of impact was revealed to be strong, since the regression weight was 0.890 (γ=0.969), which was statistically significant at a 0.001 level. This result implies that SCC is to increase the level of SCC by 0.890 with one level of increase in five-Likert scales. The result suggests that collaborative advantage is significantly enhanced by the role of SCC between the port and port users in the containerised maritime context.

Apart from the main analysis, this study also tested the relationships between six sub-components of SCC and the higher order of collaborative advantage as shown in section 7.4.2, chapter 7 in an attempt to compare the higher-order and first-order factors of structural models. The relationships of IS-CA (γ=0.117), KC-CA (γ=0.161) and CC-CA (γ=0.526) were supported, whereas the associations of GS-CA (γ=0.079), JPM-CA (γ=0.087), DH-CA (γ=0.105) were not significant. This result is partly consistent with the higher-order structural model that indicated the positive impact of SCC on collaborative advantage. This result also typically demonstrates that the higher-order factors tend to be superior in terms of nomological validity, showing that the effect of three sub-components of SCC on collaborative advantage was not certified. Although it turns out that three first-order factors do not improve collaborative advantage, it is difficult to suggest that the ports and port users possess a higher degree of SCC only because they have a high degree of either information sharing, knowledge creation or collaborative communication. Therefore, it is inferred that the ports and port users should make an effort to cover all six sub-dimensions of SCC at the same time for improved collaborative advantage when they undertake the SCC practices.

Additionally, for confirmatory purposes, this study inspects the impact of the higher-order of SCC on the first-order factors of collaborative advantage in order to accurately and to simultaneously identify which sub-dimensions of collaborative advantage were not increased by SCC. All direct impacts of SCC-BS (γ=0.771), SCC-QL (γ=0.793), SCC-IN (γ=0.850) and SCC-FL (γ=0.799) were statistically significant at the 0.001 level. This result implies that the SCC activities between ports and port users can contribute to better business synergy, quality, innovation and flexibility. Consequently, the port should collaborate with port users for enhancing business synergy, quality, innovation and flexibility as crucial sub-element factors of collaborative advantage.

8.1.3.2 Impact of CA on PP: research question 4

The proposed association from collaborative advantage to port performance was found to be significant, since the standardised coefficient from collaborative advantage to port performance was statistically significant at a 0.05 level (regression weight=1.331, γ=1.022). Therefore, the proposed hypothesis was accepted, implying that collaborative advantage has a positive influence on port performance. In addition, it is expected that port performance is improved by 1.331 points in five-Likert scales by one point of increase of collaborative advantage. This result demonstrates that port performance is positively improved by the role of collaborative advantage between the ports and port users in the containerised maritime context.

Aside from the main structural model, this work also evaluated the association from collaborative advantage to seven sub-dimensions of port performance to compare the higher-order and first-order factors of structural models as displayed in section 7.4.2, chapter 7. Notably, the associations of CA-CV (γ=0.601), CA-VAS (γ=0.787), CA-SS (γ=0.640), CA-EO (γ=0.728), CA-CE (γ=0.867), CA-RL (γ=0.704) and CA-CPU (γ=0.707) were all significant at the 0.001 level. The result is fully consistent with the higher-order structural model's result. Therefore, it is concluded that seven-dimensions of port performance can be enhanced by the higher level of collaborative advantage between ports and port users.

Furthermore, for confirmatory purposes, this study tested the relationships between the sub-dimensions of collaborative advantage and higher-order of port performance to accurately and simultaneously investigate whether or not each sub-dimension of collaborative advantage positively affects the higher-order of port performance. All direct impacts of BS-PP (γ=0.132), IN-PP (γ=0.790) and FL-PP (γ=0.146) were statistically significant at the 0.001 level except for QL-PP (γ=0.031). This result is partly in line with the higher-order structural model that provides evidence for direct impact of collaborative advantage on port performance. This result also typically shows that the higher-order factors are likely to be excellent in terms of nomological validity, because the effect of one sub-component of collaborative advantage (QL-PP) on port performance was not ensured. Although only one factor (quality) of collaborative advantage does not have a positive impact on port performance, it is unlikely to say that higher degree of port performance can be gained only due to the high degree either business synergy, innovation or flexibility. Therefore, it is implied that the port should emphasise the importance of all four sub-dimensions of collaborative advantage simultaneously to enhance port performance.

8.1.3.3 Impact of SCC on PP: research question 5

Interestingly, the proposed hypothesis for the direct impact of SCC on port performance was revealed to be statistically insignificant, which indicates that port performance is not improved by the direct impact of SCC. The regression weight was 0.027 (γ=0.022), which is not significant at a 95 percent level.

Therefore, the proposed hypothesis was rejected, implying that SCC has no direct positive impact on port performance.

There were strong positive relationships between SCC and collaborative advantage, and collaborative advantage and port performance respectively, but the empirical evidence suggests that the path from SCC to port performance was statistically rejected. Therefore, for confirmatory purposes, it is worthwhile investigating a mediating role of collaborative advantage on the association between SCC and port performance. In fact, this investigation explains how SCC between the port and port user enhances port performance by achieving collaborative advantage between them. To confirm the mediation effect, this study applied a hierarchical approach as Baron and Kenny (1986) recommended. Through comparisons between model 1-5 in section 7.4.4 in chapter 7, it is discovered that the full mediation effect of collaborative advantage on the relationship between SCC and port performance is confirmed by satisfying all conditions Baron and Kenny (1986) suggested. Therefore, the higher degree of SCC between the port and port user enables them to gain the higher degree of collaborative advantage, and, in turn, this collaborative advantage can contribute to augmenting better port performance.

8.2 Implications

This study contributes to benefitting the theories in SCM and academics and practitioners in the containerised maritime logistics industry with various theoretical and managerial implications.

8.2.1 Contribution to theories

The theoretical underpinning of transaction cost theory (TCT), resource based theory (RBT) and relational view (RV) are grounds for further understanding of role of SCC and collaborative advantage for this study.

To reduce associated costs and problems from both hierarchies and markets, SCC is known as the third alternative way of organising them (Koh and Venkatraman, 1991). Internalising activities which are not their competencies could be shunned by SCC (Cao and Zhang, 2011). In addition, SCC may enable organisations to minimise the opportunism and monitoring costs during market transactions via enhanced and integrated systems and trust (Croom, 2001). In this regard, the prevalent forms of SCC may be well explained by TCT.

This study has also adopted RBT to examine causal relationship between SCC, collaborative advantage and port performance in the containerised maritime context. RBT well explained the proposed hypotheses by providing useful explanations of the MLO's strategic behaviours and its outcomes. Collaborative supply chains cultivate the processes to identify, integrate and exploit various resources along the supply chains for generating unique customer value (Fawcett *et al.*, 2012), which builds on RBT. According to RBT, the ports and port users in port supply chain collectively improve collaborative advantage by exchanging information, creating knowledge and harmonising goals. It is apparent that developing the capability of collaborating with other related MLOs in various activities into core competency level is a viable strategic capability. In other words, RBT successfully elucidates the ports and port users' capability and its impact on outcomes. Hence, RBT appears to be acceptable for this study.

In order to complement and extend RBT, the RV is primarily concerned with a dyad or network in place of individual organisations as the component of analysis, offering a more coherent backing for SCM contexts (Chen and Paulraj, 2004). By adopting RV, this study dealt with the extent to which relational capabilities mould the foundation of durable strategic advantage such as collaborative advantage (Paulraj *et al.*, 2008). The positive path from SCC to collaborative advantage is explained by joint value creation process according to RV (Dyer and Singh, 1998). A port and port user can create relational rents via collaborative supply chain activities. In addition, the value appropriation process supports the association from collaborative advantage to port performance. In other words, the ports and port users are able to enhance port performance by appropriating relational rents. Finally, the direct relationship between SCC and port performance describes the spill-over (internal) rents that benefit to the ports (focal organisation). However, the effects of spill-over rents were rejected in this study.

8.2.2 Theoretical implications

This study contributed to SCC knowledge by developing instruments in containerised maritime logistics and validating them based on comprehensive and rigorous standards of developing and validating measurement scales (Churchill, 1979, Segars and Grover, 1998, Xia and Lee, 2005). Neglect of SCC in maritime logistics contrasts with other industries such as agri-food (Matopoulos et al., 2007); construction (Akintoye *et al.*, 2000); manufacturing, distribution and retailing (Stank *et al.*, 2001); engineering and assembly (Vereecke and Muylle, 2006); and the automotive sector (Wiengarten *et al.*, 2010) where SCC has been actively explored to gain competitive advantage. Six a priori dimensions (information sharing, knowledge creation, goal similarity, collaborative communication, decision harmonisation and joint supply chain performance measurement) were identified to analyse the degree of SCC between ports and port users that handle maritime containers in South Korea. One theoretical contribution of this work has been to expand the concept of SCC into containerised maritime contexts, capturing the perspective of various containerised MLOs. Further, despite numerous maritime studies which extol the importance of collaboration between the ports and port users, no systematic approach has previously developed and validated SCC scales in containerised maritime sectors. Scale development to measure constructs is vital to empirical research (Froehle and Roth, 2004) but has hereto been eschewed in maritime studies (Woo *et al.*, 2011a, Woo *et al.*, 2011b).

This work also examined the degree of SCC practice, with relatively high mean scores revealing that MLOs do implement SCC practices. This is consistent with UNCTAD's (2004) suggestion that maritime logistics industries must strive to collaborate closely with different actors in the supply chain due to developments in production and trading systems. In addition, it is in line with argument that the contemporary role of ports is a perfect networking site where different port supply chain members can meet and interact (Bichou and Gray, 2005b). Similarly, Pettit and Beresford (2009) envisaged that the changing commercial environments have resulted in tighter and more sophisticated relations between port service providers, port users, facilitators and end customers. This result may reflect attempts by South Korean MLOs pitted against competitors in China and Japan striving to host the leading maritime logistics clusters in Northeast Asia. Competitive pressures to out-perform adjacent supply chains compel ports and port users to implement SCC which engages their ultimate customers.

The measurement scales proposed for SCC fit the empirical data well. The instruments developed and validated are parsimonious and pertinent, and model-testing revealed that the proposed scales were reliable and valid. They met the requirements for reliability, convergent validity and discriminant validity. The first-order model showed that the proposed multidimensional model is appropriate. Likewise, second-order model testing supported a second-order construct of SCC in containerised maritime logistics which implies conceptualisation as a higher-order multidimensional construct. The level of SCC is determined by a series of parameters which were developed and validated empirically implying that containerised MLOs believe that SCC practices should be multifaceted, and not restricted to particular practices such as information sharing. The second-order model suggests that SCC practices in the maritime context should be well rounded, to at least incorporate information sharing, knowledge creation, goal similarity, collaborative communication, decision harmonisation and joint supply chain performance measurement factors. This evidence suggests that containerised MLOs aiming for a greater degree of collaboration into the port supply chain should pursue a strategy which considers all six main dimensions as constructs. Information sharing has been confirmed as a crucial component of SCC (Bennett and Gabriel, 2001, Carbone and De Martino, 2003, Lee *et al.*, 2003, Paixão and Marlow, 2003, Carbone and Gouvernal, 2007). Numerous emphases on SCC in ports and the importance of goal similarity in a maritime context were upheld (Paixão and Marlow, 2003, UNCTAD, 2004, Carbone and Gouvernal, 2007, Vitsounis and Pallis, 2012). The collaborative communication is a vital element for SCC which is consistent with prior studies (Frankel, 1999, UNESCAP, 2005, Heaver, 2011). The importance of relevant knowledge creation is upheld (Heaver *et al.*, 2001, Lee and Song, 2010, Song and Lee, 2012, Panayides and Song, 2013), as is the significance of joint supply chain performance measurement in a port supply chain context (Bennett and Gabriel, 2001, Lee *et al.*, 2003, Bichou and Gray, 2004, UNCTAD, 2004, Heaver, 2011). In addition, decision harmonisation was identified as necessary for SCC, which is consistent with prior maritime studies (Marlow and Paixão, 2003, Islam *et al.*, 2005, Carbone and Gouvernal, 2007).

This study also contributed to developing and validating collaborative advantage and port performance in the containerised maritime context through the typical standards of measurement development. The development of empirically validated scales of collaborative advantage and port performance makes it possible for researchers and practitioners to evaluate the extent to which the port and port users achieve collaborative advantage and to which the port maintains the high level of port performance. A scale of constructs cannot be assessed directly owing to its multi-faceted theoretical nature (DeVellis, 1991). The empirical results support the conceptualisation that collaborative advantage and port performance are higher order constructs comprising a variety of measures. Particularly, the development of collaborative advantage in the maritime context is original for the first time.

The findings presented expand understanding of the impact of SCC on collaborative advantage and port performance in the containerised maritime context. To date, literature on the SCC has mainly focused on the manufacturers' perspective and the role of SCC on firm performance (Cao and Zhang, 2011, Cao and Zhang, 2013), operational performance (Simatupang and Sridharan, 2005a, Daugherty *et al.*, 2006), success of collaboration and long-term (future) collaboration (Ramanathan and Gunasekaran, 2014) and satisfaction with relationship (Nyaga *et al.*, 2010). Accordingly, this work presents an initial endeavour to examine the role of SCC in the maritime context to provide a broader picture of important aspects of its development, which is based on a comprehensive, rigorous and systematic conceptualisation of SCC, collaborative advantage and port performance. In this regard, this work answered the calls of maritime research that emphasises the need for empirical research that investigates the characteristics and results of collaboration between the port and port user by empirical data (Carbone and De Martino, 2003, Carbone and Gouvernal, 2007, Heaver, 2011, Vitsounis and Pallis, 2012, Heaver, 2014). The results discovered the important role of SCC and the augmenting role of collaborative advantage in gaining port performance.

It has been demonstrated that collaborative advantage must be accompanied by SCC. This result is consistent with prior studies which concluded that a high level of collaborative advantage is achieved via SCC between supply chain partners (Kanter, 1994, Fawcett *et al.*, 2008, Cao and Zhang, 2011, Cao and Zhang, 2013). Heightened SCC between the port and port user can enlarge profit by synergy effects via collaborative activities (Spekman *et al.*, 1998, Jap, 2001, Daugherty *et al.*, 2006). By working together, partners can yield operational excellence that synergistically creates value (Bowersox *et al.*, 2005). This is in line with Notteboom (2008)'s claim that the success of a port is determined by an ability to shape efficient supply chains through the networks of business relationships for exploiting synergies with other nodes and other players. Similarly, UNESCAP (2005) argued that cooperation between shipping lines, terminal operators and port authorities benefits all parties involved in the network. By collaborative activities such as information sharing, knowledge creation, collaborative communication, goal similarity, decision harmonisation and joint supply chain performance measurement between ports and port users along port supply chain, they are capable of generating business synergy, quality, innovation and flexibility. The findings of this study confirm general SCC studies' results, which indicate a positive effect of SCC on quality and flexibility (Vereecke and Muylle, 2006). Nyaga *et al.* (2010) commented that firms are expanding their collaborative relationships with supply chain partners so as to escalate flexibility. This study found that the port with a high SCC fosters collaborative advantage with its port user. Thus, it appears that collaborative advantage is difficult to acquire where the terminal operators or MLOs are reluctant to spend their efforts in developing collaborative activities.

Some sub-components of SCC did not influence the port supply chain partners to gain collaborative advantage. Amongst six sub-dimensions of SCC, information sharing, knowledge creation and collaborative communication encouraged the port and port users to achieve collaborative advantage. Other factors such as goal similarity, decision harmonisation and joint supply chain performance measurement did not necessarily influence collaborative advantage, but it is still important for the success of SCC. This finding is consistent with the conceptualisation that information sharing (Daugherty *et al.*, 2006), knowledge creation (Lee and Song, 2010) and collaborative communication (Daugherty *et al.*, 2006, Paulraj *et al.*, 2008) enables the supply chain members to enhance collaborative advantage. This result confirms Lee and Song (2010)'s proposition that a strategy for creating knowledge assist MLOs in maximising their logistics value, as advantages of knowledge include operational efficiency and service effectiveness. Daugherty *et al.* (2006) contended that suitably leveraged information sharing can cultivate a synergistic advantage and also have significant strategic value. This result also supports

Christopher (1992)'s proposition that open and frequent communication contributes to maintaining value-enhancing relationships, and Anderson and Weitz (1992)' argument that it creates relational rents. However, this is inconsistent with Cao and Zhang's (2011) findings that goal similarity, decision harmonisation and joint supply chain performance measurement can improve collaborative advantage.

Additionally, all the direct impacts of SCC on business synergy, quality, innovation and flexibility were significant. This is consistent with prior research that argues that SCC can enhance business synergy (Asanuma, 1989, Kotzab and Teller, 2003, Fawcett *et al.*, 2008), quality (Boddy *et al.*, 1998), innovation (Boddy *et al.*, 1998, Jenssen, 2003, Jenssen and Randoy, 2006, Swink, 2006, Soosay *et al.*, 2008) and flexibility (Fisher, 1997, Lee *et al.*, 1997, Gosain *et al.*, 2004, Holweg *et al.*, 2005). Both innovation and quality are envisaged via sharing information and the more open process of problem-solving, which occurs in effective SCC (Boddy *et al.*, 1998). Soosay *et al.* (2008) asserted that SCC is vital if the supply chain members want to enhance innovation or capabilities for continuous innovation. By collaboration in facilitating the tacit and explicit knowledge sharing, supply chain members can augment knowledge creation and innovation spill-overs (Inkpen, 1996, Swink, 2006). In the maritime context, Jenssen (2003) found that there seems to be an agreement in regard to the value of creating more inter-organisational collaboration such as close communication and information sharing procedures so as to gain innovation in Norwegian shipping industry, and argued that the strong relationships with demanding customers are important for innovation. Simatupang and Sridharan (2005a) argued that close collaboration helps supply chain partners to augment their ability to satisfy customer's requirements by providing flexible services. As

De Martino and Morvillo (2008) pointed out, a port is considered as a network of players that perform diverse activities in port supply chain in close collaboration by sharing different resources. They assumed that the higher level of collaboration between ports and port users, the more superior the benefits that they would perceive in fostering strong interdependencies amongst port supply chain partners by stressing a collaborative spirit in order to create reciprocal benefits.

Further, the positive association between collaborative advantage and performance is consistent with prior studies' results (Cao and Zhang, 2011, Cao and Zhang, 2013, Yu *et al.*, 2013). In general, collaborative advantage would improve financial performance for each supply chain partner (Yu *et al.*, 2013). Notably, this study investigated port performance instead of firm performance so as to examine the role of collaborative advantage in the maritime context. If a port and port user acquire more collaborative advantage, it is more likely to achieve better port performance such as connectivity, value-added service, safety and security, efficient operation, cost efficiency, reliability and convenience of port users. This result also confirms Mason and Nair (2013)'s argument that the provision of flexibility in the maritime industry leads to enhanced efficiency and effectiveness. Both efficiency and effectiveness may be the key components of perceived port performance in volatile environments (Woo *et al.*, 2011b). In addition, this result is consistent with previous studies' argument that innovation can positively exert financial and operational performance of the firm (Jenssen and Randoy, 2006, Panayides and Venus Lun, 2009, Yang *et al.*, 2009).

In addition, this work has scrutinised the association between the higher order of collaborative advantage and seven sub-facets of port performance to compare the influence of the higher-order of collaborative advantage on port performance with that of first-order on port performance. At first glance, the link from collaborative advantage to connectivity, value-added services, safety and security, efficient operation, cost efficiency, reliability and convenience of port users were all statistically significant. These findings were in line with previous research that ascertained that the collaborative advantage exerts operational, logistical and supply chain performance.

Additionally, likewise above, this work empirically evaluated the associations between the four sub-dimensions of collaborative advantage and higher-order of port performance to precisely and concurrently probe whether each sub-dimension of collaborative advantage has a positively influence on the higher-order of port performance. The associations from business synergy, innovation and flexibility towards port performance were significant with the exception of the association from quality towards port performance. These results were consistent with prior studies that contended that performance can be improved by business synergy, innovation and flexibility, whilst the effect of quality on performance was inconsistent with prior research (Cao and Zhang 2011, Cao and Zhang 2013).

Interestingly, despite much evidence for the relationship between SCC and various performance in previous studies (Stank *et al.*, 2001, Duffy and Fearne, 2004, Simatupang and Sridharan, 2005a, Cao and Zhang, 2011, Cao and Zhang, 2013), the result of this study is inconsistent with those. This result rejected Lee *et al.*' (2003) simulation model results that argue that strong partnership with respect to sufficient resources and speedy cranes between port supply chain members within the port increases operational efficiency. Also, this result is not in line with Acosta *et al.*’s (2007) proposition that collaboration of the companies involved in the port activity may be the determinants of port competitiveness. Whilst first and second hypotheses were supported, the third research hypothesis for the association between SCC and port performance was rejected, which appears to defy intuition. It implies that SCC has no direct positive impact on port performance. Given that there were strong positive relationships between SCC and collaborative advantage, and collaborative advantage and port performance respectively, for confirmatory purposes, it is worthwhile investigating a mediating role of collaborative advantage on the association between SCC and port performance. The full mediation effect of collaborative advantage on the relationship between SCC and port performance is uncovered. Therefore, the higher degree of SCC between the port and port user enables them to gain a higher degree of collaborative advantage, and in turn this collaborative advantage can contribute to the higher level of port performance. Notably, this result is consistent with Van Weele (2002)’s assertion that SCC would result in better performance but it cannot be taken at face value. This result also is in line with Martin and Thomas (2001)’s suggestion that the activities that are conducted within port operations are closely interdependent and interrelated, and therefore, should be collaborated if a terminal is to operate effectively and efficiently.

In conclusion, the concept of SCC theoretically envisages that the port supply chain members who are actively involved in SCC practices outperform other port supply chains with less involvement in SCC by achieving collaborative advantage, which in turn affects port performance.

8.2.3 Managerial implications

The empirical findings have various managerial implications for practitioners in the maritime industry. The terminal operators and port users such as shipping lines, inland transport companies, ship management companies, freight forwarders and third-party logistics providers could adopt the results of this study when they implement SCC practices and pursue higher collaborative advantage. This work heeds practitioners in container MLOs to focus on balancing the facets of SCC to transport flows of containers seamlessly and efficiently from door-to-door, since SCM philosophy forces the maritime industry to become more integrated into the shippers' supply chain. Practically, they should strive to augment multiple facets of SCC practices for their port supply chain by constantly redefining their collaborative endeavours. This study contributes to developing a metric to evaluate the level of SCC practices for containerised MLOs within a strategic overview of the port supply chain seeking to facilitate the implementation of SCC practices. One reason why SCC in the containerised maritime context has not been active might be because there is a lack of guidelines how to actually do it. Conceptualisation at higher levels provides managers with insights to objectively evaluate their SCC by understanding their strategy and circumstances to identify specific actions to improve port supply chain processes that benefit related port supply chain members and final customers. For example, if a terminal operator fails to "develop systems to enable shippers to identify their cargoes' location" it generates a need to augment relevant actions for that item. To obtain sound SCC practices, close and collaborative inter-relationships between the port and port user are imperative. Maintaining high SCC assists related organisations to satisfy their final customers the shippers, and their intermediate customers the shipping lines, and hence to retain their customers (Seo *et al.*, 2013). The scales for SCC practices at a higher level of abstraction provide managers with insights into recognising grey areas for further enhancement or for making strategic initiatives required for overall enhancement of SCC practices. This work emphasises the importance of inter-organisational and inter-dependence relationships within port supply chain to outperform other port supply chains. As De Souza *et al.* (2003) stressed, terminal operators are striving to remain attractive to be the selected port supply chain by providing door-to-door and one-stop services as an integrated transport system through cooperation with port users. Managers seeking successful SCC practices must remember that they are strategically inter-connected and should be willing to allow their goals and decisions to converge, to share information and create knowledge, thus promoting joint supply chain performance measures. Further, the government of South Korea seeks to form a leading maritime logistics hub which embraces the ports of Busan, Gwangyang and Incheon. This hub will provide value-added services based on SCM contexts by adopting collaborative supply chains in containerised maritime logistics and thereby aim to eliminate excessive and unnecessary competition.

In order to boost port performance and satisfy customers, ports are seeking new strategies or redevelopment of current facilities by investing a large amount of money, time and endeavours. Ports are likely to have huge sunk costs because it is difficult and costly to dispose of completed construction (Alderton, 2008). SCC practices that the port adopted might be a very efficient and effective strategy in terms of costs and time rather than redeveloping port infrastructure, as it can be initiated shortly from the tiny operational collaboration with other port users. In this way, the measures of SCC presented here will assist policy makers to recognise the current status of SCC in containerised maritime logistics and facilitate state planning of a maritime logistics hub.

The collaborative advantage and port performance constructs including both second-order dimensions and the corresponding sub-dimensions of constructs contribute to providing further managerial implications. Those second-order factors can be utilised as ideas and guidelines how to achieve the higher degrees of collaborative advantage and port performance at a higher managerial level for senior managers. In addition, the definition and measurement scales can serve as a self-diagnosis tool for managers to augment collaborative advantage and port performance at a practical level. They are able to assess which measures the terminal need to enhance.

The result of this research shows that SCC practices between the ports and port users have a positive influence on collaborative advantage. It suggests that SCC contributes to worthwhile benefits of SCC to both the ports and port users. This finding suggests that the terminal operators and containerised MLOs should strive to improve or align their information sharing, knowledge creation, collaborative communication, goal similarity, decision harmonisation, and joint supply chain performance measurement to establish and maintain a high degree of collaborative advantage in their port supply chain. Managers can reduce wasteful activities through knowledge creation that may be applied to their practices, which in turn result in the provision of the more responsive and flexible services. By doing so, the whole port supply chain can be more effectively operated by capturing new knowledge. In addition, managers should be encouraged to adopt information and communication technology (ICT) to facilitate information sharing and knowledge creation, since strong relationships were found between ICT sector and the maritime industry (Jenssen and Randoy, 2006). As Mangan *et al.* (2008) claimed, optimising port supply chain is not a simple and easy task, because each member tries to optimise its own operations at the expense of the whole. The managers of ports and port users should take into account SCC philosophy from the operational to strategic collaboration as a priority owing to its paramount importance for collaborative advantage.

In a changing environment, it is necessary for port managers to discern the diverse determinants of port performance or port competitiveness to formulate modest strategies and efficacious actions (Acosta *et al.*, 2007). Any actions ports and port users take to enhance collaborative advantage for their port supply chain will result in greater port performance. In other words, port managers must optimise port operations in conjunction with their port users for considerable efficiency and effectiveness of the port. Business synergy, innovation, quality and flexibility could impact port performance. Therefore, the result suggests that port managers wishing to gain greater port performance should invest efforts both in developing business synergy, innovation, quality and flexibility. The importance of innovation should be constantly stressed by managers since it contributes to reducing costs and creating superior value for final customers (Jenssen and Randoy, 2006).

SCC presents a positive influence on port performance only indirectly through collaborative advantage, which implies that SCC does not automatically deliver better port performance. It is not surprising because port performance could be affected by the maritime accessibility, infrastructure, superstructure, geographical location, hinterland size, port size, human resource, the level of competition and so on. SCC may be one of the determinants of port performance. Poor SCC practices and unwillingness of collaboration between the port and port user would prevent their port supply chain from enhancing collaborative advantage and port performance. In Acosta et al.'s (2007) empirical study, they found that collaboration of the port supply chain members facilitates the accessibility of ships to the port, the transhipment of cargoes, decreased maritime safety and efficient operations. The managers of MLOs should be aware of their reliance on the port to shun sub-optimal solutions. It can be suggested that managers of port supply chain relationships involving the information sharing, knowledge creation, collaborative communication, goal similarity, decision harmonisation and joint supply chain performance can indirectly circuitously augment port performance by exerting an influence on collaborative advantage. Managers must strive to remove their organisations' barriers for facilitating information and knowledge sharing as a way of diminishing uncertainty and opportunistic behaviour, as the information and knowledge flow acts as the nerve centre in any type of relationship. Traditionally, the ports have taken into account their decisions for their own sake, without considering the objective of port users for their port supply chain, which is called as myopic decision process. However, this individual behaviour has been transforming into more harmonisation of decisions in order to benefit the whole port supply chain. Therefore, managers should take into a consideration the superordinate or even partially compatible objective of various port supply chain partners involved in the port activities for better port performance for port users, as it is plausible that better port performance may have an influence on port user's performance. The most important aspect that managers should bear in mind is that they must be able to remain more integrated into demanding shippers' supply chains and adapt to changes and uncertainty.

8.3 Limitations and recommendation for the future research

Despite its implications, this work has several limitations. Firstly, the data presented was collected in South Korea, implying a need to replicate and further validate findings elsewhere with slightly different focuses. For example, in Europe, greater emphasis would be on collaborative activities to barge and short-sea shipping (Heaver, 2014), whilst North America gives more attention to rail transport for effective container transport. In order to fully validate the instruments proposed, it will require further refinement and testing across different samples and regions as validation of scales developed is an ongoing process (DeVellis, 1991). The scales developed and validated here will facilitate further confirmation of theories in the maritime context. Secondly, this study only focused on the relationship between the port (terminal operator) and port users, so it did not consider the relationships between port users (e.g. shipping lines-inland transport companies or ship management companies-shipping lines). Thus, the future study may be undertaken by considering the dynamics of various relationships between port users. Thirdly, the sample of respondents represents one group of containerised MLOs. Future work representing other perspectives including shippers as an additional perspective may yield different results by alleviating biased assessments. Fourthly, this work in containerised maritime logistics also invites confirmatory studies in other maritime sectors engaging for example wet and dry bulk supply chains. Fifthly, the nature of SCC and its impact on collaborative advantage and performance may take a long time. Besides, collaboration induces additional collaboration over time (Lambert *et al.*, 1996). Therefore, future research should adopt a longitudinal study, which may yield accurate insights. Sixthly, collaboration occurs sometimes against an organisation's will due to power inequality. Some organisations may be compelled to be involved. It would be worthwhile if any future study qualitatively and empirically scrutinises this power inequality in order to know how organisations initiate and develop collaboration under the asymmetric power. As Kampstra *et al.* (2006) proposed, it would be interesting that if the future study examines the aforementioned aspects by categorising MLOs into collaboration leader, collaboration coordinator and remaining collaboration members. Seventhly, this study did not consider horizontal collaboration between the organisations that provide the same services. As Mason *et al.* (2007) suggested, if future research considers the combination of vertical collaboration with horizontal collaboration, it would have more considerable value for managers. Finally, this study collected the data from single respondents per an organisation, which may cause a response bias, measurement inaccuracy. Hence, future study should gather multiple responses from each organisation.

8.4 Summary

This chapter considered the research findings, implications and limitations and recommendation for the future research. Although various industries such as agri-food, construction, manufacturing, distribution and retailing, engineering and assembly and the automotive sector found considerable benefits from SCC, SCC in maritime logistics is still in its infancy. Using a multiple rigorous quantitative methods, the issue of SCC in the maritime logistics sector was examined to acquire a comprehensive understanding of how SCC influences CA and PP. The finding by using SEM models with the web-based survey of the maritime logistics industry in South Korea confirmed that SCC has a positive impact on CA, and in turn, this improved CA has a positive impact on PP.

References

Acosta, M., Coronado, D. and Mar Cerban, M. 2007. Port competitiveness in container traffic from an internal point of view: the experience of the Port of Algeciras Bay. *Maritime Policy and Management,* 34 (5), pp. 501-520.

Akintoye, A., McIntosh, G. and Fitzgerald, E. 2000. A survey of supply chain collaboration and management in the UK construction industry. *European Journal of Purchasing and Supply Management,* 6 (3-4), pp. 159-168.

Alderton, P.M. 2008. *Port Management and Operations,* London, Informa.

Amit, R. and Schoemaker, P.J.H. 1993. Strategic assets and organizational rent. *Strategic Management Journal,* 14 (1), pp. 33-46.

Anderson, C.M., Park, Y.-A., Chang, Y.-T., Yang, C.-H., Lee, T.-W. and Luo, M. 2008. A game-theoretic analysis of competition among container port hubs: the case of Busan and Shanghai. *Maritime Policy and Management,* 35 (1), pp.

Anderson, E. and Weitz, B. 1992. The use of pledges to build and sustain commitment in distribution channels. *Journal of marketing research,* 29 (1), pp. 18-34.

Anderson, J.C. and Gerbing, D.W. 1988. Structural equation modelling in practice: a review and recommended two-step approach. *Psychological Bulletin,* 103 (3), pp. 411-423.

Anderson, J.C., Gerbing, D.W. and Hunter, J.E. 1987. On the assessment of unidimensional measurement: internal and external consistency, and overall consistency criteria. *Journal of marketing research,* 24 (4), pp. 432-437.

Anderson, J.C. and Narus, J.A. 1990. A model of distributor firm and manufacturer firm working partnerships. *Journal of Marketing,* 54 (1), pp. 42-58.

Andraski, J.C. 1998. Leadership and the reailization of supply chain collaboration. *Journal of Business Logistics,* 19 (2), pp. 9-11.

Ang, S.H. 2008. Competitive intensity and collaboration: impact on firm growth across technological environments. *Strategic Management Journal,* 29 (10), pp. 1057-1075.

Angeles, R. and Nath, R. 2001. Partner congruence in electronic data interchange (EDI) enabled relationships. *Journal of Business Logistics,* 22 (2), pp. 109-127.

Arbuckle, J.L. 2011. *AMOS 20 User's Guide*, Amos Development Corporation.

Armstrong, J.S. and Overton, T.S. 1977. Estimating nonresponse bias in mail surveys. *Journal of marketing research,* 14, pp. 396-402.

Arshinder, Kanda, A. and Deshmukh, S.G. 2008. Supply chain coordination: perspectives, empirical studies and research directions. *International Journal of Production Economics,* 115 (2), pp. 316-335.

Asanuma, B. 1989. Manufacturer-supplier relationships in Japan and the concept of relation-specific skill. *Journal of the Japanese and International Economies,* 3, pp. 1-30.

Avery, P. 2000. *Strategies for Container Ports: A Cargo Systems Report,* London, IIR Publications.

Bagozzi, R., Yi, Y. and Phillips, L. 1991. Assessing construct validity in organizational research. *Administrative Science Quarterly,* 36 (3), pp. 421-458.

Bagozzi, R.P. 1984. A prospectus for theory construction in marketing. *The Journal of Marketing,* 48 (1), pp. 11-29.

Baird, A.J. 2007. The development of global container transhipment terminals. *In:* WANG, J., OLIVIER, D., NOTTEBOOM, T. & SLACK, B. (eds.) *Ports, Cities, and Global Supply Chains.* Hampshire: Ashgate, pp. 69-87.

Banomyong, R. 2005. The impact of port and trade security initiatives on maritime supply-chain management. *Maritime Policy and Management,* 32 (1), pp. 3-13.

Barney, J.B. 1991. Firm resources and sustained competitive advantage. *Journal of Management,* 17 (1), pp. 99-120.

Barney, J.B. 2001. Resource-based theories of competitive advantage: a ten-year retrospective on the resource-based view. *Journal of Management,* 27 (6), pp. 643-650.

Baron, R.M. and Kenny, D.A. 1986. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology,* 51 (6), pp. 1173-1182.

Barratt, M. 2004. Understanding the meaning of collaboration in the supply chain. *Supply Chain Management: An International Journal,* 9 (1), pp. 30-42.

Barros, C.P. and Athanassiou, M. 2004. Efficiency in European seaports with DEA: evidence from Greece and Portugal. *Maritime Economics and Logistics,* 6 (2), pp. 122-140.

Baumgartner, H. and Homburg, C. 1996. Applications of structural equation modeling in marketing and consumer research: a review. *International Journal of Research in Marketing,* 13 (2), pp. 139-161.

Bengtsson, M. and Kock, S. 1999. Cooperation and competition in relationships between competitors in business networks. *Journal of Business and Industrial Marketing,* 14 (3), pp. 178-193.

Bennett, R. and Gabriel, H. 2001. Reputation, trust and supplier commitment: the case of shipping company/seaport relations. *Journal of Business and Industrial Marketing,* 16 (6), pp. 424-438.

Bentler, P.M. 1990. Comparative fit indexes in structural models. *Psychological Bulletin,* 107 (2), pp. 238-246.

Bichou, K. 2007. Review of port performance approaches and a supply chain framework to port performance benchmarking. *In:* BROOKS, M. R. & CULLINANE, K. (eds.) *Devolution, Port Governance and Port Performance.* Oxford: Elsevier, pp. 567-598.

Bichou, K. and Bell, M.G. 2007. Internationalisation and consolidation of the container port industry: assessment of channel structure and relationships. *Maritime Economics and Logistics,* 9 (1), pp. 35-51.

Bichou, K. and Gray, R. 2004. A logistics and supply chain management approach to port performance measurement. *Maritime Policy and Management,* 31 (1), pp. 47-67.

Bichou, K. and Gray, R. 2005a. A critical review of conventional terminology for classifying seaports. *Transportation Research Part A: Policy and Practice,* 39 (1), pp. 75-92.

Bichou, K. and Gray, R. 2005b. A logistics and supply chain approach to seaport efficiency - an inquiry based on action research methodology. *In:* KOTZAB, H., SEURING, S., MULLER, M. & REINER, G. (eds.) *Research Methodologies in Supply Chain Management.* Heidelgerg: Physica-Verlag pp. 413-428.

Boddy, D., Cahill, C., Charles, M., Fraser-Kraus, H. and Macbeth, M. 1998. Success and failure in implementing supply chain partnering: an empirical study. *European Journal of Purchasing and Supply Management,* 4 (2-3), pp. 143-151.

Boddy, D., Macbeth, D. and Wagner, B. 2000. Implementing collaboration between organizations: an empirical study of supply chain parnering. *Journal of Management Studies,* 37 (3), pp. 1003-1017.

Bowersox, D.J., Closs, D.J. and Drayer, R.W. 2005. The digital transformation: technology and beyond. *Supply Chain Management Review,* 9 (1), pp. 22-29.

Branch, A.E. 2007. *Elements of Shipping,* New York, Routledge.

Brooks, M.R. 2007. Issues in measuring port devolution program performance: a managerial perspective. *In:* BROOKS, M. R. & CULLINANE, K. (eds.) *Devolution, Port Governance and Port Performance.* Oxford: Elsevier, pp. 599-620.

Brooks, M.R., McCalla, R., Pallis, A.A. and Van Der Lugt, L.M. Coordination and cooperation in strategic port management: the case of Atlantic Canada's ports. IAME, 2009 Copenhagen.

Browne, M.W. and Cudeck, R. 1993. Alternative ways of assessing model fit. *In:* BOLLEN, K. A. & LONG, J. S. (eds.) *Testing Structural Equation Models.* Newbury Park: Sage pp. 136-162.

Bryman, A. and Bell, E. 2011. *Business Research Methods,* New York, Oxford University Press.

Burnes, B. and New, S. 1997. Collaboration in customer-supplier relationships: strategy, operations and the function of rhetoric. *International Journal of Purchasing and Materials Management,* 33 (4), pp. 10-17.

Byrne, B.M. 2010. *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming,* New York, Routledge.

Campbell, D.T. and Fiske, D.W. 1959. Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin,* 56 (2), pp. 81-105.

Cao, M., Vonderembse, M.A., Zhang, Q. and Ragu-Nathan, T.S. 2010. Supply chain collaboration: conceptualisation and instrument development. *International Journal of Production Research,* 48 (22), pp. 6613-6635.

Cao, M. and Zhang, Q. 2011. Supply chain collaboration: impact on collaborative advantage and firm performance. *Journal of Operations Management,* 29 (3), pp. 163-180.

Cao, M. and Zhang, Q. 2013. *Supply Chain Collaboration: Role of Interorganizational Systems, Trust, and Collaborative Culture,* London, Springer.

Carbone, V. and De Martino, M. 2003. The changing role of ports in supply-chain management: an empirical analysis. *Maritime Policy and Management,* 30 (4), pp. 305-320.

Carbone, V. and Gouvernal, E. 2007. Supply chain and supply chain management: appropriate concepts for maritime studies. *In:* WANG, J., OLIVIER, D., NOTTEBOOM, T. & SLACK, B. (eds.) *Ports, Cities, and Global Supply Chains.* Hampshire: Ashgate.

Cetindamar, D., Çatay, B. and Basmaci, O.S. 2005. Competition through collaboration: insights from an initiative in the Turkish textile supply chain. *Supply Chain Management: An International Journal,* 10 (4), pp. 238-240.

Chang, Y.-T., Lee, S.-Y. and Tongzon, J.L. 2008. Port selection factors by shipping lines: different perspectives between trunk liners and feeder service providers. *Marine Policy,* 32 (6), pp. 877-885.

Chen, I.J. and Paulraj, A. 2004. Towards a theory of supply chain management: the constructs and measurements. *Journal of Operations Management,* 22 (2), pp. 119-150.

Christopher, M. 1992. *Logistics and Supply Chain Management: Strategies for Reducing Costs and Improving Services,* London, Pitman.

Churchill, G.A. 1979. A paradigm for developing better measures of marketing constructs. *Journal of marketing research,* 16 (1), pp. 64-73.

Churchill, G.A. 1992. Better measurement practices are critical to better understanding of sales management issues. *Journal of Personal Selling and Sales Management,* 12 (2), pp. 73-80.

Churchill, G.A. 2001. *Basic Marketing Research,* Orlando, Harcourt.

Churchill, G.A. and Iacobucci, D. 2009. *Marketing research: Methodological foundations,* Mason, South-Western Cengage Learning.

Coase, R.H. 1937. The nature of the firm. *Economica,* 4 (16), pp. 386-405.

Cohen, W.D. and Levinthal, D.A. 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly,* 35 (1), pp. 128-152.

Collis, J. and Hussey, R. 2009. *Business Research: A Practical Guide for Undergraduate and Postgraduate Students,* Hampshire, Palgrave MacMillan.

Comtois, C. and Slack, B. 2011. Measuring port performance: lessons from the waterfront. *In:* HALL, P., MCCALLA, R., COMTOIS, C. & SLACK, B.

(eds.) *Integrating Seaports and Trade Corridors.* Surrey: Ashgate, pp. 101-118.

Cooper, D.R. and Schindler, P.S. 2011. *Business Research Methods,* Singapore, McGraw-Hill.

Corbett, C.J., Blackburn, J.D. and Van Wassenhove, L.V. 1999. Partnerships to improve supply chains. *Sloan Management Review,* 40 (4), pp. 71-82.

Creswell, J.W. 1994. *Research Design: Qualitative and Quantitative Approaches,* New York, Sage.

Croom, S. 2001. Restructuring supply chains through information channel innovation. *International Journal of Operations and Production Management,* 21 (4), pp. 504-515.

Cullinane, K. and Wang, T.F. 2007. Data envelopment analysis (DEA) and improving container port efficiency. *In:* BROOKS, M. R. & CULLINANE, K. (eds.) *Devolution, Port Governance and Port Performance.* Oxford: Elsevier, pp. 517-566.

Das, T.K. and Teng, B.-S. 2000. A resource-based theory of strategic alliances. *Journal of Management,* 26 (1), pp. 31-61.

Daugherty, P.J., Richey, R.G., Roath, A.S., Min, S., Chen, H., Arndt, A.D. and Genchev, S.E. 2006. Is collaboration paying off for firms? *Business Horizons,* 49 (1), pp. 61-70.

De Langen, P.W. 2004. *The performance of seaport clusters: a framework to analyze cluster performance and an application to the seaport clusters of Durban, Rotterdam, and Lower Mississippi, Rotterdam.* Doctors of Philosophy Doctors of Philosophy, Erasmus University.

De Langen, P.W. and Pallis, A.A. 2006. Analysis of the benefits of intra-port competition. *International Journal of Transport Economics,* 33 (1), pp. 69-86.

De Leeuw, S. and Fransoo, J. 2009. Drivers of close supply chain collaboration: one size fits all? *International Journal of Operations and Production Management,* 29 (7), pp. 720-739.

De Martino, M. and Morvillo, A. 2008. Activities, resources and inter-organizational relationships: key factors in port competitiveness. *Maritime Policy and Management,* 35 (6), pp. 571-589.

De Souza, G.A., Beresford, A.K.C. and Petit, S.J. 2003. Liner shipping companies and terminal operators: internationalisation or globalisation? *Maritime Economics and Logistics,* 5 (4), pp. 393-412.

Delmas, M., Hoffmann, V.H. and Kuss, M. 2011. Under the tip of the iceberg: absorptive capacity, environmental strategy, and competitive advantage. *Business and Society,* 50 (1), pp. 116-154.

Denise, L. 1999. Collaboration vs. c-three (cooperation, coordination and communication). *Innovating,* 7 (3), pp. 25-35.

Dess, G.G. and Robinson, R.B. 1984. Measuring organizational performance in the absence of objective measures: the case of the privately-held firm and conglomerate business unit. *Strategic Management Journal,* 5 (3), pp. 265-273.

Devaraj, S., Krajewski, L. and Wei, J.C. 2007. Impact of eBusiness technologies on operational performance: the role of production information integration in the supply chain. *Journal of Operations Management,* 25 (6), pp. 1199-1216.

DeVellis, R.F. 1991. *Scale Development: Theory and Application,* California, Sage.

Devine, A., Boyle, E. and Boyd, S. 2011. Towards a theory of collaborative advantage for the sports tourism policy arena. *International Journal of Public Sector Management,* 24 (1), pp. 23-41.

Doll, W.J., Raghunathan, T., Lim, J.S. and Gupta, Y.P. 1995. A confirmatory factor analysis of the user information satisfaction instrument. *Information Systems Research,* 6 (2), pp. 177-188.

Donselaar, P.W.-V. and Kolkman, J. 2010. Societal costs and benefits of cooperation between port authorities. *Maritime Policy and Management,* 37 (3), pp. 271-284.

Driel, H.V. 1992. Co-operation in the Dutch container transport industry. *The Service Industries Journal,* 12 (4), pp. 512-532.

Ducruet, C. and Van Der Horst, M.R. 2009. Transport integration at european ports: measuring the role and position of intermediaries. *European Journal of Transport Infrastucture Research,* 9 (2), pp. 121-142.

Duffy, R. and Fearne, A. 2004. The impact of supply chain partnerships on supplier performance. *International Journal of Logistics Management,* 15 (1), pp. 57-72.

Dunn, S.C., Seaker, R.F. and Waller, M.A. 1994. Latent variables in business logistics research: scale development and validation. *Journal of Business Logistics,* 15 (2), pp. 145-172.

Dyer, J.H. 2000. *Collaborative Advantage: Winning through Extended Enterprise Supplier Networks,* New York, Oxford University Press.

Dyer, J.H. and Hatch, N.W. 2006. Relation-specific capabilities and barriers to knowledge transfers: creating advantage through network relationships. *Strategic Management Journal,* 27 (8), pp. 701-719.

Dyer, J.H. and Singh, H. 1998. The relational view: cooperative strategy and sources of interorganizational competitive advantage. *The Academy of Management Review,* 23 (4), pp. 660-679.

Easterby-Smith, M., Thorpe, R. and Jackson, P.R. 2012. *Management Research,* London, SAGE.

Esper, T.L. and Williams, L.R. 2003. The value of collaborative transportation management (CTM): its relationship to CPFR and information technology. *Transportation Journal,* 42 (4), pp. 55-65.

Fawcett, S.E., Fawcett, A.M., Watson, B.J. and Magnan, G.M. 2012. Peeking inside the black box: toward an understanding of supply chain collaboration dymanics. *Journal of Supply Chain Management,* 48 (1), pp. 44-72.

Fawcett, S.E. and Magnan, G.M. 2002. The rhetoric and reality of supply chain integration. *International Journal of Physical Distribution and Logistics Management,* 32 (5), pp. 339 - 361.

Fawcett, S.E., Magnan, G.M. and McCarter, M.W. 2008. A three-stage implementation model for supply chain collaboration. *Journal of Business Logistics,* 29 (1), pp. 93-112.

Feng, M., Mangan, J. and Lalwani, C. 2012. Comparing port performance: Western European versus Eastern Asian ports. *International Journal of Physical Distribution and Logistics Management,* 42 (5), pp. 490-512.

Feng, T., Sun, L. and Zhang, Y. 2010. The effects of customer and supplier involvement on competitive advantage: an empirical study in China. *Industrial Marketing Management,* 39 (8), pp. 1384-1394.

Ferrari, C. and Benacchio, M. 2002. Recent trends in the market structure of container terminal services: which way to integration? *Pomorski zbornik-Annals of Maritime Studies,* 40 (1), pp. 153-176.

Ferrari, C., Parola, F. and Morchio, E. 2006. Southern European ports and the spatial distribution of EDCs. *Maritime Economics and Logistics,* 8 (1), pp. 60-81.

Ferratt, T.W., Lederer, A.L., Hall, S.R. and Krella, J.M. 1996. Swords and plowshares: information technology for collaborative advantage. *Information and Management,* 30 (3), pp. 131-142.

Fisher, M.L. 1997. What is the right supply chain for your product? *Harvard Business Review,* 75 (2), pp. 105-116.

Fornell, C. and Larker, D.F. 1981. Structural equation models with unobserable variables and measurement errors: algebra and statistics. *Journal of marketing research,* 18 (3), pp. 382-388.

Foss, N.J. and Nielsen, B.B. 2010. *Researching collaborative advantage: some conceptual and multi-level issues* [Online].

Foss, N.J. and Nielsen, B.B. 2012. Researching multilevel phenomena: the case of collaborative advantage in strategic management. *Journal of CENTRUM Cathedra,* 5 (1), pp. 11-23.

Foster, F. and Sanjay, S. 2005. Imperatives for successful collaboration. *Supply Chain Management Review,* 9 (1), pp. 30-37.

Franc, P. and Van der Horst, M. 2010. Understanding hinterland service integration by shipping lines and terminal operators: a theoretical and empirical analysis. *Journal of Transport Geography,* 18 (4), pp. 557-566.

Frankel, E.G. 1999. The economics of total-ocean supply chain management. *Maritime Economics and Logistics,* 1, pp. 61-69.

Frémont, A. 2009. Shipping lines and logistics. *Transport Reviews,* 29 (4), pp. 537-554.

Fritsch, M. 2004. Cooperation and the efficiency of regional R&D activities. *Cambridge Journal of Economics,* 28 (6), pp. 829-846.

Froehle, C.M. and Roth, A.V. 2004. New measurement scales for evaluating perceptions of technology-mediated custmer service experience. *Journal of Operations Management,* 22 (1), pp. 1-21.

Garver, M.S. and Mentzer, J.T. 1999. Logistics research methods: Employing structural equation modeling to test for consruct validity. *Journal of Business Logistics,* 20 (1), pp. 33-57.

Garvin, D. 1987. Competing on the eight dimensions of quality. *Harvard Business Review,* 65 (6), pp. 101-109.

Garvin, D.A. 1988. *Managing Quality: The Strategic and Competitive Edge,* New York, Simon & Schuster.

Gerbing, D.W. and Anderson, J.C. 1988. An updated paradigm for scale development incorporating unidimensionality and its assessment. *Journal of marketing research,* 25 (2), pp. 186-192.

Gill, J. and Johnson, P. 2010. *Research Methods for Managers,* London, Sage.

Gnyawali, D.R., He, J. and Madhavan, R. 2006. Impact of co-opetition on firm competitive behavior: an empirical examination. *Journal of Management,* 32 (4), pp. 507-530.

Goffin, K., Lemke, F. and Szwejczewski, M. 2006. An exploratory study of 'close' supplier–manufacturer relationships. *Journal of Operations Management,* 24 (2), pp. 189-209.

Gosain, S., Malhotra, A. and El Sawy, O.A. 2004. Coordinating for flexibility in e-business supply chains. *Journal of Management Information Systems,* 21 (3), pp. 7-45.

Graham, M.G. 1998. Stability and competition in intermodal container shipping: finding a balance. *Maritime Policy and Management,* 25 (2), pp. 129-147.

Gray, B. 1989. *Collaborating: Finding Common Ground for Multiparty Problems,* San Francisco, Jossey-Bass

Gulati, R. 1999. Network location and learning: the influence of network resources and firm capabilities on alliance formation. *Strategic Management Journal,* 20 (5), pp. 397-420.

Haezendonck, E. and Notteboom, T. 2002. The competitive advantage of seaports. *In:* HUYBRECHTS, M., MEERSMAN, H., VAN DE VOORDE, E., VAN HOOYDONK, E., VERBEKE, A. & WINKELMANS, W. (eds.) *Port Competitiveness: An Economic and Legal Analysis of the Factors Determining the Competitiveness of Seaports.* Antwerp: De Boeck, pp. 67-87.

Hair, J., Money, A., Page, M. and Samouel, P. 2007. *Research Methods for Business,* West Sussex, John Wiley and Sons.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. 2010. *Multivariate Data Analysis,* New York, Prentice Hall.

Hansen, M.T. and Nohria, N. 2004. How to build collaborative advantage. *MIT Sloan Management Review,* 46 (1), pp. 22-30.

Haralambides, H.E., Cariou, P. and Benacchio, M. 2002. Costs, benefits and pricing of dedicated container terminals. *International Journal of Maritime Economics,* 4 (1), pp. 21-34.

Harland, C., Zheng, J., Johnsen, T. and Lamming, R. 2004. A conceptual model for researching the creation and operation of supply networks. *British Journal of Management,* 15 (1), pp. 1-21.

Harrington, H.J. 1991. *Business Process Improvement: The Breakthrough Strategy for Total Quality, Productivity, and Competitiveness,* New York, McGraw-Hill.

Harrison, A. and Van Hoek, R.I. 2005. *Logistics Management and Strategy,* Harlow, Pearson Education.

Hayuth, Y. 2007. Globalisation and the port-urban interface: conflicts and opportunities. *In:* WANG, J., OLIVER, D., NOTTEBOOM, T. & SLACK, B. (eds.) *Ports, Cities, and Global Supply Chains.* Hampshire: Ashgate, pp. 141-156.

Heaver, T., Meersman, H., Moglia, F. and Van De Voorde, E. 2000. Do mergers and alliances influence European shipping and port competition? *Maritime Policy and Management,* 27 (4), pp. 363-373.

Heaver, T., Meersman, H. and Van De Voorde, E. 2001. Co-operation and competition in international container transport: strategies for ports. *Maritime Policy and Management,* 28 (3), pp. 293-305.

Heaver, T.D. 1995. The implications of increased competition among ports for port policy and management. *Maritime Policy and Management,* 22 (2), pp. 125-133.

Heaver, T.D. 2010. The response of liner shipping companies to the evolution of global supply chain management. *In:* GRAMMENOS, C. T. (ed.) *The*

Handbook of Maritime Economics and Business. 2nd ed. London: Lloyd's List, pp. 457-477.

Heaver, T.D. 2011. Coordinating in multi-actor logistics operations: challenges at the port interface. *In:* HALL, P., MCCALLA, R. J., COMTOIS, C. & SLACK, B. (eds.) *Integrating Seaports and Trade Corridors.* Surrey: Ashgate, pp. 155-170.

Heaver, T.D. 2014. Increased collaborative relationships in international logistics: Canadian and other national and corporate examples. *Maritime Policy and Management,* DOI: 10.1080/03088839.2013.873547, pp.

Hennart, J.-F. 1988. A transaction costs theory of equity joint ventures. *Strategic Management Journal,* 9 (4), pp. 361-374.

Himmelman, A.T. 1996. On the theory and practice of transformational collaboration: from social service to social justice. *In:* HUXHAM, C. (ed.) *Creating Collaborative Advantage.* London: Sage, pp. 19-43.

Holweg, M., Disney, S., Holmström, J. and Småros, J. 2005. Supply chain collaboration: making sense of the strategy continuum. *European Management Journal,* 23 (2), pp. 170-181.

Hooper, D., Coughlan, J. and Mullen, M.R. 2008. Structural equation modelling: guidelines for determining model fit. *Electronic Journal of Business Research Methods,* 6 (1), pp. 53-60.

Hop, O., Lea, R. and Lindjord, J.-E. Measuring port performance and user costs of small ports. International Association of Maritime Economists (IAME), 1996 Vancouver, Canada.

Hopwood, C.J. 2007. Moderation and mediation in structural equation modeling: Applications for early intervention research. *Journal of Earily Intervention,* 29 (3), pp. 262-272.

Horvath, L. 2001. Collaboration: the key to value creation in supply chain management. *Supply Chain Management: An International Journal,* 6 (5), pp. 205-207.

Hoyt, J. and Huq, F. 2000. From arms-length to collaborative relationships in the supply chain. *International Journal of Physical Distribution and Logistics Management,* 30 (9), pp. 750-764.

Hu, L.T. and Bentler, P.M. 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal,* 6 (1), pp. 1-55.

Huxham, C. 1993. Pursuing collaborative advantage. *The Journal of the Operational Research Society,* 44 (6), pp. 599-611.

Huxham, C. 1996. Collaboration and collaborative advantage. *In:* HUXHAM, C. (ed.) *Creating Collaborative Advantage.* London: Sage, pp. 1-18.

Huxham, C. and Macdonald, D. 1992. Introducing collaborative advantage: achieving inter-organizational effectiveness through meta-strategy. *Management Decision,* 30 (3), pp. 50-56.

Huxham, C. and Vangen, S. 2004. Doing things collaboratively: realizing the advantage or succumbing to inertia? *Organizational Dynamics,* 33 (2), pp. 190-201.

Huxham, C. and Vangen, S. 2005a. Aiming for collaborative advantage: challenging the concept of shared vision. *Advanced Institute of Management Research Working Paper,* 15, pp. 1-47.

Huxham, C. and Vangen, S. 2005b. *Magaging to Collaborate: The Theory and Practice of Collaborative Advantage,* Abingdon, Routledge.

IMO 2009. Second IMO GHG Study 2009. London: International Mritime Organisation.

Inkpen, A.C. 1996. Creating knowledge through collaboration. *California Management Review,* 39 (1), pp. 123-140.

Ireland, R.K. and Crum, C. 2005. *Supply Chain Collaboration: How to Implement CPFR and Other Best Collaborative Practices,* Fort Lauderdale, J. ROss

IRMAPA. 2014. *Incheon Regional Maritime Affairs and Port Administration* [Online]. Incheon.

Islam, D.M.Z., Dinwoodie, J. and Roe, M. 2005. Towards supply chain integration through multimodal transport in developing economies: the case of Bangladesh. *Maritime Economics and Logistics,* 7 (4), pp. 382-399.

Jacobs, W. and Hall, P. 2007. What conditions supply chain strategies of ports? the case of Dubai. *GeoJournal,* 68 (4), pp. 327-342.

Jap, S.D. 2001. Perspectives on joint competitive advantages in buyer–supplier relationships. *International Journal of Research in Marketing,* 18 (1–2), pp. 19-35.

Jenssen, J.I. 2003. Innovation, capabilities and competitive advantage in Norwegian shipping. *Maritime Policy and Management,* 30 (2), pp. 93-106.

Jenssen, J.I. and Randoy, T. 2006. The performance effect of innovation in shipping companies. *Maritime Policy and Management,* 33 (4), pp. 327-343.

Jonsson, P. and Zineldin, M. 2003. Achieving high satisfaction in supplier-dealer working relationships. *Supply Chain Management: An International Journal,* 8 (3), pp. 224-240.

Jöreskog, K.G. 1971. Statistical analysis of sets of congeneric tests. *Psychometrika,* 36 (2), pp. 109-133.

Kähkönen, A.-K. 2014. The influence of power position on the depth of collaboration. *Supply Chain Management: An International Journal,* 19 (1), pp. 17-30.

Kahn, K.B. and Mentzer, J.T. 1996. Logistics and interdepartmental integration. *International Journal of Physical Distribution and Logistics Management,* 26 (8), pp. 6-14.

Kalwani, M.U. and Narayandas, N. 1995. Long-term manufacturer-supplier relationships: do they pay off for supplier firms? *Journal of Marketing,* 59 (1), pp. 1-16.

Kampstra, R.P., Ashayeri, J. and Gattorna, J.L. 2006. Realities of supply chain collaboration. *The International Journal of Logistics Management,* 17 (3), pp. 312-330.

Kanter, R.M. 1994. Collaborative advantage: the art of alliances. *Harvard Business Review,* 72 (4), pp. 96-108.

Kaufman, A., Wood, C.H. and Theyel, G. 2000. Collaboration and technology linkages: a strategic supplier typology. *Strategic Management Journal,* 21 (6), pp. 649-663.

King, J. 1997. Globalization of logistics management: present status and prospects. *Maritime Policy and Management,* 24 (4), pp. 381-387.

Kline, R.B. 2011. *Principles and Practices of Structural Equation Modeling,* New York, The guilford Press.

Kline, T.J.B. and Klammer, J.D. 2001. Path model analyzed with ordinary least squares multiple regression versus LISREL. *The Journal of Psychology,* 135 (2), pp. 213-225.

Knudsen, D. 2003. Aligning corporate strategy, procurement strategy and e-procurement tools. *International Journal of Physical Distribution and Logistics Management,* 38 (8), pp. 720-734.

Knudsen, L. and Nielsen, B.B. 2010. Collaborative capability in R&D alliances: exploring the link between organisational and individual level factors. *International Journal of Knowledge Management Studies,* 4 (2), pp. 152-175.

Koh, J. and Venkatraman, N. 1991. Joint venture formations and stock market reactions: an assessment in the information technology sector. *Academy of Management Journal,* 34 (4), pp.

Kotzab, H. and Teller, C. 2003. Value-adding partnerships and co-opetition models in the grocery industry. *International Journal of Physical Distribution and Logistics Management,* 33 (3), pp. 268-281.

Koufteros, X.A. 1999. Testing a model of pull production: a paradigm for manufacturing research using structural equation modeling. *Journal of Operations Management,* 17 (4), pp. 467-488.

Lado, A.A., Boyd, N.G. and Hanlon, S.C. 1997. Competition, cooperation, and the search for economic rents: a syncretic model. *Academy of Management,* 22 (1), pp. 110-141.

Lai, K.-H., Ngai, E.W.T. and Cheng, T.C.E. 2002. Measures for evaluating supply chain performance in transport logistics. *Transportation Research Part E: Logistics and Transportation Review,* 38 (6), pp. 439-456.

Lam, J.S.L. 2011. Patterns of maritime supply chains: slot capacity analysis. *Journal of Transport Geography,* 19 (2), pp. 366-374.

Lambert, D.M., Emmelhainz, M.A. and Gardner, J.T. 1996. Developing and implementing suppy chain partnerships. *The International Journal of Logistics Management,* 7 (2), pp. 1-17.

Lambert, D.M., Emmelhainz, M.A. and Gardner, J.T. 1999. Building successful logistics partnerships. *Journal of Business Logistics,* 20 (1), pp. 165-181.

Larson, P.D. and Rogers, D.S. 1998. Supply chain management: definition, growth and approaches. *Journal of Marketing Theory and Practice,* 6 (4), pp. 1-15.

Lasker, R.D., Weiss, E.S. and Miller, R. 2001. Partnership synergy: a practical framework for studying and strengthening the collaborative advantage. *Milbank Quarterly,* 79 (2), pp. 179-205.

Lavie, D. 2006. The competitive advantage of interconncected firms: an extension of the resource-based view. *The Academy of Management Review,* 31 (3), pp. 638-658.

Lee, E.-S. and Song, D.-W. 2010. Knowledge management for maritime logistics value: discussing conceptual issues. *Maritime Policy and Management,* 37 (6), pp. 563-583.

Lee, H.L., Padmanabhan, V. and Whang, S. 1997. The bullwhip effect in supply chains. *Sloan Management Review,* 38 (3), pp. 93-102.

Lee, S.-W. and Kim, G.-S. 2009. Port challenge in Northeast Asia: Korea's two-hub port strategy. *In:* NOTTEBOOM, T., DUCRUET, C. & DE LANGEN, P. (eds.) *Ports in Proximity: Competition and Coordination among Adjacent Seaports.* Surrey: Ashgate, pp. 247-260.

Lee, T.W., Park, N.K. and Lee, D.W. 2003. A simulation study for the logistics planning of a container terminal in view of SCM. *Maritime Policy and Management,* 30 (3), pp. 243-254.

Lejeune, N. and Yakova, N. 2005. On characterizing the 4C's in supply chain management. *Journal of Operations Management,* 23 (1), pp. 81-100.

Li, L. 2012. Effects of enterprise technology on supply chain collaboration: analysis of China-lined supply chain. *Enterprise Information Systems,* 6 (1), pp. 55-77.

Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S. and Subba Rao, S. 2006. The impact of supply chain management practices on competitive advantage and organizational performance. *Omega,* 34 (2), pp. 107-124.

Lirn, T.-C., Thanopoulou, H.A. and Beresford, A.K.C. 2003. Transhipment port selection and decision-making behaviour: analysing the Taiwanese case. *International Journal of Logistics Research and Applications,* 6 (4), pp. 229-244.

López, R.C. and Poole, N. 1998. Qality assurance in the maritime port logistics chain: the case of Valencia. *Supply Chain Management: An International Journal,* 3 (1), pp. 33-44.

Makadok, R. 2001. Toward a synthesis of the resource-based and dynamic-capability views of rent creation. *Strategic Management Journal,* 22 (5), pp. 387-401.

Malhotra, A., Gasain, S. and Sawy, O. 2005. Absortive capacity configurations in supply chains: gearing for partner-enabled market knowledge creation. *MIS Quarterly,* 29 (1), pp. 145-187.

Malone, T.W. and Crowston, K. 1994. The interdisciplinary study of coordination. *ACM Computing Surveys,* 26 (1), pp. 87-119.

Mangan, J., Lalwani, C. and Fynes, B. 2008. Port-centric logistics. *International Journal of Logistics Management,* 19 (1), pp. 29-41.

Manthou, V., Vlachopoulou, M. and Folinas, D. 2004. Virtual e-Chain (VeC) model for supply chain collaboration. *International Journal of Production Economics,* 87 (3), pp. 241-250.

Marlow, P.B. and Paixão, A.C. 2003. Measuring lean ports performance. *International Journal of Transport Management,* 1 (4), pp. 189-202.

Marsh, H.W., Balla, J.R. and Mcdonald, R.P. 1988. Goodness-of-fit indexes in confirmatory factor analysis: the effect of sample size. *Psychological Bulletin,* 103 (3), pp. 391-410.

Marsh, H.W. and Hocevar, D. 1985. Application of confirmatory factor analysis to the study of self-concept: first- and higher-order factor models and their invariance across groups. *Psychological Bulletin,* 97 (3), pp. 562-582.

Martin, J. and Thomas, B.J. 2001. The container terminal community. *Maritime Policy and Management,* 28 (3), pp. 279-292.

Mason, R. and Lalwani, C. 2006. Transport integration tools for supply chain management. *International Journal of Logistics Research and Applications,* 9 (1), pp. 57-74.

Mason, R., Lalwani, C. and Boughton, R. 2007. Combining vertical and horizontal collaboration for transport optimisation. *Supply Chain Management: An International Journal,* 12 (3), pp. 187-199.

Mason, R. and Nair, R. 2013. Strategic flexibility capabilities in the container liner shipping sector. *Production Planning and Control,* 24 (7), pp. 640-651.

Matopoulos, A., Vlachopoulou, M., Manthou, V. and Manos, B. 2007. A conceptual framework for supply chain collaboration: empirical evidence from the agri-food industry. *Supply Chain Management: An International Journal,* 12 (3), pp. 177-186.

Mayo, M. 1997. Partnerships for regeneration and community development: some opportunities, challenges and constraints. *Critical Social Policy,* 17 (52), pp. 3-26.

McCarthy, T.M. and Golicic, S.L. 2002. Implementing collaborative forecasting to improve supply chain performance. *International Journal of Physical Distribution and Logistics Management,* 32 (6), pp. 431-454.

McClelland, S.B. 1994. Training needs assessment data-gathering methods: part 1, survey questionnaires. *Journal of European Industrial Training,* 18 (1), pp. 22-26.

McDaniel, C. and Gates, R. 2013. *Marketing Research,* Singapore, John Wiley and Sons.

Medsker, G.J., Williams, L.J. and Holahan, P.J. 1994. A review of current practices for evaluating causal models in organizational behavior and human resources management research. *Journal of Management,* 20 (2), pp. 439-464.

Meersman, H., Van De Voorde, E. and Vanelslander, T. 2005. Ports as hubs in the logistics chain. *In:* LEGGATE, H., MCCONVILLE, J. & MORVILLO, A. (eds.) *International Maritime Transport: Perspectives.* Abringdon: Routledge, pp. 123-129.

Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D. and Zacharia, Z.G. 2001. Defining supply chain management. *Journal of Business Logistics,* 22 (2), pp. 1-25.

Mentzer, J.T. and Flint, D.J. 1997. Validity in logistics research. *Journal of Business Logistics,* 18 (1), pp. 199-216.

Mentzer, J.T., Foggin, J.H. and Golicic, S.L. 2000. Collaboration: the enablers, impediments, and benefits. *Supply Chain Management Review,* 4 (4), pp. 52-58.

Midoro, R., Musso, E. and Parola, F. 2005. Maritime liner shipping and the stevedoring industry: market structure and competition strategies. *Maritime Policy and Management,* 32 (2), pp. 89-106.

Min, S. and Mentzer, J.T. 2004. Developing and measuring supply chain manangement concepts. *Journal of Business Logistics,* 25 (1), pp. 63-99.

Min, S., Roath, A.S., Daugherty, P.J., Genchev, S.E., Chen, H., Arndt, A.D. and Richey, R.G. 2005. Supply chain collaboration: what's happening? *The International Journal of Logistics Management,* 16 (2), pp. 237-256.

MLTMA. 2013. *Ministry of Land, Transport and Maritime Affairs* [Online]. Seoul.

Mohr, J. and Nevin, J.R. 1990. Communication strategies in marketing channels: a theoretical perspective. *Journal of Marketing,* 54 (4), pp. 36-51.

Mohr, J. and Spekman, R. 1994. Characteristics of partnership success: partnership attributes, communication behavior, and conflict resolution techniques. *Strategic Management Journal,* 15 (2), pp. 135-152.

Moore, G.C. and Benbasat, I. 1991. Development of an instrument to measure the perceptions of adopting an instrument technology innovation. *Information Systems Research,* 2 (3), pp. 192-222.

Munson, C.L., Rosenblatt, M.J. and Rosenblatt, Z. 1999. The use and abuse of power in supply chains. *Business Horizons,* 42 (1), pp. 55-65.

Murphy, P.R. and Daley, J.M. 1994. A comparative analysis of port selection factors. *Transportation Journal,* 34 (1), pp. 15-21.

Musso, E., Ferrari, C. and Benacchio, M. 2000. Co-operation in maritime and port industry and its effects on markets structure. *In:* BREBBIA, C. A. &

OLIVELLA, J. (eds.) *International Conference on Maritime Engineering and Ports II* Barcelona , ESPAGNE: WIT Press.

Naim, M.M., Potter, A.T., Mason, R.J. and Bateman, N. 2006. The role of transport flexibility in logistics provision. *The International Journal of Logistics Management,* 17 (3), pp. 297-311.

Nam, H.-S. and Song, D.-W. 2011. Defining maritime logistics hub and its implication for container port. *Maritime Policy and Management,* 38 (3), pp. 269-292.

Navarro, A., Losada, F., Ruzo, E. and Díez, J.A. 2010. Implications of perceived competitive advantages, adaptation of marketing tactics and export commitment on export performance. *Journal of World Business,* 45 (1), pp. 49-58.

Ng, A.S.F. 2012. Container flows and empty container repositioning. *In:* SONG, D. W. & PANAYIDES, P. M. (eds.) *Maritime Logistics: Contemporary Issues.* Bingley: Emerald Group, pp. 29-48.

Ng, K.Y.A. 2006. Assessing the attractiveness of ports in the North European container transhipment market: an agenda for future research in port competition. *Maritime Economics and Logistics,* 8 (3), pp. 234-250.

Notteboom, T. 2008. The relationship between seaports and the inter-modal hinterland in light of global supply chains: European challanges.

Notteboom, T.E. 2002. Consolidation and contestability in the European container handling industry. *Maritime Policy and Management,* 29 (3), pp. 257-269.

Notteboom, T.E. and Rodrigue, J.-P. 2005. Port regionalization: towards a new phase in port development. *Maritime Policy and Management,* 32 (3), pp. 297-313.

Notteboom, T.E. and Winkelmans, W. 2001. Structural changes in logistics: how will port authorities face the challenge? *Maritime Policy and Management,* 28 (1), pp. 71-89.

Nunnally, J. 1978. *Psychometric Theory,* New York, Mc-Graw-Hill.

Nyaga, G.N., Whipple, J.M. and Lynch, D.F. 2010. Examining supply chain relationships: do buyer and supplier perspectives on collaborative relationships differ? *Journal of Operations Management,* 28 (2), pp. 101-114.

Osarenkhoe, A. 2010. A study of inter-firm dynamics between competition and cooperation - a coopetition strategy. *Journal of Database Marketing and Customer Strategy Management,* 17 (3-4), pp. 201-221.

Paixão, A.C. and Marlow, P.B. 2003. Fourth generation ports – a question of agility? *International Journal of Physical Distribution and Logistics Management,* 33 (4), pp. 355 - 376.

Paixão, A.C. and Marlow, P.B. 2005. The competitiveness of short sea shipping in multimodal logistics supply chains: service attributes. *Maritime Policy and Management,* 32 (4), pp. 363-382.

Pallis, A.A. and Vitsounis, T.K. 2011. Key interactions and value drivers towards port users' satisfaction. *In:* HALL, P., MCCALLA, R. J., COMTOIS, C. & SLACK, B. (eds.) *Integrating Seaports and Trade Corridors.* Surrey: Ashgate, pp. 119-136.

Panayides, P.M. 2006. Maritime logistics and global supply chains: towards a research agenda. *Maritime Economics and Logistics,* 8 (1), pp. 3-18.

Panayides, P.M., Maxoulis, C.N., Wang, T.F. and Ng, K.Y.A. 2009. A critical analysis of DEA applications to seaport economic efficiency measurement. *Transport Reviews,* 29 (2), pp. 183-206.

Panayides, P.M. and Song, D.-W. 2008. Evaluating the integration of seaport container terminals in supply chains. *International Journal of Physical Distribution and Logistics Management,* 38 (7), pp. 562-584.

Panayides, P.M. and Song, D.-W. 2009. Port integration in global supply chains: measures and implications for maritime logistics. *International Journal of Logistics Research and Applications,* 12 (2), pp. 133-145.

Panayides, P.M. and Song, D.-W. 2013. Maritime logistics as an emerging discipline. *Maritime Policy and Management,* 40 (3), pp. 295-308.

Panayides, P.M. and Venus Lun, Y.H. 2009. The impact of trust on innovativeness and supply chain performance. *International Journal of Production Economics,* 122 (1), pp. 35-46.

Park, N.K., Mezias, J.M. and Song, J. 2004. A resource-based view of strategic alliances and firm value in the electronic marketplace. *Journal of Management,* 30 (1), pp. 7-27.

Park, S.-H. and Russo, M.V. 1996. When competition eclipses cooperation: an event history analysis of joint venture failure. *Management Science,* 42 (6), pp. 875-890.

Paulraj, A., Lado, A.A. and Chen, I.J. 2008. Inter-organizational communication as a relational competency: antecedents and performance outcomes in collaborative buyer–supplier relationships. *Journal of Operations Management,* 26 (1), pp. 45-64.

Peter, J.P. 1979. Reliability: a review of psychometric basics and recent marketing practices. *Journal of marketing research,* 16 (1), pp. 6-17.

Peteraf, M.A. 1993. The cornerstones of competitive advantage: a resource-based view. *Strategic Management Journal,* 14 (3), pp. 179-191.

Pettit, S.J. and Beresford, A.K.C. 2009. Port development: from gateways to logistics hub. *Maritime Policy and Management,* 36 (3), pp. 253-267.

Podsakoff, P.M., Mackenzie, S.B., Lee, J.Y. and Podsakoff, N.P. 2003. Common bethod bias in behavioural research: a critical review of the literature and recommeded remedies. *Journal of Applied Psychology,* 88 (5), pp. 879-903.

Pouloudi, A. 1999. Information technology for collaborative advantage in healthcare revisited. *Information and Management,* 35 (6), pp. 345-356.

Prahalad, C.K. and Hamel, G. 1990. The core competence of the corporation. *Harvard Business Review,* 68 (3), pp. 79-91.

Prahinski, C. and Benton, W.C. 2004. Supplier evaluations: communication strategies to improve supplier performance. *Journal of Operations Management,* 22 (1), pp. 39-62.

Preacher, K.J., Rucker, D.D. and Hayes, A.F. 2007. Addressing moderated mediation hypotheses: theory, methods, and prescriptions. *Multivariate Behavioral Research,* 42 (1), pp. 185-227.

Qrunfleh, S. and Tarafdar, M. 2013. Lean and agile supply chain strategies and supply chain responsiveness: the role of strategic supplier partnership and postponement. *Supply Chain Management: An International Journal,* 18 (6), pp. 571-582.

Ramanathan, U. 2013. Aligning supply chain collaboration using Analytic Hierarchy Process. *Omega,* 41 (2), pp. 431-440.

Ramanathan, U. 2014. Performance of supply chain collaboration - a simulation study. *Expert Systems with Applications,* 41 (1), pp. 210-220.

Ramanathan, U. and Gunasekaran, A. 2014. Supply chain collaboration: impact of success in long-term partnerships. *International Journal of Production Economics,* 147 (B), pp. 252-259.

Robinson, R. 2002. Ports as elements in value-driven chain systems: the new paradigm. *Maritime Policy and Management,* 29 (3), pp. 241-255.

Roll, Y. and Hayuth, Y. 1993. Port performance comparison applying data envelopment analysis (DEA). *Maritime Policy and Management,* 20 (2), pp. 153-161.

Sabath, R.E. and Fontanella, J. 2005. The unfulfilled promise of supply chain collaboration. *Supply Chain Management Review,* 6 (4), pp. 24-29.

Saunders, M., Lewis, P. and Thornhill, A. 2012. *Research Methods for Business Students,* Essex, Financial Times/Prentice Hall.

Schumacker, R.E. and Lomax, R.G. 2004. *A Beginner's Guide to Structural Equation Modelling,* New Jersey, Lawrence Erlbaum Associates.

Segars, A.H. and Grover, V. 1998. Strategic information systems planning success: an investigation of the construct and its measurement. *MIS Quarterly,* 22 (2), pp. 139-163.

Sekaran, U. and Bougie, R. 2009. *Research Methods for Business: A Skill Building Approach,* West Sussex, John Wiley and Sons.

Seo, Y.-J., Dinwoodie, J. and Michael, R. Co-opetition for collaborative advantage in supply chains involving maritime organizations. International Association of Maritime Economics (IAME), 3-5 July 2013 Marseille, France.

Sheu, C., Yen, H.R. and Chae, B. 2006. Determinants of supplier-retailer collaboration: evidence from an international study. *International Journal of Operations and Production Management,* 26 (1), pp. 24-49.

Simatupang, T.M. and Sridharan, R. 2002. The collaborative supply chain. *The International Journal of Logistics Management,* 13 (1), pp. 15-30.

Simatupang, T.M. and Sridharan, R. 2004. A benchmarking scheme for supply chain collaboration. *Benchmarking: An International Journal,* 11 (1), pp. 9-30.

Simatupang, T.M. and Sridharan, R. 2005a. The collaboration index: a measure for supply chain collaboration. *International Journal of Physical Distribution and Logistics Management,* 35 (1), pp. 44-62.

Simatupang, T.M. and Sridharan, R. 2005b. An integrative framework for supply chain collaboration. *International Journal of Logistics Management,* 16 (2), pp. 257-274.

Simatupang, T.M. and Sridharan, R. 2008. Design for supply chain collaboration. *Business Process Management Journal,* 14 (3), pp. 401-418.

Simatupang, T.M., Wright, A.C. and Sridharan, R. 2004. Applying the theory of constraints to supply chain collaboration. *Supply Chain Management: An International Journal,* 9 (1), pp. 57-70.

Singh, P.J. and Power, D. 2009. The nature and effectiveness of collaboration between firms, their customers and suppliers: a supply chain perspective. *Supply Chain Management: An International Journal,* 14 (3), pp. 189-200.

Slack, B. 1985. Containerization, inter-port competition, and port selection. *Maritime Policy and Management,* 12 (4), pp. 293-303.

Slack, B. 1993. Pawns in the game: ports in a global transportation system. *Growth and Change,* 24 (4), pp. 579-588.

Slack, B. 2007. The terminalisation of seaports. *In:* WANG, J., OLIVIER, D., NOTTEBOOM, T. & SLACK, B. (eds.) *Ports, Cities, and Global Supply Chains.* Hampshire: Ashgate, pp. 41-50.

Smaros, J. 2007. Forecasting collaboration in the European grocery sector: observations from a case study. *Journal of Operations Management,* 25 (3), pp. 702-716.

Sobel, M.E. 1982. Asymptotic confidence intervals for indirect effects in structural equation models. *Sociological Methodology,* 13, pp. 290-312.

Song, D.-W. 2003. Port co-opetition in concept and practice. *Maritime Policy and Management,* 30 (1), pp. 29-44.

Song, D.-W. 2004. Regional container port competition and co-operation: the case of Hong Kong and South China. *Journal of Transport Geography,* 10 (2), pp. 99-110.

Song, D.-W. and Lee, E.-S. 2012. Coopetitive networks, knowledge acquisition and maritime logistics value. *International Journal of Logistics Research and Applications,* 15 (1), pp. 15-35.

Song, D.-W. and Panayides, P.M. 2008. Global supply chain and port/terminal: integration and competitiveness. *Maritime Policy and Management,* 35 (1), pp. 73-87.

Song, D.-W. and Yeo, K.-T. 2004. A competitive analysis of Chinese container ports using the analytic hierarchy process. *Maritime Economics and Logistics,* 6 (1), pp. 34-52.

Soosay, C.A., Hyland, P.W. and Ferrer, M. 2008. Supply chain collaboration: capabilities for continuous innovation. *Supply Chain Management: An International Journal,* 13 (2), pp. 160-169.

Soppé, M., Parola, F. and Frémont, A. 2009. Emerging inter-industry partnerships between shipping lines and stevedores: from rivalry to cooperation? *Journal of Transport Geography,* 17 (1), pp. 10-20.

Spekman, R.E., Kamauff, J.W.J. and Myhr, N. 1998. An empirical investigation into supply chain management: a perspective on partnerships. *Supply Chain Management: An International Journal,* 3 (2), pp. 53-67.

Stank, T.P., Keller, S.B. and Daugherty, P.J. 2001. Supply chain collaboration and logistical service performance. *Journal of Business Logistics,* 22 (1), pp. 29-48.

Steenkamp, J.-B.E.M. and Van Trijp, H.C.M. 1991. The use of lisrel in validating marketing constructs. *International Journal of Research in Marketing,* 8 (4), pp. 283-299.

Stopford, M. 2009. *Maritime Economics,* Abingdon, Routledge.

Strauss, A.L. and Corbin, J.M. 1990. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques,* Newbury Park, Sage.

Stuart, T.E. 2000. Interorganizational alliances and the performance of firms: a study of growth and innovation rates in a high-technology industry. *Strategic Management Journal,* 21 (8), pp. 791–811.

Sumpor, M. 2006. Creating collaborative advantages through coordination of regional development activities. *46th Congress of the European Regional Science Association.* Greece.

Swink, M. 2006. Building collaborative innovation capability. *Research Technology Management,* 49 (2), pp. 37-47.

Tabachnick, B.G. and Fidell, L.S. 2012. *Using Multivariate Statistics,* New York, Pearson Education.

Talley, W.K. 2007. Port performance: an economics perspective. *In:* BROOKS, M. R. & CULLINANE, K. (eds.) *Devolution, Port Governance and Port Performance.* Oxford: Elsevier, pp. 499-516.

Talley, W.K. 2009. *Port Economics,* New York, Routledge.

Teece, D.J., Pisano, P.G. and Shuen, A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal,* 18 (7), pp. 509-533.

Teng, B.S. 2003. collaborative advantage of strategic alliances: value creation in the value net. *Journal of General Managment,* 29 (2), pp. 1-22.

Teo, T.S.H. and Pian, Y. 2003. A contingency perspective on Internet adoption and competitive advantage. *European Journal of Information Systems,* 12 (2), pp. 78-92.

Tongzon, J., Chang, Y.-T. and Lee, S.-Y. 2009. How supply chain oriented is the port sector? *International Journal of Production Economics,* 122 (1), pp. 21-34.

Tongzon, J. and Heng, W. 2005. Port privatization, efficiency and competitiveness: some empirical evidence from container ports (terminals). *Transportation Research Part A: Policy and Practice,* 39 (5), pp. 405-424.

Tongzon, J.L. 1995. Determinants of port performance and efficiency. *Transportation Research Part A: Policy and Practice,* 29 (3), pp. 245-252.

Tongzon, J.L. 2009. Port choice and freight forwarders. *Transportation Research Part E: Logistics and Transportation Review,* 45 (1), pp. 186-195.

Tongzon, J.L. and Ganesalingam, S. 1994. An evaluation of ASEAN port performance and efficiency. *Asian Economic Journal,* 8 (3), pp. 317-330.

Turnbull, P., Oliver, N. and Wilkinson, B. 1992. Buyer-supplier relations in the UK - automotive industry: strategic implications of the Japanese manufacturing model. *Strategic Management Journal,* 13 (2), pp. 159-168.

UNCTAD. 1985. *Co-operation between ports* [Online]. UNCTAD secretariat.

UNCTAD. 1995. *Facing the challenge of integrated transport services* [Online]. UNCTAD secretariat.

UNCTAD. 1996. *Potentialities for regional port cooperation* [Online]. UNCTAD secretariat.

UNCTAD. 2004. *Assessment of a seaport land interface: an analytical framework* [Online]. UNCTAD secretariat.

UNCTAD. 2013. *Review of maritime transport* [Online]. New York: UNCTAD secretariat.

UNESCAP 2005. *Development of shipping and ports in North-East Asia,* Thailand, United Nations Economic and Social Commission for Asia and the Pacific.

UNESCAP 2007. *Regional shipping and port development: container traffic forecost 2007 update,* Thailand, United Nations Economic and Social Commission for Asia and the Pacific.

Van de Voorde, E.E.M. 2005. What future the maritime sector?: some considerations on globalisation, co-operation and market power. *Research in Transportation Economics,* 13, pp. 253-277.

Van de Voorde, E.E.M. and Winkelmans, W. 2002. A general introduction to port competition and management. *In:* HUYBRECHTS, M., MEERSMAN, H., VAN DE VOORDE, E., VAN HOOYDONK, E., VERBEKE, A. & WINKELMANS, W. (eds.) *Port Competitiveness: An Economic and Legal Analysis of the Factors Determining the Competitiveness of Seaports.* Antwerp: De Boeck, pp. 1-16.

Van Der Horst, M.R. and De Langen, P.W. 2008. Coordination in hinterland transport chains: a major challenge for the seaport community. *Maritime Economics and Logistics,* 10 (1-2), pp. 108–129.

Van Der Horst, M.R. and Van Der Lugt, L.M. 2011. Coordination mechanisms in improving hinterland accessibility: empirical analysis in the port of Rotterdam. *Maritime Policy and Management,* 38 (4), pp. 415-435.

Van Maanen, J. 1983. *Qualitative Methodology,* London, Sage.

Van Weele, A.J. 2002. *Purchasing and Supply Chain Management,* Stamford, Thomson Learning.

Vangen, S. and Huxham, C. 2003. Enacting leadership for collaborative advantage: dilemmas of ideology and pragmatism in the activities of partnership managers. *British Journal of Management,* 14, pp. S61-S76.

Venkatraman, N. 1989. Strategic orientation of business enterprise: the construct, dimensionality, and measurement. *Management Science,* 35 (8), pp. 942-962.

Vereecke, A. and Muylle, S. 2006. Performance improvement through supply chain collaboration in Europe. *International Journal of Operations and Production Management,* 26 (11), pp. 1176-1198.

Verma, N. 2004. Collaborative advantage: a case for creating strategic business alliances in oil sector in India. *Delhi Business Review,* 5 (1), pp. 113-121.

Vitsounis, T.K. and Pallis, A.A. 2012. Port value chains and the role of interdependencies. *In:* SONG, D. W. & PANAYIDES, P. M. (eds.) *Maritime Logistics: Contemporary Issues.* Bingely: Emerald Group, pp. 155-173.

Wang, T.F. and Cullinane, K. 2006. The efficiency of European container terminals and implications for supply chain management. *Maritime Economics and Logistics,* 8 (1), pp. 82-99.

Webster's 1966. *Webster's Third New International Dictionary.* Chicago: William Benton.

Wernerfelt, B. 1984. A resource-based view of the firm. *Strategic Management Journal,* 5 (2), pp. 171-180.

Whipple, J.M. and Russell, D. 2007. Building supply chain collaboration: a typology of collaborative approaches. *The International Journal of Logistics Management,* 18 (2), pp. 174-196.

Wiegmans, B.W., Hoest, A.V.D. and Notteboom, T.E. 2008. Port and terminal selection by deep-sea container operators. *Maritime Policy and Management,* 35 (6), pp. 517-534.

Wiengarten, F., Humphreys, P., Cao, G., Fynes, B. and McKittrick, A. 2010. Collaborative supply chain practices and performance: exploring the key role of information quality. *Supply Chain Management: An International Journal,* 15 (6), pp. 463-473.

Wiengarten, F., Humphreys, P., McKittrick, A. and Fynes, B. 2013. Investing the impact of e-business applications on supply chain collaboration in the German automotive industry. *International Journal of Operations and Production Management,* 33 (1), pp. 25-48.

Wijanto, S.H. 2008. Structural equation modeling (SEM): a tool for research in business and management. *Journal of Quantitative methods,* 4 (2), pp. 25-41.

Wilding, R. and Humphries, A.S. 2006. Understanding collaborative supply chain relationships through the application of the Williamson organisational failure framework. *International Journal of Physical Distribution and Logistics Management,* 36 (4), pp. 309-329.

Wilhelm, M.M. and Kohlbacher, F. 2011. Co-opetition and knowledge co-creation in Japanese supplier-networks: the case of Toyota. *Asian Business and Management,* 10 (1), pp. 66-86.

Williamson, O.E. 1975. *Markets and Hierarchies,* New York, Free Press.

Williamson, O.E. 1985. *The Economic Institutions of Capitalism,* New York, The Free Press.

Williamson, O.E. 1991. Strategizing, economizing, and economic organization. *Strategic Management Journal,* 12 (S2), pp. 75-94.

Williamson, O.E. 1993. Calculativeness, trust, and economic organization. *Journal of Law and Economics,* 36 (1), pp. 453-486.

Wilson, J. 2010. *Essentials of Business Research: A Guide to Doing Your Research Project,* London, Sage

Wisner, J.D. 2003. A structural equation model of supply chain management strategies and firm performance. *Journal of Business Logistics,* 24 (1), pp. 1-26.

Woo, J.-K. and Moon, D.S.-H. 2014. The effect of slow steaming on the environmental performance in liner shipping. *Maritime Policy and Management,* 41 (2), pp. 176-191.

Woo, S.-H., Petit, S.J., Kwak, D.-W. and Beresford, A.K.C. 2011a. Seaport research: a structured literature review on methodological issues since the 1980s. *Transportation Research Part A: Policy and Practice,* 45 (7), pp. 667-685.

Woo, S.-H., Pettit, S. and Beresford, A.K.C. 2011b. Port evolution and performance in changing logistics environments. *Maritime Economics and Logistics,* 13 (3), pp. 250-277.

Woo, S.-H., Pettit, S.J. and Beresford, A.K.C. 2013. An assessment of the integration of seaports into supply chains using a structural equation model. *Supply Chain Management: An International Journal,* 18 (3), pp. 235-252.

World-Bank 2007. *Port Reform Toolkit: Framework for Port Reform,* Washington, World Bank.

Xia, W. and Lee, G. 2005. Complexity of information systems development projects: conceptualization and measurement developments. *Journal of Management Information Systems,* 22 (1), pp. 45-83.

Yang, C.-C., Marlow, P.B. and Lu, C.-S. 2009. Assessing resources, logistics service capabilities, innovation capabilities and the performance of container shipping services in Taiwan. *International Journal of Production Economics,* 122 (1), pp. 4-20.

Yap, W.Y. and Lam, J.S.L. 2006. Competition dynamics between container ports in East Asia. *Transportation Research Part A: Policy and Practice,* 40 (1), pp. 35-51.

Yeo, K.-T., Roe, M. and Dinwoodie, J. 2008. Evaluating the competitiveness of container ports in Korea and China. *Transportation Research Part A: Policy and Practice,* 42 (6), pp. 910-921.

Yu, W., Jacobs, M.A., Salisbury, W.D. and Enns, H. 2013. The effects of supply chain integration on customer satisfaction and financial performance: an organizational learning perspective. *International Journal of Production Economics,* 146 (1), pp. 346-358.

Yuen, C.-l.A., Zhang, A. and Cheung, W. 2012. Port competitiveness from the users' perspective: an analysis of major container ports in China and its neighboring countries. *Research in Transportation Economics,* 35 (1), pp. 34-40.

Zacharia, Z.G., Nix, N.W. and Lusch, R.F. 2011. Capabilities that enhance outcomes of an episodic supply chain collaboration. *Journal of Operations Management,* 29 (6), pp. 591-603.

Zhao, X., Lynch, J.G. and Chen, Q. 2010. Reconsidering Baron and Kenny: myths and truths about mediation analysis. *Journal of Consumer Research,* 37 (2), pp. 197-206.

Zikmund, W.G., Babin, B.J., Carr, J.C. and Griffin, M. 2013. *Business Research Methods,* Mason, Cengage Learning.

Zineldin, M. 1998. Towards an ecological collaborative relationship management: a "co-opetive" perspective. *European Journal of Marketing,* 32 (11/12), pp. 1138-1164.

Appendix A. Questionnaire

Northeast Asian Containerised Maritime Logistics: Supply Chain Collaboration, Collaborative Advantage and Performance

Dear Sir/Madam,

I am currently engaged in a PhD study in international shipping, Logistics & Operation Group in Plymouth Business School (www.plymouth.ac.uk) in the UK. My research primarily explores the relationships between supply chain collaboration, collaborative advantage and port performance in the maritime context. This study may reveal how to enhance collaborative advantage and port performance by supply chain collaboration between containerised maritime logistics organisations

As an expert, I would like to invite you to participate in this study. There are no right or wrong answers. Please answer all the questions from the perspective of your organisation. This questionnaire should take around 15 minutes to complete.

The survey frame is anonymous. Any information provided is in the strictest confidence and only aggregated results will be reported. No specific details about companies or respondents will be reported. The results of this survey will be utilised only for academic purposes and a summary of these will be if you wish. Thank you for your kind co-operation.

Yours sincerely,

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<Questionnaire for terminal operators>

SECTION A – Supply chain collaboration

* Please tick (√) one box to indicate the extent to which you agree or disagree with each statement. The item scales are five-point Likert scales with 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree.

Information sharing		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners provide any information that might help within our port supply chain.					
2	Our terminal and other port supply chain partners frequently exchange information within our port supply chain.					
3	Our terminal and other port supply chain partners have informed each other of changing needs in advance within our port supply chain.					
4	Our terminal and other port supply chain partners keep each other informed about events or changes that may affect our port supply chain.					
5	Our terminal and other port supply chain partners exchange accurate information within our port supply chain.					
Knowledge creation		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners search and acquire new and relevant knowledge within our port supply chain.					
2	Our terminal and other port supply chain partners assimilate and apply relevant knowledge within our port supply chain.					
3	Our terminal and other port supply chain partners identify customer needs for our port supply chain.					
4	Our terminal and other port supply chain partners discover new technology for our port supply chain.					
5	Our terminal and other port supply chain partners learn the intensions and capabilities of other port supply chains in competition.					
Goal similarity		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners pursue efficient multi-modal transport of container cargoes for our port supply chain.					
2	Our terminal and other port supply chain partners stress the importance of collaboration within our port supply chain.					
3	Our terminal and other port supply chain partners pursue the provision of value-added logistics services for our port supply chain.					
4	Our terminal and other port supply chain partners					

	pursue cost reduction throughout our port supply chain.					
5	Our terminal and other port supply chain partners pursue reduced cycle times and enhanced inventory management for our port supply chain.					
Decision harmonisation		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners plan on emergent situations within our port supply chain.					
2	Our terminal and other port supply chain partners plan on altering schedules and amending orders when customers demand them within our port supply chain.					
3	Our terminal and other port supply chain partners manage the flow of cargoes within port supply chain.					
4	Our terminal and other port supply chain partners plan on transport planning and scheduling transport within our port supply chain.					
5	Our terminal and other port supply chain partners advise each other of any potential problems in meeting the shipper's needs within our port supply chain.					
Collaborative communication		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners have frequent contacts on a regular basis for our port supply chain.					
2	Our terminal and other port supply chain partners have open and two way communication for our port supply chain.					
3	Our terminal and other port supply chain partners have informal communication for our port supply chain.					
4	Our terminal and other port supply chain partners have many different channels to communicate for our port supply chain.					
5	Our terminal and other port supply chain partners have influence each other's decisions through discussion for our port supply chain.					
Joint supply chain performance measurement		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners develop systems to evaluate supply chain performance for our port supply chain.					
2	Our terminal and other port supply chain partners deal with security and risks that may occur for our port supply chain.					
3	Our terminal and other port supply chain partners develop systems to enable shippers to identify their cargoes' location for our port supply chain.					
4	Our terminal and other port supply chain partners					

	keep seamless transport flows even in a peak time for our port supply chain.					
5	Our terminal and other port supply chain partners solve the problems together (i.e. delay and accidents in transport) for our port supply chain.					

SECTION B – Collaborative advantage

* Please tick (√) one box to indicate the extent to which you agree or disagree with each statement. The item scales are five-point Likert scales with 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree.

Business synergy		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners have an integrated IT infrastructure for our port supply chain.					
2	Our terminal and other port supply chain partners have integrated knowledge bases and know-how for our port supply chain.					
3	Our terminal and other port supply chain partners have integrated marketing efforts for our port supply chain.					
4	Our terminal and other port supply chain partners have integrated services for our port supply chain.					
Quality		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners offer services that are highly reliable for our port supply chain.					
2	Our terminal and other port supply chain partners offer services that are highly punctual for our port supply chain.					
3	Our terminal and other port supply chain partners offer high quality services to our customers for our port supply chain.					
4	Our terminal and other port supply chain partners have helped each other to improve service quality for our port supply chain.					
Innovation		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners introduce new services to market quickly for our port supply chain.					
2	Our terminal and other port supply chain partners have rapid new services development for our port supply chain.					
3	Our terminal and other port supply chain partners innovate frequently (e.g., state-of-the art communication systems, latest skills for faster container transport) for our port supply chain.					
Flexibility		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	Our terminal and other port supply chain partners offer a variety of services efficiently for our port					

	supply chain.					
2	Our terminal and other port supply chain partners offer customised services with different features quickly for our port supply chain.					
3	Our terminal and other port supply chain partners meet different customer demands efficiently for our port supply chain.					
4	Our terminal and other port supply chain partners have good customer responsiveness for our port supply chain.					

SECTION C – Port performance

* Please tick (√) one box to indicate how your port performs compared to your major competitors. The item scales are five-point Likert scales with 5 = much better, 4 = better, 3 = no difference, 2 = worse, 1 = much worse.

Connectivity		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Capacity of inland transport services is good.					
2	Transportation time to hinterland is short.					
Value-added service (VAS)		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Cargo is attracted by VAS (warehousing).					
2	VA is increased from VAS.					
3	We have adequate facility for VAS.					
Safety and security		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Our port is compliant to security regulations.					
2	The number of accident is low.					
Efficient operation		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Terminal productivity is high.					
2	Port turnaround time is short (ship waiting time due to congestion).					
3	Port operating hours (24/7/365).					
Cost efficiency		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Our total price is low.					
2	Our cargo handling charge is low.					
3	Our auxiliary service charge is low (pilotage, towage, customers).					
4	Cost of inland transport services is low.					
Reliability		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Our port handles cargo on quoted or anticipated time.					
2	Our port handles cargo on time customers require.					
3	Our port’s service lead time is short.					
4	Our port provides shipment information accurately					
Convenience of port users		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Our port has information technology ability (EDI; port-MIS) for port users.					
2	Our port has easy and fast operation process for port users.					

3	Our port has convenience of custom procedures for port users.					

<Questionnaire port users: shipping lines, inland transport companies, freight forwarders, ship management companies and third-party logistics providers >

SECTION A – Supply chain collaboration

* Please tick (√) one box to indicate the extent to which you agree or disagree with each statement. The item scales are five-point Likert scales with 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree.

Information sharing		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	We and our terminal provide any information that might help within our port supply chain.					
2	We and our terminal frequently exchange information within our port supply chain.					
3	We and our terminal have informed each other of changing needs in advance within our port supply chain.					
4	We and our terminal keep each other informed about events or changes that may affect our port supply chain.					
5	We and our terminal exchange accurate information within our port supply chain.					
Knowledge creation		**1** strongly disagree	**2** disagree	**3** neutral	**4** agree	**5** strongly agree
1	We and our terminal search and acquire new and relevant knowledge within our port supply chain.					
2	We and our terminal assimilate and apply relevant knowledge within our port supply chain.					
3	We and our terminal identify customer needs for our port supply chain.					
4	We and our terminal discover new technology for our port supply chain.					
5	We and our terminal learn the intensions and capabilities of other port supply chains in competition.					
Goal similarity		**1** strongly disagree	**2** disagree	**3** neutral	**4** agree	**5** strongly agree
1	We and our terminal pursue efficient multi-modal transport of container cargoes for our port supply chain.					
2	We and our terminal stress the importance of collaboration within our port supply chain.					
3	We and our terminal pursue the provision of value-added logistics services for our port supply chain.					
4	We and our terminal pursue cost reduction throughout our port supply chain.					
5	We and our terminal pursue reduced cycle times and enhanced inventory management for our port supply chain.					
Decision harmonisation		**1** strongly disagree	**2** disagree	**3** neutral	**4** agree	**5** strongly agree
1	We and our terminal plan on emergent situations					

	within our port supply chain.					
2	We and our terminal plan on altering schedules and amending orders when customers demand them within our port supply chain.					
3	We and our terminal manage the flow of cargoes within port supply chain.					
4	We and our terminal plan on transport planning and scheduling transport within our port supply chain.					
5	We and our terminal advise each other of any potential problems in meeting the shipper's needs within our port supply chain.					
Collaborative communication		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	We and our terminal have frequent contacts on a regular basis for our port supply chain.					
2	We and our terminal have open and two way communication for our port supply chain.					
3	We and our terminal have informal communication for our port supply chain.					
4	We and our terminal have many different channels to communicate for our port supply chain.					
5	We and our terminal have influence each other's decisions through discussion for our port supply chain.					
Joint supply chain performance measurement		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	We and our terminal develop systems to evaluate supply chain performance for our port supply chain.					
2	We and our terminal deal with security and risks that may occur for our port supply chain.					
3	We and our terminal develop systems to enable shippers to identify their cargoes' location for our port supply chain.					
4	We and our terminal keep seamless transport flows even in a peak time for our port supply chain.					
5	We and our terminal solve the problems together (i.e. delay and accidents in transport) for our port supply chain.					

SECTION B – Collaborative advantage

* Please tick (√) one box to indicate the extent to which you agree or disagree with each statement. The item scales are five-point Likert scales with 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree.

Business synergy		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	We and our terminal have an integrated IT infrastructure for our port supply chain.					
2	We and our terminal have integrated knowledge bases and know-how for our port supply chain.					
3	We and our terminal have integrated marketing efforts for our port supply chain.					
4	We and our terminal have integrated services for our					

	port supply chain.					
Quality		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	We and our terminal offer services that are highly reliable for our port supply chain.					
2	We and our terminal offer services that are highly punctual for our port supply chain.					
3	We and our terminal offer high quality services to our customers for our port supply chain.					
4	We and our terminal have helped each other to improve service quality for our port supply chain.					
Innovation		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	We and our terminal introduce new services to market quickly for our port supply chain.					
2	We and our terminal have rapid new services development for our port supply chain.					
3	We and our terminal innovate frequently (e.g., state-of-the art communication systems, latest skills for faster container transport) for our port supply chain.					
Flexibility		1 strongly disagree	2 disagree	3 neutral	4 agree	5 strongly agree
1	We and our terminal offer a variety of services efficiently for our port supply chain.					
2	We and our terminal offer customised services with different features quickly for our port supply chain.					
3	We and our terminal meet different customer demands efficiently for our port supply chain.					
4	We and our terminal have good customer responsiveness for our port supply chain.					

SECTION C – Port performance

* Please tick (√) one box to indicate how your port performs compared to your major competitors. The item scales are five-point Likert scales with 5 = much better, 4 = better, 3 = no difference, 2 = worse, 1 = much worse.

Connectivity		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Capacity of inland transport services is good.					
2	Transportation time to hinterland is short.					
Value-added service (VAS)		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Cargo is attracted by VAS (warehousing).					
2	VA is increased from VAS.					
3	We have adequate facility for VAS.					
Safety and security		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Our port is compliant to security regulations.					
2	The number of accident is low.					
Efficient operation		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Terminal productivity is high.					
2	Port turnaround time is short (ship waiting time due to congestion).					

3	Port operating hours (24/7/365).					
Cost efficiency		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Our total price is low.					
2	Our cargo handling charge is low.					
3	Our auxiliary service charge is low (pilotage, towage, customers).					
4	Cost of inland transport services is low.					
Reliability		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Our port handles cargo on quoted or anticipated time.					
2	Our port handles cargo on time customers require.					
3	Our port's service lead time is short.					
4	Our port provides shipment information accurately					
Convenience of port users		1 Much worse	2 Worse	3 No difference	4 Better	5 Much better
1	Our port has information technology ability (EDI; port-MIS) for port users.					
2	Our port has easy and fast operation process for port users.					
3	Our port has convenience of custom procedures for port users					

SECTION D – The respondent profile

1. What are major business areas of your organisations?

① terminal operator ( ) ② shipping line ( ) ③ inland transport company ( ) ④ freight forwarder ( ) ⑤ ship management company ( ) ⑥ third-party logistics provider ( )

2. Which ports do your organisations mostly use or involve?

① Busan ( ) ② Gwangyang ( ) ③ Incheon ( )

3. How long have you been worked in the maritime industry?

① 1-3 years ( ) ②4-6 ( ) ③7-9 ( ) ④10-12 ( ) ⑤13-15 ( ) ⑥16-18 ( ) ⑦ over 19 ( )

4. How long have you been worked in the current organisation?

① 1-3 years ( ) ②4-6 ( ) ③7-9 ( ) ④10-12 ( ) ⑤13-15 ( ) ⑥16-18 ( ) ⑦ over 19 ( )

5. What is your current position in your organisation?

① Assistant manager ( ) ② manager ( ) ③ deputy general manager ( ) ④ department manager ( ) ⑤ managing direct ( ) ⑥ CEO ( )

6. How long did your organisation do business in the maritime industry?

①1-3 years ( ) ②4-6 ( ) ③7-9 ( ) ④10-12 ( ) ⑤13-15 ( ) ⑥16-18 ( ) ⑦ over 19 ( )

7. How many full-time employees does your organisation have?

① Less than 50 (   ) ② 50~100 (   ) ③ 100-150 (   ) ④150-200 (   ) ⑤ 200-250 (   ) ⑥ 250-300 (   ) ⑦ over 300 (   )

8. What is name of your organisation? (e.g. Hanjin Shipping, BNCT, INTERGIS) (   )

Would you like to receive the result of this study?   YES (   ) NO (   )
If yes, please write down your email address.
E-mail address: (   )

Thank your for your participation!

<Korean questionnaire for terminal operators>

공급사슬협력이 협력 우위 및 항만 성과에 미치는 영향에 관한 연구

안녕하십니까.

저는 현재 영국 플리머스 대학교(www.plymouth.ac.uk) 내의 International Shipping, Logistics & Operations Group 에서 박사 과정을 이수하고 있습니다.

오늘날의 항만 경쟁은 단순히 항만간의 경쟁이 아니라, 항만에서 물류공급활동을 수행하고 있는 주체들(Port Logistics Supply Chains)간의 경쟁으로 변화하고 있습니다. 공급사슬협력 (Supply Chain Collaboration)의 상호 작용을 통하여 화물과 정보의 원활한 흐름을 통하여 항만 수요의 궁극적 소비자인 화주를 만족시키고 있으며, 이를 통하여 항만물류공급활동 주체의 경쟁우위 확보 제고와 성과를 달성할 수 있습니다. 이에 터미널 (port) 과 타 해운항만업체들 (port users)간의 공급사슬협력은 해당 항만공급체인 전체의 협력우위에 영향을 미쳐, 타 공급항만체인보다 높은 협력우위를 달성하여 대상 항만 경쟁력을 높일 수 있습니다. 이러한 배경에서 동일항만내의 여러 해운항만관련업체 (컨테이너 터미널 운영사, 선사, 육상운송업체, 항만관련업체 등) 간의 공급사슬협력의 상호작용이 협력우위 (Collaborative Advantage)와 항만성과 (Port performance)에 영향을 어떠한 영향을 미치는가에 대한 연구를 위한 본 설문을 수집하고자 합니다.

본 설문지는 이러한 연구수행에 필요한 자료를 수집하기 위해 작성되었습니다. 통계법에 따라 본 설문에 응답한 내용은 연구목적 이외의 다른 목적에는 절대 사용되지 않을 것이며 회사 및 응답자의 비밀은 철저히 보장됩니다. 업무에 바쁘신 관계로 번거로우시겠지만 본 설문에 응답하여 주신다면 본 연구에 많은 도움이 될 뿐만 아니라 우리나라 해운항만물류관련 시장의 발전 및 환경개선에도 커다란 도움이 될 것입니다. 다시 한 번 귀하의 성실한 답변을 부탁드리며, 귀중한 시간 할애해 주신 점 감사드립니다. 끝으로 본 설문지 작성에는 10~15 분 정도 소요될 것으로 예상됩니다. 작성 시 설문에 대한 의문사항은 아래의 연락처로 연락하여 주시기 바랍니다.

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<컨테이너 터미널 운영사 설문지>

SECTION A – 공급사슬협력 (Supply chain collaboration)

* 다음은 귀사가 속해 있는 항만에서 타 해운항만업체 (선사, 육상운송업체, 포워더, 선박관리업체, 제 3 자 물류업체 등)과의 공급사슬협력에 관한 질문입니다. 귀사가 동의하는 정도를 표시해 주시기 바랍니다.

	정보공유 (Information sharing)	1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 서로에게 도움이 될 만한 정보를 제공한다.					
2	우리 터미널과 항만공급사슬파트너는 자주 정보를 교환한다.					
3	우리 터미널과 항만공급사슬파트너는 시시각각 변화하는 요구를 미리 알린다.					
4	우리 터미널과 항만공급사슬파트너는 서로에게 영향을 줄 수 있는 일이나 사건에 대해 정보를 교환한다.					
5	우리 터미널과 항만공급사슬파트너는 정확한 정보를 교환한다.					

	지식창조 (Knowledge creation)	1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 우리 항만공급체인을 위해 관련된 새로운 지식을 찾는다.					
2	우리 터미널과 항만공급사슬파트너는 우리 항만공급체인을 위해 관련 지식을 이해하고 적용한다.					
3	우리 터미널과 항만공급사슬파트너는 우리 항만공급체인을 위해 고객의 요구사항을 확인한다.					
4	우리 터미널과 항만공급사슬파트너는 우리 항만공급체인을 위해 새로운 기술을 찾는다.					
5	우리 터미널과 항만공급사슬파트너는 경쟁 항만공급사슬의 의도와 역량을 파악한다.					

	목표유사성 (Goal similarity)	1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 컨테이너 화물의 효율적인 복합운송을 위해 노력한다.					
2	우리 터미널과 항만공급사슬파트너는 우리항만공급체인내의 협력적 활동에 대해 중요시한다.					
3	우리 터미널과 항만공급사슬파트너는 우리항만공급체인내의 부가가치 물류서비스를 제공하기 위해 노력한다.					
4	우리 터미널과 항만공급사슬파트너는 우리항만공급체인 전반에 비용을 줄이려고 노력한다.					
5	우리 터미널과 항만공급사슬파트너는 우리항만공급체인 전반에 짧은 사이클 타임과 더 나은 재고관리를 위해 노력한다.					

결정 조화 (Decision harmonisation)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 비상상황을 함께 대응한다.					
2	우리 터미널과 항만공급사슬파트너는 고객이 변경된 스케쥴을 요구할때 신속히 대응한다.					
3	우리 터미널과 항만공급사슬파트너는 화물의 흐름을 함께 관리한다.					
4	우리 터미널과 항만공급사슬파트너는 운송계획을 함께 실행한다.					
5	우리 터미널과 항만공급사슬파트너는 화주의 요구에 대응하기 위해 어떤 잠재적인 문제에 대해 서로 의견을 교환한다.					
협력적 커뮤니케이션 (Collaborative communication)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 정기적인 빈번한 연락을 한다.					
2	우리 터미널과 항만공급사슬파트너는 열려있는 쌍방향의 커뮤니케이션을 한다.					
3	우리 터미널과 항만공급사슬파트너는 비공식적인 커뮤니케이션 채널을 가지고 있다.					
4	우리 터미널과 항만공급사슬파트너는 의사소통할 수 있는 여러가지 채널을 가지고 있다.					
5	우리 터미널과 항만공급사슬파트너는 토론을 통해 상대의 결정에 영향을 미친다.					
공동공급사슬성과측정 (Joint supply chain performance measurement)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 공급사슬성과를 측정하기 위한 시스템을 개발한다.					
2	우리 터미널과 항만공급사슬파트너는 발생할 수 있는 보안과 리스크에 대응한다.					
3	우리 터미널과 항만공급사슬파트너는 화주가 화물의 위치를 파악할 수 있도록 시스템을 개발한다.					
4	우리 터미널과 항만공급사슬파트너는 피크타임에도 화물의 흐름이 원활하도록 관리한다.					
5	우리 터미널과 항만공급사슬파트너는 문제를 함께 해결한다 (예: 운송시 지연과 사고)					

SECTION B - 협력 우위 (Collaborative advantage)

* 다음은 귀사가 속해 있는 항만에서 타 해운항만업체 (선사, 육상운송업체, 포워더, 선박관리업체, 제 3 자 물류업체 등)과의 협력우위에 관한 질문입니다. 귀사가 동의하는 정도를 표시해 주시기 바랍니다.

비즈니스 시너지(Business synergy)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 통합된 IT 시설을 가지고 있다.					
2	우리 터미널과 항만공급사슬파트너는 통합된					

	지식베이스와 노하우를 가지고 있다.					
3	우리 터미널과 항만공급사슬파트너는 통합된 마케팅 노력을 한다.					
4	우리 터미널과 항만공급사슬파트너는 통합된 서비스를 제공한다.					
서비스 품질 (Quality)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 신뢰할 수 있는 서비스를 제공한다.					
2	우리 터미널과 항만공급사슬파트너는 정시성이 높은 서비스를 제공한다.					
3	우리 터미널과 항만공급사슬파트너는 높은 품질의 서비스를 제공한다.					
4	우리 터미널과 항만공급사슬파트너는 서비스 품질을 높이기 위해 서로 협력한다.					
혁신 (Innovation)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 새로운 서비스를 마켓에 신속히 도입한다.					
2	우리 터미널과 항만공급사슬파트너는 신속하게 새로운 서비스 개발을 한다.					
3	우리 터미널과 항만공급사슬파트너는 빈번하게 쇄신 한다. (예: 최신통신시스템, 더 빠른 컨테이너 운송을 위한 최신 기술)					
유연성 (Flexibility)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 터미널과 항만공급사슬파트너는 다양한 종류의 서비스를 효율적으로 제공한다.					
2	우리 터미널과 항만공급사슬파트너는 맞춤형 서비스를 신속하게 제공한다.					
3	우리 터미널과 항만공급사슬파트너는 다양한 고객의 요구를 맞춘다.					
4	우리 터미널과 항만공급사슬파트너는 높은 고객 반응성을 가진다.					

SECTION C – 항만 성과 (Port performance)

* 다음은 귀사가 속해 있는 항만의 성과에 관한 질문입니다. 귀사의 터미널과 경쟁사를 비교하여 동의하는 정도를 표시해 주시기 바랍니다.

복합운송 연결 (Connectivity)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	내륙운송서비스 능력 (capacity)이 좋다.					
2	배후부지로의 운송시간이 짧다.					
부가가치서비스(Value-added service)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	화물이 부가가치서비스 (보관)으로 인해 유치된다.					
2	부가가치서비스로 인해 부가가치가 향상된다.					

3	우리 터미널은 부가가치서비스를 위한 충분한 시설을 확보하고 있다.					
안전 및 보안 (Safety and security)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	우리 터미널은 보안규율을 잘 준수한다.					
2	우리 터미널은 사고건수가 낮다.					
효율적 운영 (Efficient operation)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	터미널 생산성이 높다.					
2	항만 적하 시간이 짧다 (정체로 인한 선박대기시간)					
3	항만운영시간이 길다 (24/7/365).					
비용 효율성 (Cost efficiency)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	총 가격이 낮다.					
2	화물처리료가 싸다.					
3	보조 서비스료가 싸다. (도선, 예선 등)					
4	육상운송서비스료가 싸다.					
신뢰성 (Reliability)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	우리 항만은 예정된 시간안에 화물을 인도한다.					
2	우리 항만은 고객이 요구하는 시간안에 화물을 처리한다.					
3	우리 항만 서비스의 리드타임은 짧다.					
4	우리 항만은 정확한 화물정보를 제공한다.					
항만사용자의 편의 (Convenience of port users)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	우리 항만은 항만사용자의 편의를 위해 정보기술능력(EDI, Port-MIS)을 보유하고 있다.					
2	우리 항만은 항만사용자의 편의를 위해 쉽고 빠른 운영프로세스를 가지고 있다.					
3	우리 항만은 항만사용자의 편의를 위해 편리한 세관프로세스를 가지고 있다.					

<Korean questionnaire for port users>

<항만사용자 설문지: 선사, 육상운송업체, 포워더, 선박관리회사, 3 자물류회사>

SECTION A – 공급사슬협력 (Supply chain collaboration)

* 다음은 귀사가 속해 있는 항만에서 귀사가 이용하는 터미널과의 공급사슬협력에 관한 질문입니다. 귀사가 동의하는 정도를 표시해 주시기 바랍니다.

정보공유 (Information sharing)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 서로에게 도움이 될 만한 정보를 제공한다.					
2	우리 회사는 터미널과 자주 정보를 교환한다.					
3	우리 터미널과 항만공급사슬파트너는 시시각각 변화하는 요구를 미리 알린다.					
4	우리 회사는 터미널과 서로에게 영향을 줄 수 있는 일이나 사건에 대해 정보를 교환한다.					
5	우리 회사는 터미널과 정확한 정보를 교환한다.					
지식창조 (Knowledge creation)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 우리 항만공급체인을 위해 관련된 새로운 지식을 찾는다.					
2	우리 회사는 터미널과 우리 항만공급체인을 위해 관련 지식을 이해하고 적용한다.					
3	우리 회사는 터미널과 우리 항만공급체인을 위해 고객의 요구사항을 확인한다.					
4	우리 회사는 터미널과 우리 항만공급체인을 위해 새로운 기술을 찾는다.					
5	우리 회사는 터미널과 경쟁 항만공급사슬의 의도와 역량을 파악한다.					
목표유사성 (Goal similarity)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 컨테이너 화물의 효율적인 복합운송을 위해 노력한다.					
2	우리 회사는 터미널과 우리항만공급체인내의 협력적 활동에 대해 중요시한다.					
3	우리 회사는 터미널과 우리항만공급체인내의 부가가치 물류서비스를 제공하기 위해 노력한다.					
4	우리 회사는 터미널과 우리항만공급체인 전반에 비용을 줄이려고 노력한다.					
5	우리 회사는 터미널과 우리항만공급체인 전반에 짧은 사이클 타임과 더 나은 재고관리를 위해 노력한다.					
결정 조화 (Decision harmonisation)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 비상상황을 함께 대응한다.					
2	우리 회사는 터미널과 고객이 변경된 스케쥴을 요구할때 신속히 대응한다.					

3	우리 회사는 터미널과 화물의 흐름을 함께 관리한다.					
4	우리 회사는 터미널과 운송계획을 함께 실행한다.					
5	우리 회사는 터미널과 화주의 요구에 대응하기 위해 어떤 잠재적인 문제에 대해 서로 의견을 교환한다.					
협력적 커뮤니케이션 (Collaborative communication)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 정기적인 빈번한 연락을 한다.					
2	우리 회사는 터미널과 열려있는 쌍방향의 커뮤니케이션을 한다.					
3	우리 회사는 터미널과 비공식적인 커뮤니케이션 채널을 가지고 있다.					
4	우리 회사는 터미널과 의사소통할 수 있는 여러가지 채널을 가지고 있다.					
5	우리 회사는 터미널과 토론을 통해 상대의 결정에 영향을 미친다.					
공동공급사슬성과측정 (Joint supply chain performance measurement)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 공급사슬성과를 측정하기 위한 시스템을 개발한다.					
2	우리 회사는 터미널과 발생할 수 있는 보안과 리스크에 대응한다.					
3	우리 회사는 터미널과 화주가 화물의 위치를 파악할 수 있도록 시스템을 개발한다.					
4	우리 회사는 터미널과 피크타임에도 화물의 흐름이 원활하도록 관리한다.					
5	우리 회사는 터미널과 문제를 함께 해결한다 (예: 운송시 지연과 사고)					

SECTION B – 협력 우위 (Collaborative advantage)

* 다음은 귀사가 속해 있는 항만에서 타 해운항만업체 (선사, 육상운송업체, 포워더, 선박관리업체, 제 3 자 물류업체 등)과의 협력우위에 관한 질문입니다. 귀사가 동의하는 정도를 표시해 주시기 바랍니다.

비즈니스 시너지(Business synergy)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 통합된 IT 시설을 가지고 있다.					
2	우리 회사는 터미널과 통합된 지식베이스와 노하우를 가지고 있다.					
3	우리 회사는 터미널과 통합된 마케팅 노력을 한다.					
4	우리 회사는 터미널과 통합된 서비스를 제공한다.					
서비스 품질 (Quality)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 신뢰할 수 있는 서비스를 제공한다.					
2	우리 회사는 터미널과 정시성이 높은 서비스를 제공한다.					
3	우리 회사는 터미널과 높은 품질의 서비스를					

	제공한다.					
4	우리 회사는 터미널과 서비스 품질을 높이기 위해 서로 협력한다.					
혁신 (Innovation)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 새로운 서비스를 마켓에 신속히 도입한다.					
2	우리 회사는 터미널과 신속하게 새로운 서비스 개발을 한다.					
3	우리 회사는 터미널과 빈번하게 쇄신 한다. (예: 최신통신시스템, 더 빠른 컨테이너 운송을 위한 최신 기술)					
유연성 (Flexibility)		1 전혀 아니다	2 조금 아니다	3 보통 이다	4 조금 그렇다	5 매우 그렇다
1	우리 회사는 터미널과 다양한 종류의 서비스를 효율적으로 제공한다.					
2	우리 회사는 터미널과 맞춤형 서비스를 신속하게 제공한다.					
3	우리 회사는 터미널과 다양한 고객의 요구를 맞춘다.					
4	우리 회사는 터미널과 높은 고객 반응성을 가진다.					

SECTION C – 항만 성과 (Port performance)

* 다음은 귀사가 속해 있는 항만의 성과에 관한 질문입니다. 귀사의 터미널과 경쟁사를 비교하여 동의하는 정도를 표시해 주시기 바랍니다.

복합운송 연결 (Connectivity)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	내륙운송서비스 능력 (capacity)이 좋다.					
2	배후부지로의 운송시간이 짧다.					
부가가치서비스 (Value-added service)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	화물이 부가가치서비스 (보관)으로 인해 유치된다.					
2	부가가치서비스로 인해 부가가치가 향상된다.					
3	우리 터미널은 부가가치서비스를 위한 충분한 시설을 확보하고 있다.					
안전 및 보안 (Safety and security)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	우리 터미널은 보안규율을 잘 준수한다.					
2	우리 터미널은 사고건수가 낮다.					
효율적 운영 (Efficient operation)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	터미널 생산성이 높다.					
2	항만 적하 시간이 짧다 (정체로 인한 선박대기시간)					
3	항만운영시간이 길다 (24/7/365).					
비용 효율성 (Cost efficiency)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	총 가격이 낮다.					
2	화물처리료가 싸다.					

3	보조 서비스료가 싸다. (도선, 예선 등)					
4	육상운송서비스료가 싸다.					
신뢰성 (Reliability)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	우리 항만은 예정된 시간안에 화물을 인도한다.					
2	우리 항만은 고객이 요구하는 시간안에 화물을 처리한다.					
3	우리 항만 서비스의 리드타임은 짧다.					
4	우리 항만은 정확한 화물정보를 제공한다.					
항만사용자의 편의 (Convenience of port users)		1 매우 나쁨	2 나쁨	3 차이 없음	4 좋음	5 훨씬 좋음
1	우리 항만은 항만사용자의 편의를 위해 정보기술능력(EDI, Port-MIS)을 보유하고 있다.					
2	우리 항만은 항만사용자의 편의를 위해 쉽고 빠른 운영프로세스를 가지고 있다.					
3	우리 항만은 항만사용자의 편의를 위해 편리한 세관프로세스를 가지고 있다.					

SECTION D – 응답자 특성

1. 귀사는 다음 어디에 해당됩니까?
① 터미널 운영사 ( ) ② 선사 ( ) ③ 육상운송업체 ( ) ④ 포워더 ( ) ⑤ 선박관리회사 ( ) ⑥ 제 3 자 물류업체( )

2. 귀하의 회사가 운영(터미널 운영사) 및 관련된 항만은 다음 중 어디입니까?
① 부산항 ( ) ② 광양항 ( ) ③ 인천항 ( )

3. 귀하는 항만업계에 몇년간 종사하셨습니까?
① 1-3 년 ( ) ②4-6 ( ) ③7-9 ( ) ④10-12 ( ) ⑤13-15 ( ) ⑥16-18 ( ) ⑦ 19 년 이상 ( )

4. 귀하는 현재의 기관에 몇년간 종사하셨습니까?
① 1-3 년 ( ) ②4-6 ( ) ③7-9 ( ) ④10-12 ( ) ⑤13-15 ( ) ⑥16-18 ( ) ⑦19 년 이상 ( )

5. 귀하의 직위는 다음 중 어느 것에 해당합니까?
① 일반사원 ( ) ② 대리/반장/주임 ( ) ③ 과장 ( ) ④ 차장 ( ) ⑤ 부장/실장/팀장 ( ) ⑥ 최고경영자 ( )

6. 귀사는 설립된지 얼마나 되었습니까?
① 1-3 년 ( ) ②4-6 ( ) ③7-9 ( ) ④10-12 ( ) ⑤13-15 ( ) ⑥16-18 ( ) ⑦ 19 년 이상 ( )

7. 귀사의 전일제 고용자수는 어느 정도 입니까?
① 50 명 이하 ( ) ② 50~100 ( ) ③ 100-150 ( ) ④150-200 ( ) ⑤ 200-250 ( ) ⑥ 250-300 ( ) ⑦300 명 이상 ( )

8. 귀하의 회사/기관명은 무엇입니까? (예: 한진해운, BNCT, 인터지스)
(   )

귀하께서는 본 설문의 결과 보고서를 받아 보시길 원하십니까?   예(   )
아니오 (   )
만약 그렇다면, 귀하의 이 메일 주소를 적어주십시오.

E-mail address: (   )

설문응답에 진심으로 감사드립니다.

Appendix B. Non-response bias test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
IS1	Equal variances assumed	4.313	.041	1.175	86	.243	.250	.213	-.173	.673
	Equal variances not assumed			1.175	80.093	.243	.250	.213	-.173	.673
IS2	Equal variances assumed	1.670	.200	.650	86	.518	.136	.210	-.281	.554
	Equal variances not assumed			.650	84.228	.518	.136	.210	-.281	.554
IS3	Equal variances assumed	1.479	.227	.637	86	.526	.136	.214	-.289	.562
	Equal variances not assumed			.637	83.869	.526	.136	.214	-.289	.562
IS4	Equal variances assumed	.500	.481	.125	86	.901	.023	.182	-.340	.385
	Equal variances not assumed			.125	85.100	.901	.023	.182	-.340	.385
IS5	Equal variances assumed	.800	.373	-.233	86	.817	-.045	.195	-.434	.343
	Equal variances not assumed			-.233	83.231	.817	-.045	.195	-.434	.343
CC1	Equal variances assumed	4.032	.048	1.009	86	.316	.227	.225	-.220	.675
	Equal variances not assumed			1.009	81.839	.316	.227	.225	-.221	.675
CC2	Equal variances assumed	6.875	.010	1.759	86	.082	.364	.207	-.047	.775
	Equal variances not assumed			1.759	75.037	.083	.364	.207	-.048	.775
CC3	Equal variances assumed	.036	.850	1.803	86	.075	.409	.227	-.042	.860

	Equal variances not assumed			1.803	85.997	.075	.409	.227	-.042	.860
CC4	Equal variances assumed	6.345	.014	1.882	86	.063	.409	.217	-.023	.841
	Equal variances not assumed			1.882	80.463	.063	.409	.217	-.023	.842
CC5	Equal variances assumed	3.260	.075	.912	86	.364	.205	.224	-.241	.650
	Equal variances not assumed			.912	82.816	.364	.205	.224	-.242	.651
KC1	Equal variances assumed	2.387	.126	.558	86	.578	.114	.204	-.291	.518
	Equal variances not assumed			.558	84.643	.578	.114	.204	-.291	.518
KC2	Equal variances assumed	1.020	.315	.114	86	.909	.023	.199	-.372	.418
	Equal variances not assumed			.114	85.705	.909	.023	.199	-.372	.418
KC3	Equal variances assumed	.414	.522	.868	86	.388	.182	.210	-.235	.598
	Equal variances not assumed			.868	85.907	.388	.182	.210	-.235	.598
KC4	Equal variances assumed	.757	.387	.479	86	.633	.091	.190	-.286	.468
	Equal variances not assumed			.479	85.998	.633	.091	.190	-.286	.468
KC5	Equal variances assumed	.708	.403	0.000	86	1.000	0.000	.210	-.418	.418
	Equal variances not assumed			0.000	84.787	1.000	0.000	.210	-.418	.418
DH1	Equal variances assumed	5.333	.023	-.105	86	.916	-.023	.216	-.452	.406
	Equal variances not assumed			-.105	78.256	.916	-.023	.216	-.452	.407
DH2	Equal variances assumed	1.113	.294	-.550	86	.584	-.114	.207	-.524	.297
	Equal variances not assumed			-.550	83.621	.584	-.114	.207	-.524	.297
DH4	Equal variances assumed	4.175	.044	-1.299	86	.197	-.250	.192	-.633	.133
	Equal variances not assumed			-1.299	79.371	.198	-.250	.192	-.633	.133
DH5	Equal variances assumed	.628	.430	-.560	86	.577	-.114	.203	-.517	.289

	Equal variances not assumed			-.560	83.828	.577	-.114	.203	-.517	.290
GS1	Equal variances assumed	1.127	.291	1.862	86	.066	.341	.183	-.023	.705
	Equal variances not assumed			1.862	81.060	.066	.341	.183	-.023	.705
GS2	Equal variances assumed	.039	.844	2.255	86	.027	.409	.181	.048	.770
	Equal variances not assumed			2.255	85.985	.027	.409	.181	.048	.770
GS3	Equal variances assumed	1.960	.165	.855	86	.395	.159	.186	-.211	.529
	Equal variances not assumed			.855	81.056	.395	.159	.186	-.211	.529
GS4	Equal variances assumed	1.396	.241	.371	86	.712	.068	.184	-.297	.434
	Equal variances not assumed			.371	81.454	.712	.068	.184	-.298	.434
GS5	Equal variances assumed	2.155	.146	1.087	86	.280	.205	.188	-.169	.579
	Equal variances not assumed			1.087	82.092	.280	.205	.188	-.170	.579
JPM1	Equal variances assumed	.987	.323	.916	86	.362	.182	.198	-.213	.576
	Equal variances not assumed			.916	85.149	.362	.182	.198	-.213	.576
JPM2	Equal variances assumed	.205	.652	.739	86	.462	.136	.185	-.231	.503
	Equal variances not assumed			.739	85.962	.462	.136	.185	-.231	.503
JPM3	Equal variances assumed	.473	.493	.661	86	.510	.136	.206	-.274	.546
	Equal variances not assumed			.661	85.619	.510	.136	.206	-.274	.546
JPM5	Equal variances assumed	.374	.542	.117	86	.907	.023	.195	-.365	.410
	Equal variances not assumed			.117	85.487	.907	.023	.195	-.365	.410
BS1	Equal variances assumed	.051	.823	.348	86	.729	.068	.196	-.321	.457
	Equal variances not assumed			.348	85.991	.729	.068	.196	-.321	.457
BS2	Equal variances assumed	2.076	.153	1.819	86	.072	.364	.200	-.034	.761

	Equal variances not assumed			1.819	85.940	.072	.364	.200	-.034	.761
BS3	Equal variances assumed	2.051	.156	.943	86	.348	.182	.193	-.202	.565
	Equal variances not assumed			.943	82.305	.349	.182	.193	-.202	.565
BS4	Equal variances assumed	.840	.362	.931	86	.354	.182	.195	-.206	.570
	Equal variances not assumed			.931	85.444	.354	.182	.195	-.206	.570
IN1	Equal variances assumed	.548	.461	-.100	86	.921	-.023	.227	-.474	.429
	Equal variances not assumed			-.100	85.809	.921	-.023	.227	-.474	.429
IN2	Equal variances assumed	1.147	.287	1.197	86	.234	.273	.228	-.180	.725
	Equal variances not assumed			1.197	85.844	.234	.273	.228	-.180	.725
IN3	Equal variances assumed	.320	.573	.663	86	.509	.136	.206	-.273	.545
	Equal variances not assumed			.663	85.880	.509	.136	.206	-.273	.545
FL1	Equal variances assumed	2.139	.147	1.514	86	.134	.295	.195	-.093	.683
	Equal variances not assumed			1.514	80.018	.134	.295	.195	-.093	.684
FL2	Equal variances assumed	.996	.321	1.538	86	.128	.295	.192	-.086	.677
	Equal variances not assumed			1.538	85.024	.128	.295	.192	-.086	.677
FL3	Equal variances assumed	2.805	.098	1.457	86	.149	.273	.187	-.099	.645
	Equal variances not assumed			1.457	82.053	.149	.273	.187	-.100	.645
FL4	Equal variances assumed	1.015	.316	2.445	86	.017	.455	.186	.085	.824
	Equal variances not assumed			2.445	84.434	.017	.455	.186	.085	.824
QL1	Equal variances assumed	.218	.642	1.647	86	.103	.318	.193	-.066	.702
	Equal variances not assumed			1.647	85.826	.103	.318	.193	-.066	.702
QL2	Equal variances assumed	.083	.774	1.200	86	.233	.250	.208	-.164	.664

	Equal variances not assumed			1.200	85.140	.233	.250	.208	-.164	.664
QL3	Equal variances assumed	2.198	.142	1.732	86	.087	.341	.197	-.050	.732
	Equal variances not assumed			1.732	81.626	.087	.341	.197	-.051	.733
QL4	Equal variances assumed	.890	.348	1.971	86	.052	.386	.196	-.003	.776
	Equal variances not assumed			1.971	85.342	.052	.386	.196	-.003	.776
CE1	Equal variances assumed	.624	.432	.873	86	.385	.182	.208	-.232	.596
	Equal variances not assumed			.873	86.000	.385	.182	.208	-.232	.596
CE2	Equal variances assumed	.009	.925	.430	86	.668	.091	.212	-.330	.511
	Equal variances not assumed			.430	85.990	.668	.091	.212	-.330	.511
CE3	Equal variances assumed	1.262	.264	.858	86	.394	.182	.212	-.240	.603
	Equal variances not assumed			.858	84.468	.394	.182	.212	-.240	.603
CE4	Equal variances assumed	.931	.337	.757	86	.451	.159	.210	-.259	.577
	Equal variances not assumed			.757	84.886	.451	.159	.210	-.259	.577
RL1	Equal variances assumed	1.207	.275	.899	86	.371	.205	.228	-.248	.657
	Equal variances not assumed			.899	84.486	.371	.205	.228	-.248	.657
RL2	Equal variances assumed	2.085	.152	.801	86	.426	.182	.227	-.270	.633
	Equal variances not assumed			.801	83.546	.426	.182	.227	-.270	.633
RL3	Equal variances assumed	.849	.359	1.199	86	.234	.273	.227	-.179	.725
	Equal variances not assumed			1.199	84.837	.234	.273	.227	-.179	.725
RL4	Equal variances assumed	.999	.320	.729	86	.468	.159	.218	-.275	.593
	Equal variances not assumed			.729	84.805	.468	.159	.218	-.275	.593
CPU1	Equal variances assumed	1.441	.233	.102	86	.919	.023	.223	-.420	.465

	Equal variances not assumed			.102	82.212	.919	.023	.223	-.420	.465
CPU2	Equal variances assumed	.493	.484	-1.350	86	.180	-.318	.236	-.787	.150
	Equal variances not assumed			-1.350	84.178	.181	-.318	.236	-.787	.150
CPU3	Equal variances assumed	.571	.452	.204	86	.839	.045	.223	-.398	.489
	Equal variances not assumed			.204	84.938	.839	.045	.223	-.398	.489
CV1	Equal variances assumed	.078	.780	1.653	86	.102	.341	.206	-.069	.751
	Equal variances not assumed			1.653	85.382	.102	.341	.206	-.069	.751
CV2	Equal variances assumed	.027	.871	1.664	86	.100	.341	.205	-.066	.748
	Equal variances not assumed			1.664	85.486	.100	.341	.205	-.066	.748
VAS1	Equal variances assumed	3.785	.055	1.817	86	.073	.432	.238	-.041	.904
	Equal variances not assumed			1.817	83.347	.073	.432	.238	-.041	.905
VAS2	Equal variances assumed	5.991	.016	1.392	86	.168	.318	.229	-.136	.773
	Equal variances not assumed			1.392	80.867	.168	.318	.229	-.137	.773
VAS3	Equal variances assumed	3.892	.052	1.861	86	.066	.432	.232	-.029	.893
	Equal variances not assumed			1.861	82.830	.066	.432	.232	-.030	.893
SS1	Equal variances assumed	1.130	.291	.750	86	.455	.159	.212	-.263	.581
	Equal variances not assumed			.750	85.092	.455	.159	.212	-.263	.581
SS2	Equal variances assumed	3.611	.061	-.105	86	.917	-.023	.217	-.455	.409
	Equal variances not assumed			-.105	83.384	.917	-.023	.217	-.455	.410
EO1	Equal variances assumed	.198	.657	-.113	86	.911	-.023	.202	-.424	.378
	Equal variances not assumed			-.113	85.036	.911	-.023	.202	-.424	.379
EO2	Equal variances assumed	.016	.900	-.247	86	.806	-.045	.184	-.412	.321

	Equal variances not assumed			-.247	85.753	.806	-.045	.184	-.412	.321
EO3	Equal variances assumed	.330	.567	0.000	86	1.000	0.000	.197	-.391	.391
	Equal variances not assumed			0.000	84.987	1.000	0.000	.197	-.391	.391
Year1	Equal variances assumed	3.502	.065	.731	86	.467	.273	.373	-.469	1.015
	Equal variances not assumed			.731	82.053	.467	.273	.373	-.470	1.015
Year2	Equal variances assumed	2.421	.123	1.815	86	.073	.682	.376	-.065	1.429
	Equal variances not assumed			1.815	84.966	.073	.682	.376	-.065	1.429
Position	Equal variances assumed	4.437	.038	-.561	86	.576	-.159	.284	-.723	.405
	Equal variances not assumed			-.561	80.257	.576	-.159	.284	-.723	.405
Establish	Equal variances assumed	1.521	.221	-1.016	86	.313	-.477	.470	-1.412	.457
	Equal variances not assumed			-1.016	85.614	.313	-.477	.470	-1.412	.457
Employment	Equal variances assumed	.147	.702	-1.078	86	.284	-.500	.464	-1.422	.422
	Equal variances not assumed			-1.078	85.749	.284	-.500	.464	-1.422	.422
Port	Equal variances assumed	.102	.751	-1.687	86	.095	-.273	.162	-.594	.049
	Equal variances not assumed			-1.687	85.538	.095	-.273	.162	-.594	.049

Appendix C. The detailed profiles of respondents

Group	Category 1	Category 2	Busan		Gwangyang		Incheon	
			Frequency	%	Frequency	%	Frequency	%
TO	Work Experience in Port industry	1-3	1	3.2%	1	8.3%	0	0.0%
		4-6	1	3.2%	2	16.7%	0	0.0%
		7-9	4	12.9%	1	8.3%	1	20.0%
		10-12	7	22.6%	1	8.3%	2	40.0%
		13-15	4	12.9%	1	8.3%	1	20.0%
		16-18	7	22.6%	2	16.7%	1	20.0%
		Over 19	7	22.6%	4	33.3%	0	0.0%
		Subtotal	31	100.0%	12	100.0%	5	100.0%
	Position	Assistant manager	1	3.2%	1	8.3%	0	0.0%
		Manager	3	9.7%	2	16.7%	0	0.0%
		Deputy general manager	7	22.6%	1	8.3%	0	0.0%
		Department manager	9	29.0%	4	33.3%	3	60.0%
		Managing director	10	32.3%	4	33.3%	2	40.0%
		CEO	1	3.2%	0	0.0%	0	0.0%
		Subtotal	31	100.0%	12	100.0%	5	100.0%
	The number of employees	Less than 50	3	9.7%	1	8.3%	0	0.0%
		50-99	4	12.9%	0	0.0%	0	0.0%
		100-149	4	12.9%	1	8.3%	1	20.0%
		150-199	3	9.7%	2	16.7%	1	20.0%
		200-249	5	16.1%	1	8.3%	0	0.0%
		250-299	5	16.1%	2	16.7%	1	20.0%
		Over 300	7	22.6%	5	41.7%	2	40.0%
		subtotal	31	100.0%	12	100.0%	5	100.0%
SL	Work Experience in Port industry	1-3	3	13.0%	1	5.0%	0	0.0%
		4-6	3	13.0%	3	15.0%	1	14.3%
		7-9	1	4.3%	7	35.0%	0	0.0%

		10-12	2	8.7%	2	10.0%	0	0.0%
		13-15	4	17.4%	5	25.0%	1	14.3%
		16-18	5	21.7%	2	10.0%	4	57.1%
		Over 19	5	21.7%	0	0.0%	1	14.3%
		Subtotal	23	100.0%	20	100.0%	7	100.0%
	Position	Assistant manager	4	17.4%	3	15.0%	0	0.0%
		Manager	2	8.7%	4	20.0%	1	14.3%
		Deputy general manager	3	13.0%	6	30.0%	1	14.3%
		Department manager	3	13.0%	6	30.0%	3	42.9%
		Managing director	9	39.1%	1	5.0%	2	28.6%
		CEO	2	8.7%	0	0.0%	0	0.0%
		Subtotal	23	100.0%	20	100.0%	7	100.0%
	The number of employees	Less than 50	4	17.4%	1	5.0%	1	14.3%
		50-99	1	4.3%	3	15.0%	0	0.0%
		100-149	5	21.7%	1	5.0%	3	42.9%
		150-199	3	13.0%	3	15.0%	1	14.3%
		200-249	0	0.0%	4	20.0%	0	0.0%
		250-299	2	8.7%	2	10.0%	1	14.3%
		Over 300	8	34.8%	6	30.0%	1	14.3%
		subtotal	23	100.0%	20	100.0%	7	100.0%
ICT	Work Experience in Port industry	1-3	1	14.3%	0	0.0%	1	25.0%
		4-6	2	28.6%	0	0.0%	0	0.0%
		7-9	0	0.0%	2	22.2%	0	0.0%
		10-12	1	14.3%	4	44.4%	0	0.0%
		13-15	2	28.6%	1	11.1%	1	25.0%
		16-18	0	0.0%	2	22.2%	0	0.0%
		Over 19	1	14.3%	0	0.0%	2	50.0%
		Subtotal	7	100.0%	9	100.0%	4	100.0%
	Position	Assistant manager	1	14.3%	0	0.0%	1	25.0%
		Manager	2	28.6%	0	0.0%	1	25.0%

		Deputy general manager	0	0.0%	2	22.2%	0	0.0%
		Department manager	2	28.6%	5	55.6%	1	25.0%
		Managing director	1	14.3%	2	22.2%	0	0.0%
		CEO	1	14.3%	0	0.0%	1	25.0%
		Subtotal	7	100.0%	9	100.0%	4	100.0%
	The number of employees	Less than 50	1	14.3%	1	11.1%	0	0.0%
		50-99	2	28.6%	0	0.0%	0	0.0%
		100-149	0	0.0%	3	33.3%	1	25.0%
		150-199	0	0.0%	3	33.3%	0	0.0%
		200-249	2	28.6%	1	11.1%	1	25.0%
		250-299	0	0.0%	1	11.1%	0	0.0%
		Over 300	2	28.6%	0	0.0%	2	50.0%
		subtotal	7	100.0%	9	100.0%	4	100.0%
FF	Work Experience in Port industry	1-3	0	0.0%	0	0.0%	0	0.0%
		4-6	0	0.0%	0	0.0%	1	33.3%
		7-9	0	0.0%	4	40.0%	0	0.0%
		10-12	3	37.5%	1	10.0%	0	0.0%
		13-15	0	0.0%	1	10.0%	1	33.3%
		16-18	1	12.5%	2	20.0%	0	0.0%
		Over 19	4	50.0%	2	20.0%	1	33.3%
		Subtotal	8	100.0%	10	100.0%	3	100.0%
	Position	Assistant manager	0	0.0%	0	0.0%	0	0.0%
		Manager	0	0.0%	2	20.0%	2	66.7%
		Deputy general manager	1	12.5%	2	20.0%	0	0.0%
		Department manager	4	50.0%	3	30.0%	0	0.0%
		Managing director	2	25.0%	2	20.0%	1	33.3%
		CEO	1	12.5%	1	10.0%	0	0.0%
		Subtotal	8	100.0%	10	100.0%	3	100.0%

	The number of employees	Less than 50	1	12.5%	0	0.0%	0	0.0%
		50-99	0	0.0%	0	0.0%	0	0.0%
		100-149	0	0.0%	3	30.0%	1	33.3%
		150-199	3	37.5%	1	10.0%	0	0.0%
		200-249	1	12.5%	4	40.0%	0	0.0%
		250-299	0	0.0%	0	0.0%	0	0.0%
		Over 300	3	37.5%	2	20.0%	2	66.7%
		subtotal	8	100.0%	10	100.0%	3	100.0%
SMC	Work Experience in Port industry	1-3	2	25.0%	1	20.0%	0	0.0%
		4-6	1	12.5%	0	0.0%	0	0.0%
		7-9	0	0.0%	0	0.0%	2	33.3%
		10-12	2	25.0%	0	0.0%	3	50.0%
		13-15	0	0.0%	1	20.0%	1	16.7%
		16-18	2	25.0%	2	40.0%	0	0.0%
		Over 19	1	12.5%	1	20.0%	0	0.0%
		Subtotal	8	100.0%	5	100.0%	6	100.0%
	Position	Assistant manager	3	37.5%	1	20.0%	0	0.0%
		Manager	0	0.0%	0	0.0%	1	16.7%
		Deputy general manager	0	0.0%	0	0.0%	2	33.3%
		Department manager	3	37.5%	3	60.0%	3	50.0%
		Managing director	1	12.5%	0	0.0%	0	0.0%
		CEO	1	12.5%	1	20.0%	0	0.0%
		Subtotal	8	100.0%	5	100.0%	6	100.0%
	The number of employees	Less than 50	2	25.0%	1	20.0%	1	16.7%
		50-99	1	12.5%	0	0.0%	1	16.7%
		100-149	0	0.0%	1	20.0%	0	0.0%
		150-199	0	0.0%	1	20.0%	0	0.0%
		200-249	1	12.5%	1	20.0%	0	0.0%
		250-299	0	0.0%	1	20.0%	2	33.3%
		Over 300	4	50.0%	0	0.0%	2	33.3%

		subtotal	8	100.0%	5	100.0%	6	100.0%
3PL	Work Experience in Port industry	1-3	2	28.6%	0	0.0%	1	11.1%
		4-6	1	14.3%	0	0.0%	2	22.2%
		7-9	1	14.3%	4	100.0%	2	22.2%
		10-12	2	28.6%	0	0.0%	0	0.0%
		13-15	0	0.0%	0	0.0%	1	11.1%
		16-18	0	0.0%	0	0.0%	3	33.3%
		Over 19	1	14.3%	0	0.0%	0	0.0%
		Subtotal	7	100.0%	4	100.0%	9	100.0%
	Position	Assistant manager	2	28.6%	0	0.0%	0	0.0%
		Manager	1	14.3%	2	50.0%	3	33.3%
		Deputy general manager	3	42.9%	1	25.0%	2	22.2%
		Department manager	0	0.0%	0	0.0%	0	0.0%
		Managing director	0	0.0%	0	0.0%	1	11.1%
		CEO	1	14.3%	1	25.0%	3	33.3%
		Subtotal	7	100.0%	4	100.0%	9	100.0%
	The number of employees	Less than 50	3	42.9%	2	50.0%	5	55.6%
		50-99	1	14.3%	0	0.0%	0	0.0%
		100-149	0	0.0%	2	50.0%	0	0.0%
		150-199	0	0.0%	0	0.0%	1	11.1%
		200-249	1	14.3%	0	0.0%	1	11.1%
		250-299	0	0.0%	0	0.0%	1	11.1%
		Over 300	2	28.6%	0	0.0%	1	11.1%
		subtotal	7	100.0%	4	100.0%	9	100.0%

Appendix D-1. Levene's tests for equality of variances for SCC in differences between ports and port users

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
IS1	Equal variances assumed	.341	.560	1.179	176	.240	.213	.181	-.144	.571
	Equal variances not assumed			1.086	72.678	.281	.213	.197	-.178	.605
IS2	Equal variances assumed	.000	.990	1.623	176	.106	.287	.177	-.062	.636
	Equal variances not assumed			1.536	75.941	.129	.287	.187	-.085	.659
IS3	Equal variances assumed	.003	.955	2.225	176	.027	.371	.167	.042	.701
	Equal variances not assumed			2.073	73.997	.042	.371	.179	.014	.729
IS4	Equal variances assumed	.018	.893	2.065	176	.040	.327	.158	.014	.639
	Equal variances not assumed			1.932	74.543	.057	.327	.169	-.010	.663
IS5	Equal variances assumed	.309	.579	1.176	176	.241	.199	.170	-.135	.534
	Equal variances not assumed			1.076	71.875	.286	.199	.185	-.170	.569
CC1	Equal variances assumed	.028	.868	1.526	176	.129	.277	.182	-.081	.636
	Equal variances not assumed			1.463	77.686	.148	.277	.190	-.100	.655
CC2	Equal variances assumed	.331	.566	1.669	176	.097	.284	.170	-.052	.619
	Equal variances not assumed			1.634	80.713	.106	.284	.174	-.062	.629

CC3	Equal variances assumed	.127	.722	1.954	176	.052	.369	.189	-.004	.742
	Equal variances not assumed			1.922	81.330	.058	.369	.192	-.013	.752
CC4	Equal variances assumed	.000	.997	1.081	176	.281	.190	.176	-.157	.538
	Equal variances not assumed			1.030	76.894	.306	.190	.185	-.178	.558
CC5	Equal variances assumed	.477	.491	1.262	176	.209	.221	.175	-.125	.568
	Equal variances not assumed			1.241	81.322	.218	.221	.178	-.134	.577
KC1	Equal variances assumed	1.688	.196	.192	176	.848	.034	.175	-.312	.380
	Equal variances not assumed			.174	70.691	.863	.034	.194	-.353	.420
KC2	Equal variances assumed	1.766	.186	-.047	176	.963	-.008	.171	-.345	.329
	Equal variances not assumed			-.043	71.886	.966	-.008	.187	-.381	.365
KC3	Equal variances assumed	.188	.665	.591	176	.555	.106	.180	-.249	.462
	Equal variances not assumed			.564	77.111	.574	.106	.189	-.269	.482
KC4	Equal variances assumed	.446	.505	-.034	176	.973	-.006	.171	-.342	.331
	Equal variances not assumed			-.032	74.160	.975	-.006	.183	-.370	.359
KC5	Equal variances assumed	1.119	.292	.470	176	.639	.086	.182	-.273	.445
	Equal variances not assumed			.442	75.169	.660	.086	.193	-.300	.471
DH1	Equal variances assumed	.635	.427	1.722	176	.087	.297	.173	-.043	.638
	Equal variances not assumed			1.741	85.842	.085	.297	.171	-.042	.636
DH2	Equal variances assumed	.220	.639	1.360	176	.175	.236	.173	-.106	.577
	Equal variances not assumed			1.361	84.051	.177	.236	.173	-.109	.580
DH4	Equal variances assumed	.031	.860	1.768	176	.079	.293	.166	-.034	.620
	Equal variances not assumed			1.736	81.115	.086	.293	.169	-.043	.629
DH5	Equal variances assumed	.404	.526	1.438	176	.152	.230	.160	-.086	.546

	Equal variances not assumed			1.463	86.815	.147	.230	.157	-.082	.543
GS1	Equal variances assumed	.466	.496	2.015	176	.045	.321	.159	.007	.634
	Equal variances not assumed			1.971	80.533	.052	.321	.163	-.003	.644
GS2	Equal variances assumed	.079	.779	1.551	176	.123	.248	.160	-.068	.564
	Equal variances not assumed			1.516	80.428	.133	.248	.164	-.077	.574
GS3	Equal variances assumed	.885	.348	1.183	176	.239	.188	.159	-.126	.501
	Equal variances not assumed			1.129	77.156	.262	.188	.166	-.143	.519
GS4	Equal variances assumed	2.118	.147	1.876	176	.062	.285	.152	-.015	.584
	Equal variances not assumed			1.815	78.968	.073	.285	.157	-.027	.597
GS5	Equal variances assumed	1.049	.307	1.821	176	.070	.279	.153	-.023	.581
	Equal variances not assumed			1.705	74.598	.092	.279	.164	-.047	.605
JPM1	Equal variances assumed	1.027	.312	2.112	176	.036	.351	.166	.023	.680
	Equal variances not assumed			1.990	75.441	.050	.351	.177	.000	.703
JPM2	Equal variances assumed	.531	.467	1.695	176	.092	.270	.159	-.044	.585
	Equal variances not assumed			1.624	77.559	.108	.270	.166	-.061	.601
JPM3	Equal variances assumed	2.208	.139	1.369	176	.173	.235	.172	-.104	.574
	Equal variances not assumed			1.266	73.149	.209	.235	.186	-.135	.605
JPM5	Equal variances assumed	2.211	.139	2.143	176	.034	.355	.166	.028	.682
	Equal variances not assumed			2.050	77.398	.044	.355	.173	.010	.699

Appendix D-2. Levene's tests for equality of variances for CA in differences between ports and port users

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
BS1	Equal variances assumed	.888	.347	.960	176	.338	.149	.155	-.157	.455
	Equal variances not assumed			.900	74.795	.371	.149	.166	-.181	.479
BS2	Equal variances assumed	.339	.561	1.464	176	.145	.251	.171	-.087	.589
	Equal variances not assumed			1.386	75.997	.170	.251	.181	-.110	.612
BS3	Equal variances assumed	1.497	.223	.542	176	.588	.084	.155	-.222	.391
	Equal variances not assumed			.500	72.683	.619	.084	.169	-.252	.420
BS4	Equal variances assumed	.210	.647	1.240	176	.216	.198	.160	-.117	.514
	Equal variances not assumed			1.177	76.363	.243	.198	.169	-.137	.534
IN1	Equal variances assumed	.035	.851	.335	176	.738	.064	.193	-.316	.445
	Equal variances not assumed			.329	81.405	.743	.064	.196	-.325	.454
IN2	Equal variances assumed	.320	.573	-.185	176	.853	-.036	.192	-.415	.344
	Equal variances not assumed			-.186	84.507	.853	-.036	.192	-.417	.346
IN3	Equal variances assumed	.001	.976	.288	176	.774	.051	.178	-.300	.403
	Equal variances not assumed			.281	79.908	.780	.051	.183	-.312	.415
FL1	Equal variances assumed	.037	.847	.695	176	.488	.103	.148	-.190	.396

	Equal variances not assumed			.710	87.507	.479	.103	.145	-.186	.392
FL2	Equal variances assumed	1.144	.286	.961	176	.338	.143	.148	-.150	.435
	Equal variances not assumed			.920	77.506	.360	.143	.155	-.166	.451
FL3	Equal variances assumed	1.520	.219	1.178	176	.240	.176	.149	-.119	.470
	Equal variances not assumed			1.113	75.654	.269	.176	.158	-.139	.490
FL4	Equal variances assumed	.000	.986	1.075	176	.284	.163	.151	-.136	.461
	Equal variances not assumed			1.073	83.736	.286	.163	.151	-.139	.464
QL1	Equal variances assumed	.399	.529	.304	176	.761	.047	.156	-.260	.355
	Equal variances not assumed			.292	77.641	.771	.047	.163	-.276	.371
QL2	Equal variances assumed	.461	.498	.717	176	.474	.118	.164	-.206	.441
	Equal variances not assumed			.690	78.158	.492	.118	.171	-.222	.457
QL3	Equal variances assumed	.841	.360	.773	176	.441	.116	.151	-.181	.414
	Equal variances not assumed			.745	78.509	.458	.116	.156	-.195	.427
QL4	Equal variances assumed	.100	.752	.397	176	.692	.064	.161	-.254	.381
	Equal variances not assumed			.387	80.198	.700	.064	.165	-.264	.392

Appendix D-3. Levene's tests for equality of variances for PP in differences between ports and port users

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
CE1	Equal variances assumed	2.699	.102	.397	176	.692	.073	.184	-.291	.437
	Equal variances not assumed			.408	88.838	.684	.073	.179	-.283	.429
CE2	Equal variances assumed	.503	.479	.073	176	.942	.014	.189	-.359	.386
	Equal variances not assumed			.069	76.024	.945	.014	.199	-.383	.411
CE3	Equal variances assumed	.005	.944	-.140	176	.889	-.026	.183	-.387	.335
	Equal variances not assumed			-.139	82.542	.890	-.026	.185	-.393	.341
CE4	Equal variances assumed	1.528	.218	.411	176	.681	.076	.186	-.290	.442
	Equal variances not assumed			.413	84.674	.681	.076	.185	-.291	.444
RL1	Equal variances assumed	.998	.319	1.328	176	.186	.248	.187	-.121	.616
	Equal variances not assumed			1.241	74.425	.218	.248	.200	-.150	.645
RL2	Equal variances assumed	.212	.646	.635	176	.526	.114	.179	-.240	.468
	Equal variances not assumed			.605	76.834	.547	.114	.188	-.261	.488
RL3	Equal variances assumed	.387	.535	1.624	176	.106	.302	.186	-.065	.668
	Equal variances not assumed			1.528	75.237	.131	.302	.197	-.092	.695
RL4	Equal variances assumed	2.378	.125	.957	176	.340	.170	.177	-.180	.520
	Equal variances not assumed			.867	70.698	.389	.170	.196	-.221	.561

CPU1	Equal variances assumed	1.426	.234	.114	176	.909	.021	.183	-.340	.382
	Equal variances not assumed			.122	96.637	.903	.021	.171	-.318	.360
CPU2	Equal variances assumed	.087	.768	.443	176	.658	.083	.188	-.288	.454
	Equal variances not assumed			.455	88.283	.650	.083	.183	-.281	.448
CPU3	Equal variances assumed	.430	.513	.381	176	.704	.068	.178	-.284	.420
	Equal variances not assumed			.392	88.949	.696	.068	.173	-.276	.412
CV1	Equal variances assumed	.550	.459	-.477	176	.634	-.086	.180	-.442	.270
	Equal variances not assumed			-.455	77.188	.650	-.086	.189	-.462	.290
CV2	Equal variances assumed	.052	.821	-.087	176	.931	-.016	.181	-.373	.341
	Equal variances not assumed			-.084	79.601	.933	-.016	.186	-.386	.355
VAS1	Equal variances assumed	2.549	.112	1.797	176	.074	.330	.184	-.032	.692
	Equal variances not assumed			1.893	93.275	.061	.330	.174	-.016	.676
VAS2	Equal variances assumed	.803	.372	1.806	176	.073	.330	.183	-.031	.690
	Equal variances not assumed			1.829	86.011	.071	.330	.180	-.029	.688
VAS3	Equal variances assumed	.059	.808	1.815	176	.071	.330	.182	-.029	.688
	Equal variances not assumed			1.790	81.801	.077	.330	.184	-.037	.696
SS1	Equal variances assumed	3.738	.055	.591	176	.555	.103	.175	-.241	.448
	Equal variances not assumed			.529	69.462	.598	.103	.195	-.286	.492
SS2	Equal variances assumed	7.727	.006	.676	176	.500	.119	.175	-.227	.465
	Equal variances not assumed			.595	67.788	.554	.119	.199	-.279	.516
EO1	Equal variances assumed	2.326	.129	.908	176	.365	.148	.163	-.174	.471
	Equal variances not assumed			.839	72.967	.404	.148	.177	-.204	.501
EO2	Equal variances assumed	2.054	.154	.993	176	.322	.153	.154	-.151	.457

	Equal variances not assumed			.929	74.565	.356	.153	.165	-.175	.481
	Equal variances assumed	3.208	.075	1.164	176	.246	.193	.166	-.134	.521
EO3	Equal variances not assumed			1.062	71.601	.292	.193	.182	-.169	.556

Appendix E. Assessment of normality

SCC						
Variable	min	max	skew	c.r.	kurtosis	c.r.
DH1	1	5	-0.54	-2.943	-0.225	-0.613
DH5	1	5	-0.456	-2.485	-0.061	-0.165
DH4	1	5	-0.338	-1.839	-0.309	-0.842
DH2	1	5	-0.491	-2.672	-0.318	-0.867
JPM5	1	5	-0.076	-0.412	-0.376	-1.024
JPM3	1	5	-0.428	-2.329	-0.222	-0.605
JPM2	1	5	-0.466	-2.536	-0.061	-0.165
JPM1	1	5	-0.269	-1.464	-0.329	-0.896
CC1	1	5	-0.678	-3.695	-0.155	-0.421
CC3	1	5	-0.666	-3.625	-0.325	-0.885
CC5	1	5	-0.723	-3.938	0.055	0.15
CC2	1	5	-0.855	-4.654	0.289	0.788
CC4	1	5	-0.745	-4.056	0.004	0.012
KC1	1	5	-0.731	-3.982	0.169	0.46
KC5	1	5	-0.493	-2.684	-0.229	-0.623
KC4	1	5	-0.573	-3.118	-0.043	-0.117
KC3	1	5	-0.438	-2.384	-0.364	-0.993
KC2	1	5	-0.65	-3.538	0.149	0.405
GS5	1	5	-0.4	-2.18	0.103	0.281
GS4	1	5	-0.102	-0.557	-0.214	-0.584
GS2	1	5	-0.234	-1.276	-0.313	-0.853
GS3	1	5	-0.517	-2.816	0.258	0.702
GS1	1	5	-0.163	-0.888	-0.137	-0.374
IS3	1	5	-0.582	-3.171	-0.174	-0.475
IS2	1	5	-0.701	-3.818	-0.273	-0.744
IS4	1	5	-0.519	-2.826	-0.3	-0.816
IS5	1	5	-0.555	-3.023	-0.284	-0.774
IS1	1	5	-0.743	-4.046	0.021	0.059
Multivariate					13.996	2.278

CA						
Variable	min	max	skew	c.r.	kurtosis	c.r.
IN3	1	5	-0.651	-3.546	-0.144	-0.392
IN2	1	5	-0.744	-4.053	-0.158	-0.431
IN1	1	5	-0.58	-3.161	-0.357	-0.972
QL1	1	5	-0.347	-1.893	-0.106	-0.288
QL4	1	5	-0.401	-2.184	-0.038	-0.102
QL3	1	5	-0.413	-2.251	-0.128	-0.349
QL2	1	5	-0.331	-1.801	-0.232	-0.631
FL4	1	5	-0.612	-3.332	0.357	0.974
FL1	1	5	-0.45	-2.453	0.152	0.414
FL3	1	5	-0.332	-1.806	-0.34	-0.925
FL2	1	5	-0.1	-0.547	-0.238	-0.648
BS4	1	5	-0.482	-2.626	0.08	0.219

BS2	1	5	-0.369	-2.01	-0.467	-1.273
BS1	1	5	-0.518	-2.819	-0.09	-0.246
BS3	1	5	-0.315	-1.717	-0.152	-0.415
Multivariate					3.885	1.148

PP

Variable	min	max	skew	c.r.	kurtosis	c.r.
SS2	1	5	-0.292	-1.589	-0.383	-1.043
SS1	1	5	-0.405	-2.206	-0.232	-0.633
CV2	1	5	-0.567	-3.087	-0.355	-0.968
CV1	1	5	-0.554	-3.016	-0.356	-0.97
EO1	1	5	-0.308	-1.679	-0.252	-0.685
EO2	1	5	-0.239	-1.301	-0.105	-0.286
EO3	1	5	-0.244	-1.327	-0.238	-0.648
CPU3	1	5	-0.497	-2.705	-0.138	-0.375
CPU1	1	5	-0.487	-2.651	-0.251	-0.684
CPU2	1	5	-0.441	-2.403	-0.496	-1.351
VAS2	1	5	-0.669	-3.646	-0.148	-0.403
VAS3	1	5	-0.714	-3.888	-0.086	-0.235
VAS1	1	5	-0.626	-3.409	-0.304	-0.827
CE1	1	5	-0.696	-3.789	-0.129	-0.351
CE4	1	5	-0.78	-4.251	0.039	0.107
CE3	1	5	-0.835	-4.551	0.201	0.548
CE2	1	5	-0.633	-3.446	-0.296	-0.806
RL4	1	5	-0.605	-3.296	-0.121	-0.33
RL3	1	5	-0.506	-2.759	-0.597	-1.625
RL1	1	5	-0.541	-2.946	-0.544	-1.48
RL2	1	5	-0.486	-2.65	-0.474	-1.291
Multivariate					19.441	4.173

Appendix F. Mahalanobis D2 distance test

Supply chain collaboration			
Observation number	Mahalanobis d-squared	p1	p2
133	54.562	0.002	0.29
177	50.764	0.005	0.244
139	50.416	0.006	0.086
174	45.468	0.02	0.469
29	44.506	0.025	0.45
19	42.599	0.038	0.674
111	42.408	0.04	0.562
76	40.236	0.063	0.878
112	39.939	0.067	0.849
153	39.103	0.079	0.905
4	38.976	0.081	0.864
178	38.848	0.083	0.816
22	38.632	0.087	0.783
10	38.512	0.089	0.725
127	38.047	0.098	0.76
41	37.88	0.101	0.72
77	37.399	0.11	0.769
59	37.355	0.111	0.701
38	37.061	0.118	0.706
65	36.673	0.126	0.744
63	36.547	0.129	0.705
70	36.495	0.13	0.64
161	36.404	0.133	0.586
81	36.363	0.134	0.514
144	36.273	0.136	0.461
56	36.218	0.137	0.397
27	35.959	0.144	0.411
57	35.924	0.145	0.345
66	35.882	0.146	0.286
37	35.625	0.152	0.304
21	35.587	0.153	0.249
135	35.178	0.165	0.324
157	35.108	0.167	0.28
103	35.078	0.168	0.228
88	34.817	0.175	0.253
145	34.68	0.179	0.239
2	34.572	0.183	0.217
131	34.414	0.188	0.213
106	34.222	0.194	0.22
91	33.741	0.21	0.337
78	33.372	0.222	0.427
154	33.356	0.223	0.365
115	33.278	0.226	0.333
94	33.212	0.228	0.297
25	32.953	0.237	0.343
97	32.933	0.238	0.289
95	32.877	0.24	0.254
156	32.784	0.244	0.234

49	32.359	0.26	0.349
168	32.306	0.262	0.312
53	32.132	0.269	0.327
83	31.894	0.279	0.374
141	31.859	0.28	0.328
42	31.851	0.281	0.274
80	31.703	0.287	0.281
123	31.532	0.294	0.298
130	31.514	0.295	0.251
121	31.485	0.296	0.213
35	31.396	0.3	0.2
98	31.292	0.304	0.191
96	31.177	0.309	0.188
60	31.126	0.312	0.163
175	31.085	0.313	0.139
71	30.627	0.334	0.257
8	30.547	0.338	0.241
173	30.172	0.355	0.357
110	30.08	0.359	0.344
158	29.994	0.364	0.33
13	29.864	0.37	0.336
99	29.794	0.373	0.315
47	29.647	0.38	0.331
52	29.644	0.38	0.278
122	29.552	0.385	0.269
143	29.181	0.403	0.396
159	29.149	0.405	0.355
119	29.1	0.407	0.324
14	28.853	0.42	0.395
73	28.757	0.425	0.387
107	28.754	0.425	0.333
84	28.631	0.431	0.34
15	28.57	0.435	0.316
101	28.512	0.438	0.292
55	28.433	0.442	0.279
43	28.115	0.458	0.386
33	28.008	0.464	0.387
5	27.617	0.485	0.548
120	27.574	0.487	0.513
140	27.52	0.49	0.484
128	27.498	0.491	0.437
142	27.456	0.494	0.402
72	27.329	0.5	0.415
150	27.152	0.51	0.457
152	27.152	0.51	0.398
117	27.031	0.517	0.408
89	26.986	0.519	0.376
105	26.862	0.526	0.388
12	26.859	0.526	0.333
68	26.824	0.528	0.298
147	26.764	0.531	0.276
102	26.73	0.533	0.243

Collaborative advantage			
Observation number	Mahalanobis d-squared	p1	p2
96	41.900	0.000	0.041
14	30.498	0.010	0.546
20	27.817	0.023	0.772
78	26.931	0.029	0.768
66	25.940	0.039	0.821
153	25.521	0.043	0.788
1	24.916	0.051	0.809
15	24.861	0.052	0.709
132	24.185	0.062	0.780
130	24.124	0.063	0.690
159	23.951	0.066	0.631
33	23.939	0.066	0.515
156	23.696	0.070	0.488
128	23.309	0.078	0.523
89	22.502	0.095	0.728
84	22.485	0.096	0.641
24	22.475	0.096	0.545
30	22.387	0.098	0.482
108	22.301	0.100	0.421
88	21.654	0.117	0.614
52	21.142	0.132	0.746
34	21.093	0.134	0.689
120	21.071	0.135	0.616
38	20.932	0.139	0.597
126	20.613	0.150	0.666
161	20.572	0.151	0.606
85	20.294	0.161	0.663
164	20.099	0.168	0.681
65	20.046	0.170	0.632
19	20.024	0.171	0.566
67	19.952	0.174	0.525
76	19.853	0.178	0.501
62	19.828	0.179	0.437
46	19.700	0.184	0.431
86	19.584	0.188	0.420
170	19.578	0.189	0.351
9	19.456	0.194	0.346
25	19.297	0.201	0.362
61	19.148	0.207	0.375
81	19.035	0.212	0.369
129	19.003	0.214	0.320
80	18.837	0.221	0.346
100	18.704	0.227	0.354
123	18.584	0.233	0.357
105	18.582	0.233	0.295
135	18.440	0.240	0.312

29	18.412	0.242	0.268
113	18.339	0.245	0.249
127	18.103	0.257	0.317
43	18.102	0.257	0.261
152	18.079	0.259	0.220
136	17.654	0.281	0.402
44	17.512	0.289	0.428
72	17.440	0.293	0.411
112	17.419	0.294	0.362
57	17.256	0.304	0.404
10	17.221	0.306	0.365
68	17.172	0.309	0.336
134	17.132	0.311	0.303
77	17.024	0.317	0.312
150	16.796	0.331	0.400
17	16.793	0.331	0.342
167	16.777	0.332	0.295
114	16.691	0.338	0.294
4	16.542	0.347	0.331
97	16.366	0.358	0.389
118	16.350	0.359	0.342
49	16.151	0.372	0.419
171	16.126	0.374	0.377
157	16.064	0.378	0.362
139	16.039	0.379	0.323
13	15.882	0.390	0.372
82	15.856	0.392	0.333
16	15.845	0.392	0.287
107	15.624	0.407	0.380
51	15.593	0.410	0.345
39	15.577	0.411	0.302
98	15.526	0.414	0.282
63	15.496	0.416	0.251
175	15.429	0.421	0.243
166	15.410	0.422	0.209
41	15.331	0.428	0.209
74	15.043	0.448	0.341
35	14.885	0.460	0.400
115	14.712	0.472	0.474
92	14.693	0.474	0.429
55	14.578	0.482	0.460
5	14.411	0.495	0.532
27	14.344	0.500	0.526
122	14.218	0.509	0.567
93	14.105	0.518	0.597
59	14.096	0.518	0.545
133	13.880	0.535	0.656
26	13.842	0.538	0.630

106	13.808	0.540	0.598
70	13.691	0.549	0.633
69	13.690	0.549	0.575
32	13.679	0.550	0.525
148	13.642	0.553	0.495
177	13.477	0.566	0.571

Port performance

Observation number	Mahalanobis d-squared	p1	p2
35	68.723	0	0
143	40.045	0.007	0.376
134	39.692	0.008	0.176
13	39.014	0.01	0.098
43	38.35	0.012	0.06
14	37.07	0.017	0.076
69	36.971	0.017	0.033
131	36.381	0.02	0.026
10	36.337	0.02	0.01
68	34.245	0.034	0.085
62	33.548	0.04	0.109
114	31.669	0.063	0.452
106	30.961	0.074	0.567
7	30.911	0.075	0.47
21	30.353	0.085	0.555
15	29.329	0.106	0.795
159	28.994	0.114	0.814
42	28.963	0.115	0.751
63	28.866	0.117	0.702
29	28.595	0.124	0.715
61	28.391	0.129	0.708
119	27.923	0.142	0.792
132	27.869	0.144	0.742
96	27.841	0.145	0.678
141	27.403	0.158	0.768
144	27.151	0.166	0.79
70	27.148	0.166	0.726
39	27.004	0.171	0.712
27	26.91	0.174	0.68
36	26.249	0.197	0.854
20	26.242	0.197	0.807
137	26.092	0.203	0.804
147	26.085	0.203	0.75
99	25.942	0.209	0.746
33	25.915	0.21	0.694
175	25.809	0.214	0.675
148	25.616	0.221	0.697
4	25.603	0.222	0.636
84	25.593	0.222	0.571
129	25.356	0.232	0.62

112	25.23	0.237	0.615
154	25.031	0.246	0.648
28	24.9	0.252	0.648
126	24.45	0.272	0.793
157	24.387	0.275	0.768
105	24.224	0.282	0.784
24	24.154	0.286	0.763
32	23.988	0.294	0.783
140	23.954	0.295	0.746
150	23.902	0.298	0.715
128	23.83	0.301	0.693
48	23.668	0.309	0.717
95	23.649	0.31	0.669
167	23.516	0.317	0.68
146	23.444	0.321	0.659
87	23.397	0.323	0.624
98	23.285	0.329	0.625
136	23.066	0.34	0.686
91	23.047	0.341	0.638
123	22.906	0.349	0.658
135	22.669	0.362	0.728
89	22.406	0.376	0.802
66	22.396	0.377	0.761
165	22.366	0.379	0.726
86	22.318	0.381	0.698
19	22.257	0.385	0.676
133	22.203	0.388	0.65
78	22.128	0.392	0.636
25	21.971	0.401	0.67
178	21.955	0.402	0.623
83	21.918	0.404	0.586
166	21.866	0.407	0.559
51	21.865	0.407	0.498
76	21.74	0.415	0.517
16	21.675	0.418	0.497
34	21.602	0.423	0.483
160	21.569	0.425	0.444
138	21.549	0.426	0.398
72	21.496	0.429	0.372
122	21.343	0.438	0.409
110	21.339	0.438	0.354
3	21.312	0.44	0.315
85	21.236	0.445	0.306
38	21.123	0.451	0.317
41	20.973	0.461	0.352
75	20.635	0.481	0.511
60	20.567	0.486	0.496
8	20.551	0.487	0.447

100	20.436	0.494	0.464
65	20.429	0.494	0.41
17	20.37	0.498	0.39
6	20.283	0.503	0.389
12	20.261	0.505	0.346
161	20.224	0.507	0.314
108	20.11	0.514	0.329
125	20.042	0.519	0.317
23	19.927	0.526	0.333
177	19.817	0.533	0.346
124	19.721	0.539	0.351
170	19.647	0.544	0.342