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Assessing Supply Chain Collaboration, Firm Capabilities and Performance: An Empirical Study of Third-Party Logistics Industry in Finland

Logistics

Master's thesis

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Abstract of master's thesis

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Abstract

Research objectives: The study aims to develop a theoretical model and validate its corresponding hypotheses to identify and explain the relationship among supply chain collaboration (SCC), firm capabilities and performance based on resourced-based view and its extension version (relational view and extended resource-based view) in the context of Finnish third-party logistics industry.

Data and methodology: Research data were obtained from an online survey, which was developed by the researchers of Logistics Department, Aalto University School of Business. The research procedures follow the typical quantitative empirical research procedure, including data collection, missing data analysis and imputation, statistical description, analysis of variance (ANOVA), exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and structural equation modeling (SEM).

Main findings and conclusions: First, the results of EFA indicated the groups of survey items are expected as our questionnaire design. We also found that the effect of firm size on most of these constructs are insignificant. Second, a five-factor model was confirmed through the assessment of convergent validity, discriminant validity and reliability. Third, a CFA was conducted to examine the discrepancies between the proposed model and the measurement model by various fit statistics. The proposed model was strongly supported by assessing the validity and reliability of the measurement model. Fourth, a SEM approach was applied to assess the fit of a structural model and validate the hypothesized relationships. The good fit indices indicated that the structural model was adequately supported. Furthermore, the empirical results supported the claim that 1) SCC increases the logistics service capability and innovation capability; 2) better logistics service capability leads to better innovation capability; 3) better operational performance could be achieved by developing innovation capability; 4) operational performance is positively linked to financial performance.

Discussions: The findings are consistent with previous studies and the theoretical propositions of the research are largely confirmed the survey responses collected from Finland's 3PL providers. The theoretical contribution is the development of a comprehensive conceptual model. In terms of practical application, the results of empirical evidences presented in this study not only advance the understanding of SCC, but also provide an instructive guidance. At last, we discussed the limitations of this study, particularly, the data collection method, and gave the suggestions in the future research to remedy these limitations.

Keywords third-party logistics, supply chain collaboration, logistics service capability, innovation capability, operational performance, financial performance, structural equation modeling

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Helsinki, 4 May 2015

Leifu Chen

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LISTS OF ABBREVIATIONS

3PL	Third-party Logistics
ANOVA	Analysis of Variance
CFA	Confirmatory Factor Analysis
EFA	Exploratory Factor Analysis
ERBV	Extended Resource-based View
LSPs	Logistics Service Provider
RBV	Resource-based View
RV	Relational View
SCC	Supply Chain Collaboration
SCI	Supply Chain Integration
SEM	Structural Equation Modeling

1. INTRODUCTION

In this Chapter, we will introduce the background and motivation of this study and then define the research objectives. After that, we will discuss the methodology we used and the expected contribution we made. The structure of the thesis will be given at the last part.

1.1. Background and motivation

There is a constant challenge for many manufacturers and retailers to improve their operational performance such as the cost and quality of product delivery. As a possible solution, third-party logistics (3PL) firms provide an opportunity for their clients to outsource their logistics functions and, as a result, pay more attention to their core competencies. To meet market demands, an increasing number of 3PL providers have broadened their scope and scale of operations such as sourcing, warehousing, material management, freight forwarding and distribution responsibilities (Selviaridis & Spring, 2007). This growing trend enables the 3PL providers to be a crucial component in the performance of supply chain activities. Thus, many previous studies have paid emphasis on the capabilities-performance relationship in the context of 3PL industry.

Lai (2004) suggested that the logistics service providers (LSPs) could be divided into four types according to their different scopes of service and argued that service performance would be affected by the types of LSPs. The results of empirical data, which were collected from shipping service industry, supported the claim that LSPs with better service capability will lead to better firm performance.

Yang, Marlow and Lu (2009) conducted a similar empirical study of ocean freight forwarders to examine the relationship among logistics service capability, innovation capability and firm performance in the context of shipping service industry. In their research, the operational and financial performance of these service providers are mainly determined by their logistics service capability. Furthermore, the empirical evidence showed that although the innovation capability has significant positive associations with the logistics service capability, which affects providers' performance indirectly.

Liu and Lyons (2011) classified the different types of LSPs according to their attributes of service capabilities and evaluated the relationship among logistics service capabilities, operational and financial performance based on a recent survey collected from UK and Taiwanese 3PL industry. They found that LSPs' logistics service capability positively influence their operational performance but it influences the financial performance insignificantly.

All the above studies are based on resource-based view (RBV), which is a very traditional theoretical foundation in the field of capabilities-performance relationship research. This view was proposed by Wernerfelt (1984) and argued that the performance of a specific organization is mainly determined by its internal resources. Historically, this theory helped researchers clarify the relationships among firm capabilities and performance at a dimension level. However, this view neglects the importance of collaboration through supply chain partners, which may have great potential to improve firm performance (Wong, Boon-Itt, & Wong, 2011).

To remedy this issue, the relational view (RV) was introduced by Dyer and Singh (1998) and then this theory was extended by Laive (2006), which is known as extended resource-based view (ERBV). Both of these views argued that companies could deploy and share the capabilities through collaboration to gain collaborative advantage that cannot be generated by either of them (Cao & Zhang, 2011). For this reason, a growing body of literatures have recognized the importance of supply chain collaboration (SCC) and supply chain integration (SCI) and a number of researchers reported the impacts of SCC or SCI on firm performance based on relational view and extended resource-based view.

Flynn, Huo and Zhao (2010) provided a definition of SCI as a measure to describe how manufacturers and their supply chain partners manage their collaborative strategy and organizational process. According to this definition, they attempted to divide SCI into three dimensions: customer integration, supplier integration and internal integration. Then the authors assessed the relationship among various dimensions of SCI, operational performance and financial performance based on survey responses of 617 Chinese manufacturing companies and their supply chain partners. The main conclusion of this research indicated that internal integration is positively related to both performances while customer integration is only positively related to operational performance. However, supplier integration has no direct impacts on either of performances.

Wong et al (2011) extended the prior study (Flynn, et al, 2010) and empirically tested the associations between SCI and operational performance based on automobile manufacturing industry in Thailand. They collapsed SCI into three dimensions (supplier, customer and internal) and divided operational performance into four dimensions (delivery, product quality, production cost and flexibility). The results supported that all dimensions of SCI have positive impacts on all dimensions of operational performance.

Cao and Zhang (2011) pointed out the difference of the definitions between SCC and SCI although these terms were sometimes used interchangeably. They suggested that SCI emphasized the process integration and central governance in collaboration while SCC paid more attention to the relational communication and governance between supply chain members. In the remainder of this paper, we will adopt the theoretical definition of SCC given by them because our study focused more on the coordination mechanism and joint relationship through supply chain partners such as information sharing and relationship building. Cao and Zhang (2011) also examined the relationship among SCC, collaborative advantage and firm performance through a large-scale online survey in US manufacturing industry and their partners. The results confirmed that SCC bring collaborative advantage and has positive impacts on firm performance.

From what we have reviewed so far, most of the existing literatures in this field were limited to assess the impact of collaboration on the firm performance and they have not treated firm capabilities in their theoretical model. As a result, these studies failed to show how SCC affects the firm capabilities.

Considering the advantage of capabilities-performance relationship and SCC research, we extend prior research by identifying the dimension of key constructs including firm capabilities and developing a theoretical model to evaluate the role of firm capabilities on the relationship between SCC and firm performance. The model combines RBV, RV and ERBV together as its theoretical foundation and is validated by survey responses collected from Finnish 3PL industry.

1.2. Research objectives

There are two primary aims of this quantitative empirical research.

The first objective is to identify the key dimensions (or, from the perspective of questionnaire design, the grouping of measurement items) of SCC, firm capabilities and performance. The expected results are that all the groupings of measurement items are similar as those on the survey, which validates the effectiveness and reliability of the survey items developed by the researchers of Logistics Department.

The second aim is to develop a theoretical framework and formulate the hypotheses to examine the role of SCC in the relationship between firm capabilities and performance. The proposed model is consisted of five factors and seven hypothesized relationships, which were developed through literature reviews. The data were gathered from the survey responses of Finland's 3PL industry. The expected result is that the proposed model are supported by the empirical evidence. In other words, the model fits are well above the recommended thresholds while all the hypothesized relationships are significant and in the predicted directions. Furthermore, we are also interested in exploring the moderating role of firm size in the relationship among SCC, firm capabilities and performance.

1.3. Methodology and contribution

The research procedures follow the typical quantitative empirical research procedure, including data collection, missing data analysis and imputation, statistical description, analysis of variance (ANOVA), exploratory factor analysis (EFA), confirmatory factor analysis (CFA) and structural equation modeling (SEM). The summary of the key steps and their findings are given below.

1.3.1. Data collection

Data were obtained from an online survey that was developed by Logistics Department. The contacting company list is selected randomly among the filtered results of a Finnish enterprise search engine. The phone call were made first to confirm the existence of the contacting company. If the respondents were interested in this research, they received an email with the link of an online survey. Totally, we mailed to 120 Finnish logistics companies. After four weeks, we received 50 usable responses. Thus, the overall response rate for this study was 41.67%.

1.3.2. Data analysis and results

After data collection and preprocessing, the analytic processes will be conducted iteratively until the results are acceptable by the relevant criteria.

First, an EFA will be performed to investigate the factor structures by identifying and removing problematic measurement items and removing through iterations.

Then, a CFA is applied to confirm the dimensions of various constructs, such as SCC, firm capabilities and performance. Similarly, the measurement model will be re-specified when the validity and reliability of the measurement model are not sufficiently good.

At last, a SEM is used to test the good fit of the structural model and validate the research hypotheses. As a result, the structural model achieved acceptable fit statistics and five of seven hypothesized relationships were significant and in the predicted direction.

Through the above procedures, we found that the theoretical propositions of this research were largely confirmed by survey responses collected from Finnish 3PL providers. Additionally, we pointed out that two hypothesized relationships were not supported by the empirical data. For example, the logistics service capability does not have positive effect directly on the operational performance. This finding may indicated that logistics service capability has less weight than innovation capability in the role of influencing the operational performance in 3PL industry, which could be a theoretical proposition in the further conceptual model development and empirical research in other contexts.

1.3.3. Our contributions

According to the results presented in this study, our research are contributing to both theory and practice. Here are the brief introduction of these contributions.

From theoretical perspective, the research will clarify the dimension of SCC, firm capabilities and performance, and show that the survey we used has the potential to collect data in the research of the similar topics.

More importantly, we developed and validated a theoretical framework to examine the relationships between firm capabilities and performances through collaboration. This framework will provide a solid foundation for explaining how firm capabilities affect performances in the context of 3PL industry, especially from the view of SCC. The results of the hypothesized relationships also give the empirical evidence to support resource-based view, relational view and extended resource-based view.

In terms of practical application, the conceptual framework and its empirical evidences not only advance the understanding of collaboration through supply chain partners, but also provide an instructive guideline for supply chain managers to improve their company's performance. For example, making investments in innovation activities to improve operational performance is more effective than making investments in logistics service.

Additionally, the results of the research will assist firms in minimizing the chance of collaboration failure and maximizing the chance of performance improvement because the constructs of SCC, firm capabilities and performance obtained from this study are viewed as a user manual for enterprises to form the partnership as needed.

1.4. Thesis Structure

The paper is structured in six chapters. Here is a brief introduction of the remaining chapters.

Chapter 2 reviews the literature on the prior research and then examines the related theories from three perspectives: RBV, RV and ERBV. The recent studies on 3PL service attributes and capabilities are also discussed.

Chapter 3 develops a theoretical model and formulate seven hypotheses to explain the network of relationships among SCC, logistics service capabilities, innovation capability, operational performance and financial performance.

Chapter 4 introduces the research methodology such as the steps of EFA, CFA and SEM. This chapter also discusses the design of questionnaire, data collection method and characteristics of respondents.

Chapter 5 examines the dimensions of SCC, firm capabilities and performance, and the relationship among them through missing data analysis and imputation, descriptive analytics, ANOVA analysis, EFA, CFA and SEM.

Chapter 6 indicates the results with theoretical and practical implications, and presents the limitation of this study and suggests the future research agenda.

2. LITERATURE REIVEW

In this Chapter, we first give a brief synopsis of the recent studies on 3PL industry and summarize the research regarding the impact of firm capabilities on firm performance. Then we discuss the related theories of this research from three perspectives: resource based view (RBV), relational view (RV), and extended resource based view (ERBV).

2.1. Literature on third-party logistics

3PL providers usually offer bundled and multiple logistics services to their customers for part or whole supply chain management functions as opposed to just take the responsibility of separate warehousing or transport management activities (Leahy, Murphy, & Poist, 1995). Another definition of the 3PL is given by Rao and Young (1994), who extended the scope of outsourcing arrangements, including shipping lines and freight forwarders. Additionally, many other terms such as “contract logistics” and “logistics alliance” have the similar meaning as 3PL although they may focus on the different role or positions of LSPs in the supply chain (Bowersox D. J., 1990). In general, these 3PL arrangements mainly depend on formal short-term or long-term contracts rather than only spot purchases of logistics functions (Murphy & Poist, 1998). Typically, the 3PL services can be scaled and customized to clients' demands based on market requirements and the clients are able to apply flexible pricing options for outsourcing arrangements, such as “fixed price, percent of sales value, activity-based rates, hybrid (part fixed, part variable) or even free-of-charge service” (Walker, 2009).

To integrate the body of knowledge in 3PL, many researchers tried to develop the framework and pointed out the future research agenda in this field. Razzaque and Sheng (1998) organized the results of literatures on outsourcing of logistics functions based on 100 published articles and papers from scholarly journals, trade publications and popular magazines. This paper attempted to propose a comprehensive framework to analyze the nature of 3PL industry, for example, four different types of contract logistics vendors and the critical success factors of outsourcing. Selviaridis et al. (2007) summarized an updated comprehensive literature review to offer a classification of 3PL studies and develop an agenda for further research. This review was based on 114 referred journal papers published during 1990-2005. The authors found that 3PL research in this field lacked a theoretical foundation because 69 percent of the papers in 3PL studies did not have any theoretical foundation. For the papers that had theoretical basis, RBV had been mostly applied to explain the capabilities of 3PL providers. They also examined the 3PL studies in three different levels such as the firm level, the dyad level (inter-organizational relationships) and the network level. They pointed out that 67 percent of studies focused on firm level while only 6 percent of studies existing were examined at the network levels.

As an important theoretical foundation in 3PL research, RBV and its complement will be discussed in the following sections. Furthermore, we will also review the 3PL studies on both firm level and collaborative level based on different theoretical choices.

2.2. Resource-based views

Wernerfelt (1984) introduced RBV as a theory to explain how organizations achieve and maintain competitive advantages by exploiting and utilizing their own strategic resources and various capabilities. In this case, resources are explained as “inputs to organizational processes” (Grant, 1991) and capabilities are defined as the firm’s ability to integrate its resource to create value (Amit & Schoemaker, 1993). This view recognizes resource and capability as its key construct. We will pay more attention to the concept of resource in this section while the nature of capability will be discussed in the next section.

As explained earlier, RBV argues that organizational performance will be mainly determined by internal tangible and intangible resource, which are assumed to have the following characteristics:

1) Heterogeneous. Organizations always possess various mix of resources. Thus, they could implement a unique strategy to outperform their rivals by using their different mix of resource. Conversely, if they have the same bundles of resources, they just simply follow the leader’s strategy, which causes no organization could gain competitive advantage.
2) Immobile: Resources cannot move across different companies in a short-run. Thus, one organization is not able to replicate its competitors’ resources strategies. Brand reputation and business process are the typical example of immobile resources.

Accordingly, performance variances across firms can be explained by their heterogeneous and immobile resources (Barney, 1991), which are regarded as the source of the firm capabilities (Grant, 1991). For this reason, RBV has been a solid theoretical foundation for capability-performance relationship research, especially for logistics industry. For example, Yang et al. (2009) provided an empirical study of container shipping service in Taiwan and demonstrated the relationship among logistics service capability, innovation capability, firm resource and performance, which is shown in Figure 1. Below are the main findings in this research.

- Firm resources directly increase logistics service and innovation capabilities.
- Logistics service capability directly increases firm performance.
- Innovation capability directly increases logistics service capability.

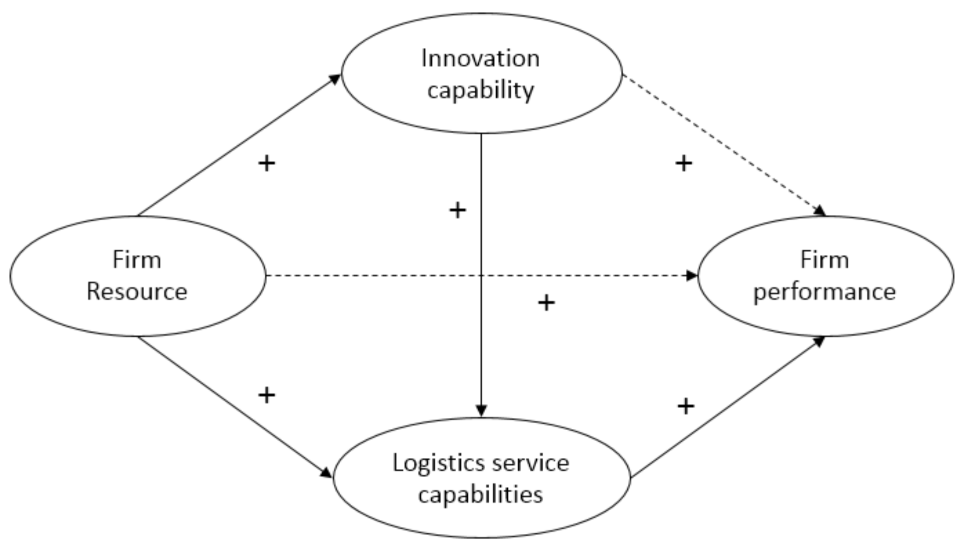

Figure 1 Proposed model by Yang et al. (2009)

More research that examined the effects of capabilities on firm performance based on RBV will be reviewed in the following sections.

2.3. Literature on the capabilities-performance relationship

Before discussing more literatures, it will be necessary to give a more detailed definition of capabilities. Day (1994) used the term “capabilities” to refer to a combination of skills and knowledge that take advantage of the resources to coordinate organizational process and perform business activities. Critical capabilities are viewed as sources of core competency and are able to achieve competitive advantage to distinguish a company from its competition (Gallon, Stillman, & Coates, 1995; Park, Mezias, & Song, 2004).

In addition to the development of the theoretical framework, the research that focused on capabilities-performance relationships were attracting considerable interest due to a strengthening of global competition. Many authors reported the significant associations between firm capabilities and performances in different contexts based on RBV.

Lai (2004) divided LSPs into four groups, as presented in Table 1, according to their different service capabilities. The results of empirical data, where were collected from shipping service industry, supported the claim that LSPs with better service capability will lead to better performance. For example, full service providers, who perform the high-level capability of all the service types, have the best performance and transformers are on the second place of ranking. Furthermore, the results showed that different services have different weights in the overall performance. The evidence is that value-added logistics and technology-enabled logistics service are much more important than freight forwarding service because nichers have better performance than traditional freight forwarders.

Table 1 Types of LSPs

	Value-added logistics service[a]	**Technology-enabled logistics service**[b]	**Freight forwarding service**[c]
Full service providers	High	High	High
Transformers	Medium	High	High
Traditional freight forwarders	Low	Low	High
Nichers	Medium	Medium	Low

[abc]See the description of service types in Table 2

Source: Lai (2004)

Liu and Lyons (2011) examined the relationship between the logistics service capabilities, operational performance and financial performance in UK and Taiwanese. The data collected from both LSPs and their clients. The results indicated that the logistics service capability positively influences operational performance but it does not have significant impacts on financial performance. Moreover, the authors conducted a cluster analysis to classify three types of LSPs with different scopes of service and the empirical results showed that that excellence in service capabilities has more weight than wide scopes of logistics service.

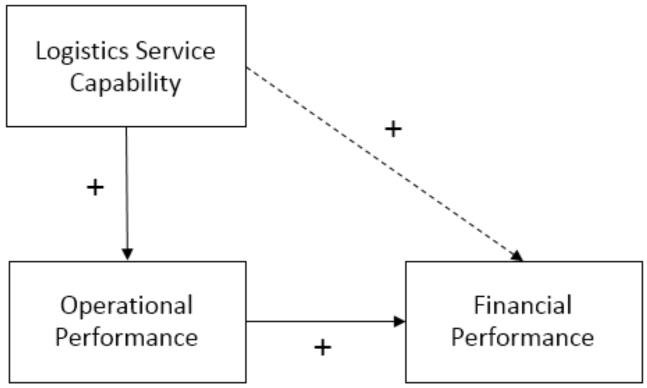

Figure 2 Proposed model by Liu and Lyons (2011)

Apart from the relationship between firm performance and logistics service capability, the associations between firm performance and other capabilities are widely discussed. Kent and John (2003) found that IT capability, which could be regarded as the fundamental of the supply chain structure, significantly improves the efficiency of information sharing between internal and external collaboration. Previous studies also revealed a correlation between IT capability and firm performance. The results demonstrated that IT capability is positively linked with firm performance and has a great potential to achieve collaborative advantage through information sharing with transaction visibility and risk planning (Kearns & Albert, 2003; Kathuria, Murugan, & Magid, 1999). Shang and Marlow (2005) used a survey of 1200 manufacturing firms in Taiwan to test the relationships among information-based (IT and information sharing) capability, benchmarking capability, logistics flexibility capability and firm performance, including logistics and finance. The results have shown that information-based capability is the only construct that has a significant positive impact on logistics performance while the link between other capabilities and firm performance were not supported.

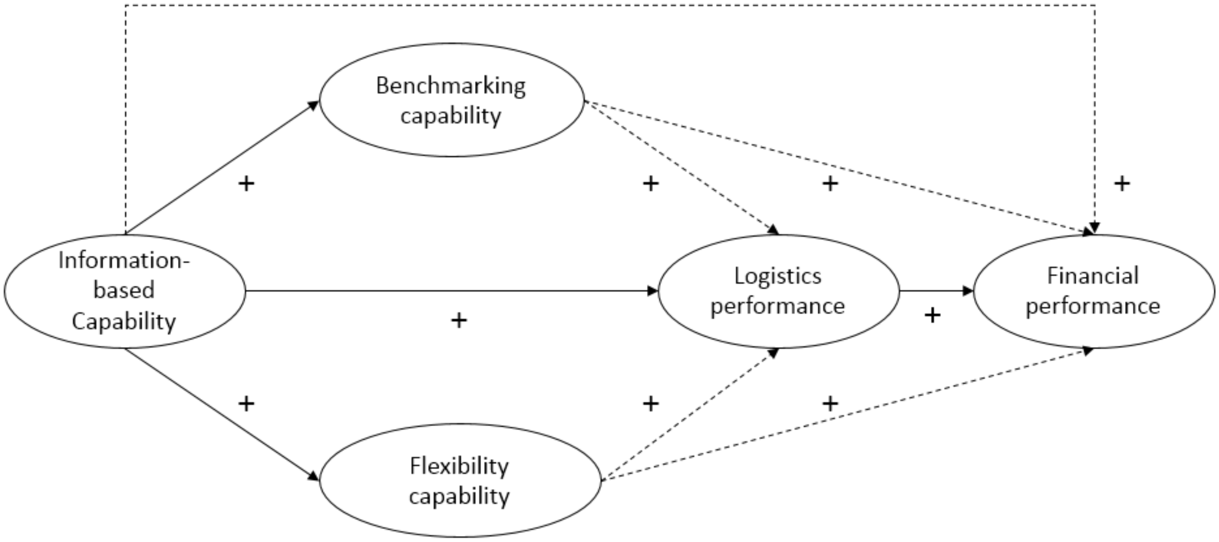

Figure 3 Summary of findings in Shang and Marlow (2005)

All the literatures we mentioned above are restricted to test associations between capabilities and performances within a firm level. However, there is an increasing demand to link capabilities with performances in an inter-organizational level since the collaboration through supply chain partners may have great potential to improve firm performance (Wong, Boon-Itt, & Wong, 2011). Thus, we will introduce other theoretical choices that are more suitable for research in this field on dyad and network level.

2.4. Relational view and extended resource-based view

The relational view (RV) is a theory arguing that an individual organization may seek out cooperation with other organizations to enhance their core competencies because of highly competitive environments (Dyer & Singh, 1998). From this view, a firm's key resources may be embedded in relational networks, which are established by the SCC of different firms.

Relational rent, which is a key concept of RV, is defined as a superior return generated through the contributions of the alliance partners. RV identifies four potential sources of relational rents: “relation-specific investments, inter-firm knowledge sharing routines, complementary resources or capabilities, and effective governance mechanisms” (Dyer & Singh, 1998).

Furthermore, RV emphasizes the mechanism of relational rent generation. There are different types of benefits, including common benefits (Dyer & Singh, 1998), which could not be generated by either of collaborative partners, and private benefits. Hamel (1991) suggested that one partner might improve its private benefits both within and without the alliance because of the different bargaining power of partners. Another example of the potential risk in the middle of collaborative process is knowledge leakage. Considering the risks of collaboration, Khanna, Gulati and Nohria (1998) introduced a new measure 'relative scope' to evaluate the impacts of cooperation and competition on the 'private benefits' and 'common benefits'.

Although collaboration might bring some difficult issues, it is not in the scope of research objective. From now on, we only focus on how organization creates common benefits during the collaboration in this study. Wong (2011) examined how Li & Fung Group, a global sourcing firm, expands its relational networks of suppliers and distributors globally to gain and maintain its competitive advantages in the face of uncertain market changes. Sa Vinhas, Heide and Jap (2012) argued that the characteristics of the individual buyer-seller relationship influence outcomes in inter-organizational networks.

Laive (2006) extended RBV in networked environments. Compared with Conventional RBV, which assumes the organizations must have the total ownership of the resources, the extended resource-based view (ERBV) only emphasizes on the ability to combine and employ both internal and external resources to achieve competitive advantages. The competitive advantages in a business alliance includes four elements, which can be divided into two groups:

Group 1: the combination of the following rents brings private benefits for the focal organization.

(1) **Internal rent** is obtained from the focal organization's shared and non-shared resources.

(2) **Inbound spillover rent** is extracted from partner's resources by knowledge absorbing.

(3) **Outbound spillover rent** is created by transferring benefits from the one organization to its alliance partners.

Group 2: the following rent provides collaborative advantage to alliance partners.

(4) **Appropriated relational rent** is generated from the shared resources of alliance partners.

Laive (2006) argued relational rents leads to collaborative advantage that cannot be created by collaborative members independently and concluded that the relationships between partners have more weight than the resources possessed by either partners in networked environments.

A number of empirical studies have attempted to investigate the effects of integration or collaboration through supply chain partners on the firm performance based on RV and ERBV. Stank, Scott and Patricia (2001) examined the relationships among external collaboration, internal collaboration and logistics service performance. They found that internal collaboration could increase logistics service performance directly while external collaboration is positively related to internal collaboration. However, there is no direct link between external collaboration and logistics service performance. As presented in Figure 4, Sanders and Premus (2005) proposed and tested a model of the associations among IT capability, internal and external collaboration, and firm performance. The result of this research supported the claim that internal collaboration has a positive impact on the firm performance. Furthermore, IT capability is able to promote both internal and external collaboration.

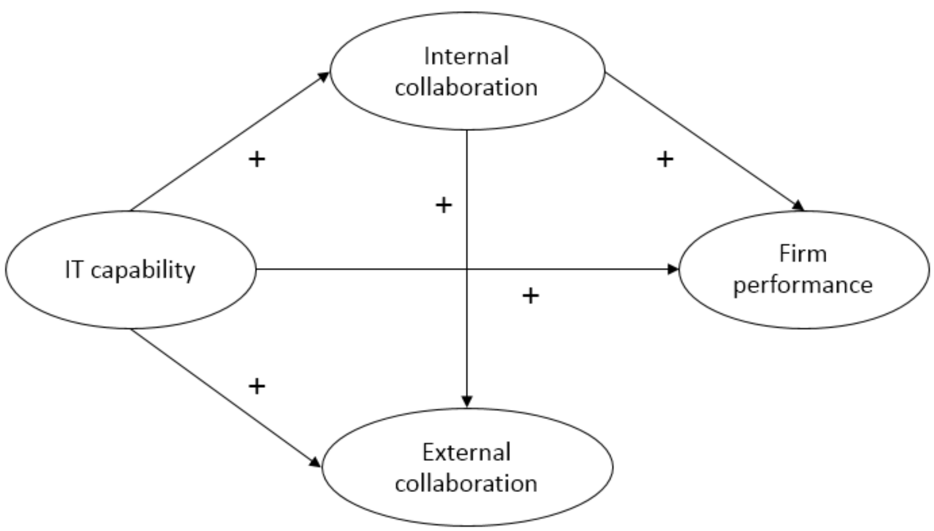

Figure 4 Research model in Sanders and Premus (2005)

In other attempts, Flynn et al. (2010) identified various dimensions of SCI such as customer integration, supplier integration and internal integration and examined the associations between various dimensions of SCI and firm performance in the context of Chinese manufacturing companies and their supply chain partners. The main findings indicated that internal integration is positively related to both performances while customer integration is only positively related to operational performance. However, supplier integration has no direct impacts on either of performances. Wong et al. (2011) extended the prior study (Flynn, et al., 2010) and collected data in Thailand's automobile manufacturing industry to investigate the link between SCI and operational performance. Similarly, the authors collapsed SCI into three dimensions: supplier, customer and internal. The results indicated that all three dimensions of SCI are positively linked to operational performance that would be measured as delivery, quality, flexibility and cost.

Cao and Zhang (2011) synthesized the literatures to point out that SCC is consisted of seven components such as information and resource sharing, collaborative communication, join knowledge creation, etc. As is shown in Figure 5, the authors proposed a theoretical model that SCC could increase collaborative advantage and thus improve the firm performance based on RV and ERBV. The results confirmed that SCC has positive impact on collaborative advantage and firm performance according to a large-scale online survey in US manufacturing industry and their partners.

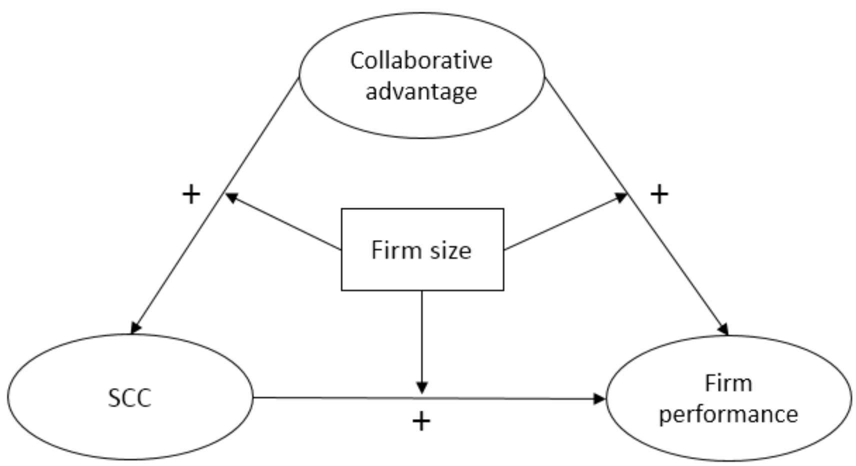

Figure 5 Structural model in Cao and Zhang (2011)

As reviewed above, we noted that some of studies used term "SCC" and other studies used term "SCI". Although sometimes they are interchangeably, Cao and Zhang (2011) proposed that SCI focused on the process integration and central governance while SCC had an emphasis on the relational communication and joint relationship. Thus, we will adopt the term "SCC" in the remainder of this study because we want to examine the effects of coordination mechanism on firm capabilities and performance. Furthermore, we found that most of the studies were restricted to link SCC with firm performance and they thus did not necessarily show how SCC affects the firm capabilities, which is a major weakness of this research topic.

Combining the advantage of capabilities-performance relationship and SCC research, in next Chapter, we will develop a new theoretical model to evaluate the role of firm capabilities on the relationship between SCC and firm performance. Both RBV and its extensions are chosen as the theoretical foundations to assess the relationships among SCC, innovation capability, logistics service capabilities and their effects on firm performance.

3. CONCEPTUAL DEVELOPMENT

In this Chapter, we develop a conceptual framework and formulate hypotheses to illustrate the network of relationships between SCC, firm capabilities and performance.

3.1. Conceptual model

Figure 6 illustrates our proposed theoretical model of the relationship among SCC, logistics service capability, innovation capability, operational performance and financial performance based on RBV, RV and ERBV.

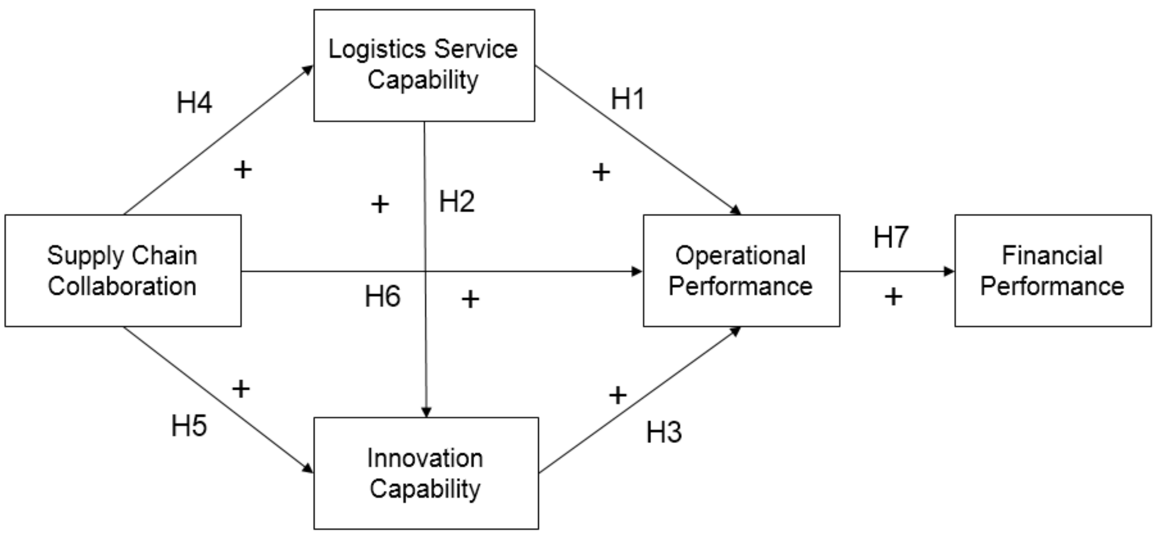

Figure 6 Initial theoretical model

The definition of SCC can be explained from two perspectives:

1) Relationship-oriented view**: S**upply chain members share resources and information to achieve their common goals and form a long-term and close alliance (Bowersox, Closs, & Stank, 2003).
2) Process-oriented view: Mentzer et al. (2001) defined SCC as a business process where two or more organizations share resources and work collaboratively to accomplish mutual goals through common understanding and vision.

Logistics service capabilities represent the process of providing diverse services to created benefit for various customers' requirements (Lai, 2004). For this reason, the range of logistics service provided by 3PLs is different and it thus affects the firm performance (Stefansson, 2006).

Innovation capabilities are perceived as an organization's ability to adopt new knowledge and inspiring ideas into new service offering in an inter-organizational environment. This capability could be a critical role for collaborative advantage, which is joint competitive advantage, in a global and dynamic competition (Lawson & Samson, 2001).

In summary, the model proposes that collaboration will influence the firm capabilities and performance. More specifically, a focal organization can improve the effectiveness of its own capabilities and enhance organizational performance by leveraging the supply chain partners' resources and capabilities. In this study, the firm performance could be measured by the customer satisfactions, service quality, sales growth, profitability, etc.

3.2. Research hypothesis

From the proposed model and the theoretical arguments in last Chapter, the detailed description of key constructs in the model are described and the research hypotheses are elaborated based on the relevant literatures.

3.2.1. Logistics service capabilities and operational performance

The first construct of this research is logistics service capability, which is an ability to exploit and utilize their own strategic resources to meet their clients' logistics demands (Lai, 2004).

Table 2 Types of logistics service

Service types	Description
Value-added logistics service	Assembling, packaging, labeling, cross-docking, order processing, printing, L/C compliance and negotiation, etc.
Technology-enabled logistics services	Customized system development, tracking system, exchange data integration, etc.
Freight forwarding service	Freight forwarding

Source: Lai (2004)

Accordng to RBV theory, 3PL providers would acquire different logistics service capabilities to offer various logistics service. As is shown in Table 2, the author extracted three main types of logistics service provision from a list of 24 different logistics service items.

The second construct is operational performance, which is a critical measure to evaluate the outcomes of organizational process. Although the definition of this term can vary depends on the contexts, there is a broad consensus in many empirical studies of logistics management. Voss, Ahlstrom and Blackmon (1997) constructed an operational performance index to measure the performance of process efficiency, such as productivity, cycle time and defect rates. Liu and Lyons (2011) synthesized the related literatures from both supplier and customer perspectives (Panayides, 2007; da Silveira & Cagliano, 2006) to summarize a series of key indicators that could measure operational performance, including production cost and flexibility, product quality, delivery, etc.

A number of researchers have reported that logistics service capabilities are positive linked to their operational performance based on RBV. Lai (2004) analyzed the correlations between service capabilities and firm performance, and found that LSPs with better service capability will lead to better performance. Moreover, the results indicated that different services have different weights in the overall performance. Lu (2007) evaluated the critical capabilities in liner shipping industry and suggested that logistics service capability, which was identified as the most crucial capability in logistics industry, leads to superior customer service significantly. Yang et al. (2009) investigated the associations between logistics service capabilities and performance of liner shipping service providers in Taiwan and the results of the study showed that logistics service capability had significant positive impacts on the firm performance including operational performance. From all above literatures we reviewed and RBV theory, we could safely hypothesized that:

H1: Logistics service capability is positively associated with firm operational performance in Finnish logistics industry.

3.2.2. Innovation capabilities and operational performance

Before proceeding to formulate more hypothesis, it is necessary to introduce third construct: innovation capabilities. From the view of service providers' operations, innovation can be divided into different categories. One taxonomy is given by Jenssen and Randøy (2006), who divided innovation into two main types: product-process innovation and market innovation. This taxonomy is developed by studying how innovation affects the firm performance according to survey responses of 46 Norwegian logistics firms.

Previous studies on the integration of logistics service and innovation capabilities found that there is a significantly positive association of these capabilities. Yang et al. (2009) reported that an ocean freight forwarder could be more innovative in logistics service capabilities through learning new knowledge or seeking creative ideas. As a result, their competitors are not able to imitate these logistics service capabilities. Moreover, the result of study by Tuominen and Hyvönen (2004) indicated that the companies could provide higher service quality and better experience to their customers to differentiate the service offerings by integrating their innovation activities into the corresponding logistics service such as customized process and systems. Petroni and Panciroli (2002) presented that both technological and managerial innovation capability had positive impacts on firms' product and process flexibility based on a survey of 198 suppliers in food packaging industry. Panayides (2006) argued that higher firms innovation capability would lead to the improvement of logistics service quality. Consequently, it is difficult for the market competitors to learn their logistics service capability and implement the similar service offerings. From the previous research and RV, the hypothesis could be given as below:

H2: Logistics service capability is positively associated with innovation capabilities in Finnish logistics industry.

Focusing on the correlation between innovation capability and operational performance, several empirical research have concluded that innovation capability can be positively associated with customer service performance. Tuominen and Hyvönen (2004) examined the relationship between innovation and competitive advantage in channel management and marketing and the results supported that both managerial and technical innovation play a vital role in achieving competitive advantage of operations. Yang et al. (2009) conducted a similar research based on liner shipping industry in Taiwan. They found that the ocean freight forwarders would be more profitable and deliver better customer service when these firms frequently adopt new technologies and look for new processes, or try to be more creative in operation methods. In other words, the higher degree of innovation capability will be strengthened the operational performance. From the above discussions and RBV theory, this study proposes the following hypothesis:

H3: Innovation capability is positively associated with firm operational performance in Finnish logistics industry.

3.2.3. Supply chain collaboration, firm capabilities and performance

As we mention in the conceptual model, the definitions of SCC have two different views: process-oriented view and relationship-oriented view. Considering both process and relationship focus, SCC could be regarded as a collaborative process where two or more organizations work collaboratively to plan, execute and monitor “supply chain operations toward common goals and mutual benefits” (Cao & Zhang, 2011).

Existing literatures have demonstrated that SCC would not only improve the process efficiency but also increase the range of service offering. Bowersox (1990) found that SCC facilitates the coordination of supply chain partners to improve their service offering and quality. Gosain, Malhota and El Sawy (2004) suggested the firm collaboration supports rapidly process changes and adapt the new requirements of product or service offering. Simatupang and Sridharan (2005) indicated that closer collaborations enable the participating members to redesign integrated process and improve their process efficiency. Through this process reengineering, 3PL providers would increase their capabilities to fulfill customer requirements and react to market uncertainty. Therefore, we develop the following hypothesis based on the above literature and ERBV:

H4: Supply chain collaboration is positively associated with logistics service capability in Finnish logistics industry.

A large number of studies suggested that collaboration promotes the knowledge-based ability such as rapid learning and knowledge transfer. Kalwani and Narayandas (1995) studied the relationship between manufacturer and supplier and found that collaboration between supply chain members plays a vital role in new product development. Stuart and McCutcheon (1996) has found that firms expect the long-term collaborative relationship will give them faster product development and more competitive products to increase the profits. Fisher (1997) argued that responsive supply chain would enable the participating members to develop innovative products more accurately and lower the risk of overproduction. Thus, they would obtain superior financial benefits. Uzzi (1997) reported that SCC promotes a faster response on market demands. For instance, solving problem collaboratively increases the speed of new product development, which means shorten the time to market. Considering both ERBV and the related studies, this study thus hypothesizes:

H5: Supply chain collaboration is positively associated with firm innovation capability in Finnish logistics industry.

In the last decades, research on SCC and firm performance has become very popular. Simatupang et al. (2005) proposed an integrative framework for SCC, which is consisted of five critical components of collaboration such as "collaborative performance system, information sharing and integrated supply chain processes". Among these features, information sharing is viewed as the "heart" (Lamming, 1996) and "foundation" (Lee & Whang, 2001) of SCC. Doll, Raghunathan, Lim and Gupta (1995) provided the definition of information sharing as the willingness to transfer transactional and analytic data such as demand forecasting, inventory availability and marketing campaign monitoring through supply chain partners. Sheu, Yen and Chae (2006) used the term "information sharing" to measure the level of sharing confidential and accurate information on time with the supply chain members. The results indicated that higher level of collaborative relationship would lead to better firm performance. Lee and Whang (2001) suggested that higher profits is significantly linked with higher levels of information sharing. The results obtained by a survey of manufacturers and retailers in the consumer products and food industry. Shen et al. (2006), Duffy and Fearne (2004) have demonstrated that both suppliers and customers are looking for long-term relationships and collaboration is regarded as an important method to improve performance. They also found that supplier firms earned great profits and increased their sales through establishing long-term strategic alliance with their partners. Simatupang et al. (2005) introduced a collaboration index to assess the degree of collaborative practices between focal organizations and their partners and the authors reported that this index has a positive impact on the operational performance. Thus, this study hypothesizes the following statement based on RV and previous research:

H6: Supply chain collaboration is positively associated with firm operational performance in Finnish logistics industry.

At last, we move on examining the correlations of various dimensions of firm performance. Venkatraman and Ramanujam (1986) examined the measurement of different firm performance and found that operational performance is regarded as the crucial factor to improve financial performance. Likewise, Liu et al. (2011) suggested that a positive association of firm performances exists. The results of the study indicated that 3PL providers, who have better operational performance and wider scope of service that meets the customers' requirements, would achieve superior financial performance. These findings have been validated in Taiwan and the UK. Hence, considering the above literatures, this study hypothesizes that:

H7: Firm operational performance is associated with firm financial performance in Finnish logistics industry.

This chapter has illustrated the conceptual model and formulated seven research hypotheses. In the next chapter, we will describe the detailed steps of research methods and design.

4. RESEARCH METHODS

In this Chapter, we first introduce the research methodology such as the steps of EFA, CFA and SEM. Then we will discuss the questionnaire design, data collection and respondents profile.

4.1. Overall research design

The procedure of our research is shown in Figure 7. The brief introduction of the research procedure is given in the reminder of this section. Note that the corresponding section number for each step is also provided in parenthesis.

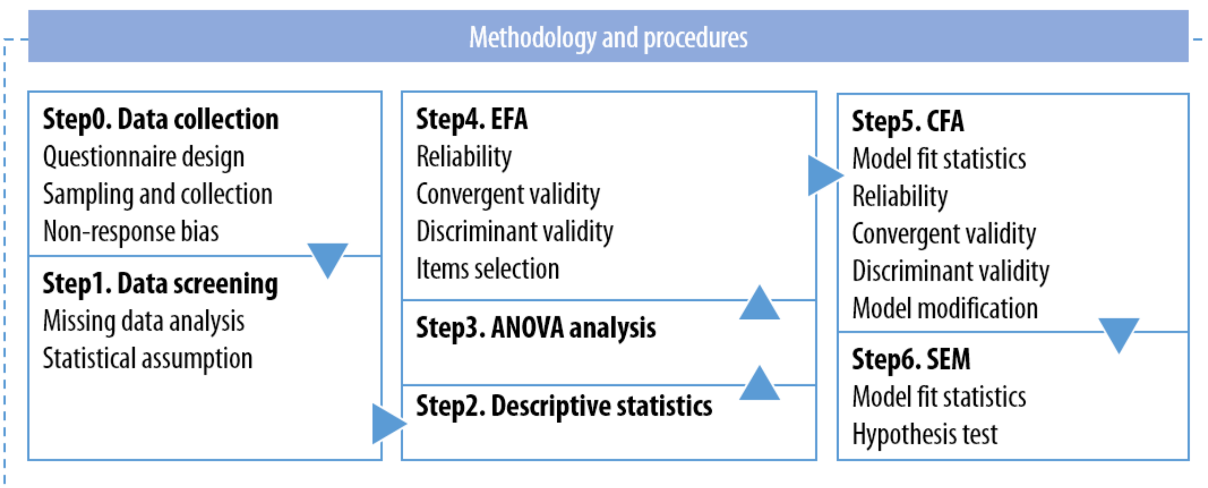

Figure 7 Overview of research procedures

At the preliminary step, we will discuss the development of questionnaire **(4.2)**, the sampling and collection techniques **(4.3)** including non-response bias, and overview of respondents' profiles **(4.4)**. In Step 1, we will conduct missing data analysis and imputation **(5.1.1)**. The assumption for multivariate data analysis will also be tested **(5.1.2)**. Step 2 reviews the descriptive statistics of survey items **(5.2)** while Step 3 performs an ANOVA analysis to compare the average scores of different firm size **(5.3)**. In Step 4, an EFA was used to identify whether the constructs are expected as our questionnaire design (**5.4.1)**. The reliability and validity of this five-factor model will also be examined **(5.4.2)**. In Step 5, we will apply CFA to examine the fit of a measurement model and assess the construct validity **(5.5.3)**. Moreover, the process of remedy to minimize the discrepancies will be shown **(5.5.1; 5.5.2).** The last step applies SEM approach to evaluate the fit of a structural model **(5.6.1)** and validate the research hypotheses **(5.6.2)**.

4.1.1. EFA process

Figure 8 introduced the specific phases to test the associations between factors with the empirical data. This procedure is modified through combining different quantitative empirical research materials (Hair, Black, Babin, Anderson, & Tatham, 2009; Lowry & Gaskin, 2014). Below are the brief instructions and key concepts of these steps, which can be classified into two categories: item selection and assessing fit.

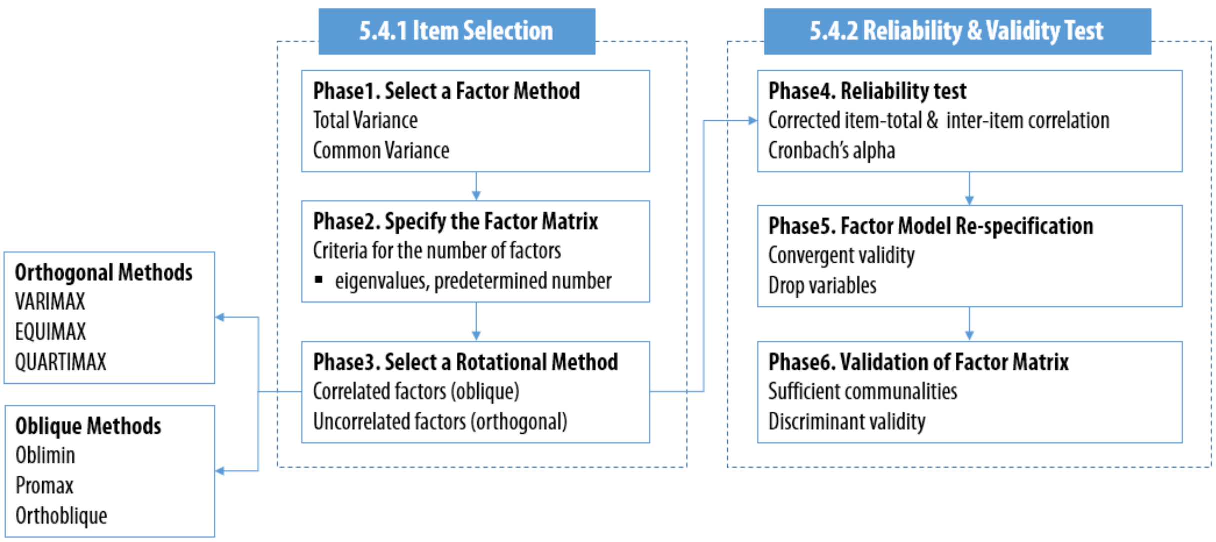

Figure 8 Overview of EFA process

Phase1 Factor extraction method selection: In terms of selecting the factor method, the most important concept is to understand the different types of variance and its corresponding extracting method.

- Total variance of a specific variable is consisted of its common, specific and error variance. Principal component analysis (PCA) focuses on extracting this type of variance to reduce the number of factors (Hotelling, 1933).
- Common variance is a variance in one variable that could be shared with other variables and could be explained by the correlation with other variables. Common factor analysis focused on extracting this type of variance to identify the dimensions of a factor. In this study, both

PCA and common factor analysis will yield similar results due to communalities of higher values (e.g. 0.60) for most variables.

- Specific variance is a variance that is associated with a specific variable. This type of variance could not be explained by the correlation with other variables.
- Error variance is a type of variance that might be caused by the measurement error and could not be explained by the correlation with other variables.

Phase2 Factor matrix specification: The number of factors is determined by different criteria.

- Latent root criterion is using the eigenvalue for creating a cutoff. For example, only the factors having the eigenvalues greater than 1 are considered significant (Churchill & Iacobucci, 2002).
- Priori criterion: This is a useful approach when the researchers have already known the exact number of factors before performing the factor analysis. For example, if the researchers want to replicate other's work, they are able to give a pre-determined number to extract the factors.
- Percentage of variance criterion: The aim of this method is to accumulate a specified percentage of variance. In social science, 60% or higher of the total variance are regarded as sufficient in analysis (Hair, et al., 2009).

Phase3 Rotational method selection: The factor rotation will improve the interpretation in most case if the rotational method is appropriate because the rotation will redistribute the variance to gain a simpler factor pattern, which means minimizing the number of high loadings on each column and maximizing a variable's loadings on a single row. There are two different categories of rotation methods.

- Orthogonal factor rotation: The axes of this rotation method are always maintained at 90 degrees. The introduction of two major orthogonal methods is given below.
    - VARIMAX is to simplify the columns of the factor matrix by maximizing the chances to gain high loadings (the absolute value is close to 1) and low loadings (the absolute value close to 0) on each column. In this situation, this method gives a much clearer factor pattern than QUARTIMAX does.
    - QUARTIMAX, on the opposite of VARIMAX, is to simplify the rows of a factor matrix by achieving a higher loading on one factor and lower loadings on all other

factors on each row. Although the implementation of this method is easier than that of VARIMAX, the factor structure might be difficult to interpret because of the large first factors.

- Oblique factor rotation: The axes of this rotation method do not need to maintain at 90 degrees. Thus, it is more suitable for correlated factors or constructs. PROMAX is the major approach is PROMAX.

Phase4 Reliability test: The internal consistency reliability, which refers to the consistency of response across items within a single construct, is examined through three diagnostic measures: corrected item-total correlation, corrected inter-item correlation and Cronbach's alpha statistic (Robinson, Shaver, & Wrightsman, 1991; Andrews, 1991). The details of these measures are provided in 5.4.2.1.

Phase5 Factor model re-specification: When the factor model is obtained, we may find it is problematic, for example, the variable does not have sufficiently high factor loading or its communality is too low. In this situation, the following remedies could be used.

- Ignore problematic variables: This is the easiest solution. The researcher just take a note that the variables in question are poorly represented in the factor, which might lead to a potential problem in the further analysis.
- Delete a variable: The researcher can drop the variable with the lowest communality and then re-specify a new factor model.
- Apply a different rotational method: If the orthogonal method has already been used, then the oblique factor rotation could be applied and new factor solution would be assessed by the model fit.
- Extract a new factor solution with different number of factors: Increasing and decreasing the number of factors will affect the model fit because the problematic variable might be represented better in a larger or smaller factor structure.
- Change a different extraction method: Although the results of the different extraction method might be similar in common research settings, the different types of variance might affect the factor structure to some extent. Thus, switching the different extraction method could be the last remedy.

Phase6 Validation of factor matrix: Further assessment of the factor solution will be conducted in this step. Two major forms of validity are described below.

- Convergent validity could be measured by the factor loadings. In general, the values of loadings should at least meet the minimum acceptable levels, which largely depends on the sample size. For example, BMDP statistical software Inc. (1993) provided a guideline for identifying significant factor loadings based on sample size, which is shown in Table 3.
- Discriminant validity could be measure by the communality and factor correlation matrix. The higher communality and lower correlation in matrix are desired.

Table 3 Identifying significant factor loadings based on sample size

Factor Loading	Sample size needed for significance[a]
0.30	350
0.35	250
0.40	200
0.45	150
0.50	120
0.55	100
0.60	85
0.65	70
0.70	60
0.75	50

[a]Significance is based on a 0.05 significance level

Source: BMDP statistical software Inc. (1993)

4.1.2. CFA and SEM process

Figure 9 described a five-stage process that combines the procedure of CFA and SEM. This procedure is inspired by the same sources as we mentioned in Figure 8 (Hair, et al., 2009; Lowry & Gaskin, 2014). The key concepts and overview of these steps are given below.

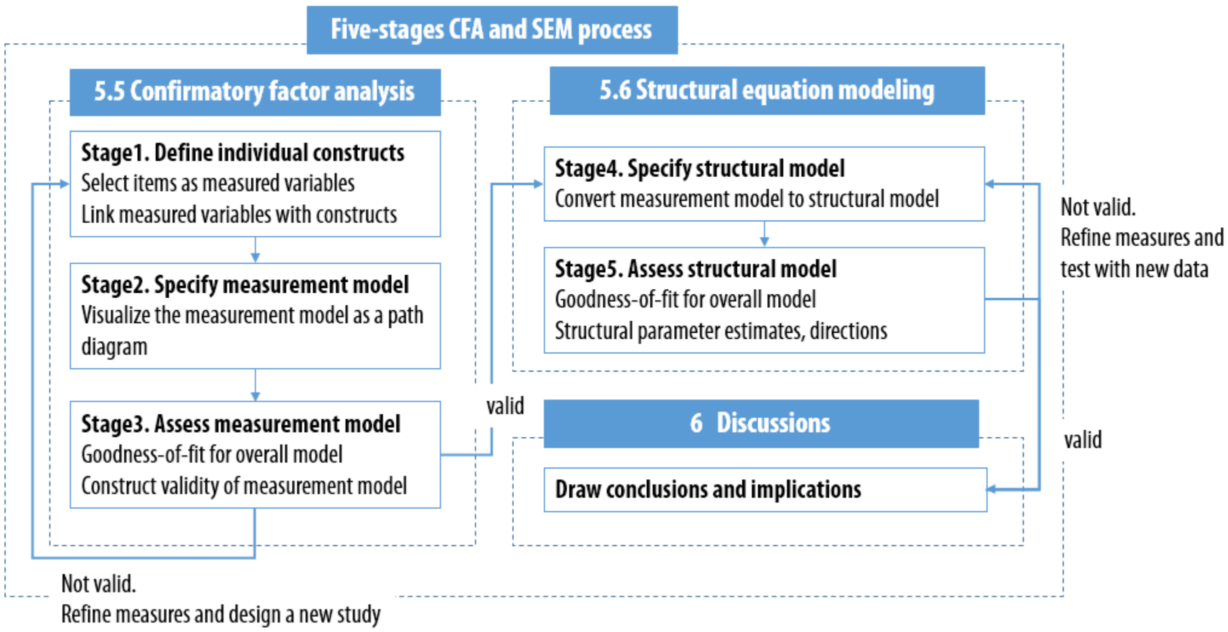

Figure 9 Overview of CFA and SEM process

Stage1 Define individual construct: Selecting the appropriate items to measure a specified construct is the foundation of CFA and SEM process. This is a very challenging part in the research process, which requires enormous time and efforts to confirm the quality of measurements. Luckily, in this study, the researchers from Logistics Department have already developed items based on previous research.

Stage2 Specify and develop measurement model: After defining all these constructs, the measurement model could be created by establishing the relationships between the different constructs. Both equations and path diagram could be used to represent the measurement model. Apart from the representation of the model, the researchers are required to resolve the different issues of the model specifications. Here are some sample questions that need to be addressed.

- Do these constructs reflects their theoretical definition?
- Do the empirical evidences support the validity and reliability of the constructs?
- How many items could be measured for each construct? Although there is no strict criterion, the researchers recommend that there should be three or four items per construct in practice (Hair, et al., 2009).
- Is there any possible solution to improve the quality of the measurement model by increasing or decreasing the number of items for a specified construct? More items for a construct will

maximize reliability. However, they also require a larger sample size. Thus, the researchers need to look for a trade-off between the number of items and sample size.

Stage3 Assess measurement model: Before conducting the further analysis, the fit of overall model will be examined first. Then the validity and reliability of the measurement model will be assessed. If the fit indices of the model do not achieve acceptable level, the researchers need to re-specify the measurement model before proceeding.

- There are many fit indices of the overall model, which could be divided into three categories:
  - Absolute fit indices include Chi-square ($\chi 2$), normed Chi-square ($\chi 2/df$), root mean square error of approximation (RMSEA) and standardized root mean square residual (SRMR). These indices provided a method to evaluate how well the conceptual model fits the empirical data (Byrne, 1998; Hair, et al., 2009; Bagozzi & Yi, 1989; Chen, Curran, Bollen, Kirby, & Paxton, 2008).
  - Incremental fit indices include comparative fit index (CFI) and Tucker Lewis index (TLI). The aim of these indices are different from absolute fit indices because they compare the measurement model with some alternative baseline models, for example, null model that assumes all items are uncorrelated. The category of these indices represents the improvement in the model fit by the model specification (Bentler & Bonett, 1980; Hu & Bentler, 1995).
  - Parsimony fit indices include adjusted goodness of fit index (AGFI) and parsimony normed fit index (PNFI). This class of fit indices focus on comparing a set of competing models according to their complexities and fits. The indices will be improved by a better model fit or a simpler model (Tanaka & Huba, 1985; Mulaik, et al., 1989).
  - The cutoff values for these fit statistics mainly depend on the sample size and the complexity of the mode, for example, the number of measurement items (Marsh, Hau, & Wen, 2004). Previous study used the simulated data to validate the effectiveness of these cutoff values. Consequently, they found that the criteria of simpler model and smaller samples should be stricter than the criteria of complex models with larger sample. Similarly, complex models with smaller samples may require less strict

criteria for assessment with a series of model fit statistics (Sharma, Mukherjee, Kumar, & Dillon, 2005).

  - Considering the objective of this research, the model fit is measured by absolute fit indices and incremental fit indices. The details of fit statistics in these two groups are provided in 5.5.1.

- The validity and reliability of the measurement model will also be assessed in this step. Here are the brief introduction of these fit statistics.
  - Convergent validity could be tested by the critical ratio (C.R.) and item reliability (R^2). If the fit statistics of the measurement model are well over the minimum acceptable level, the measurement items have adequate convergent validity (Hair, et al., 2009.
  - Internal reliability are evaluated by the composite reliability (CR) and average variance extracted (AVE). If the fit statistics of the measurement model are well over the minimum acceptable level, it means these constructs are well represented by their measurement items (Bacon, Sauer, & Young, 1995; Fornell & Larcker, 1981).
  - Discriminant validity can be checked by comparing the inter-correlations between constructs with the square root of the AVE. If the value of latter is greater than the value of former, it means that these constructs demonstrates the sufficient discriminant validity (Fornell & Larcker, 1981).
  - The details of the above fit statistics are provided in 5.5.3.

Stage4 Specify structural model: When the indices of measurement model meet the acceptable level, the structural model could be considered in this step. The development of structural model is accomplished by assigning links between different constructs based on the theoretical model. This step pays emphasis on establishing the dependence relationships or, from the perspective of path diagram, adding directional arrows that could represent the hypotheses in the model. Using the specific structural path to replace the correlations between constructs is one of the main difference between CFA and SEM. Although the focus of this step is the structural part, both measurement model and structural relationships will be represented in a path diagram.

Stage5 Assess structural model: The assessment of the proposed structural model not only includes the measurement relationship between indicators to constructs, but also covers the hypothesized structural relationship among constructs. In the first part, the model fit of structural model can be evaluated with the same criteria of the measurement model. In the second part, the specified hypothesis will be examined to determine whether the results of individual parameter estimates are statistically significant and in their predictions.

4.2. Questionnaire development

The survey we used in this research was developed by the researchers of Logistics Department, Aalto University School of Business. The survey items were selected and modified from previous studies (Liu & Lyons, 2011; Chen & Paulraj, 2004; Prajogo & Olhager, 2012). In the survey, the respondents are required to provide the background information such as job title, firm size, service provision and business area in the first part. Then, they rate the satisfaction levels of their firm capabilities and the firm performance levels, relative to industry advantage. Furthermore, they need to provide the ratings of agreement levels regarding information sharing and relationship building. All these ratings were measured as a seven-point Likert scale.

4.3. Sampling technique and data collection

In this study, Fonecta, a search engine for Finnish enterprises, was used to filter the companies that meet with the searching criteria such as the service provision, firm size and business area. Then, the sample of 120 companies for this study was randomly selected from the 910 filtered companies.

To improve the response rate, following suggestions from Frohlich (2002), we called all 120 respondents before sending out the online survey. At last, we received 52 responses and drop 2 of them due to incomplete responses, which resulted in 50 usable responses. A response rate of 41.66% is well above the recommended number for empirical study in operation management (Malhotra & Grover, 1998). Therefore, it is reasonable to claim that non-response bias will threat the validity of our results.

4.4. Overview of respondents' profile

This section provides an overview of respondents' profile such as job title, firm size, service provision, business area and certification of quality management.

In terms of the job title, the results of Table 4 showed that more than 70% of respondents are presidents or managing director while 12% of respondents are unit or functions managers. This distribution provided a more reliable view for our research because presidents are the people who have the accurate information about their own firm' performance, especially for financial performance, relative to industry average, while the managers are familiar with the operational and innovation activities within a company because they are always actively in the daily operation.

Table 4 Respondents' profile – job title

	Number of respondents	Percentage of samples (%)
Job title		
Company owner/co-owner	6	12.0%
Chairman of the Board	2	4.0%
President/managing director	36	72.0%
Business unit manager	3	6.0%
Transport/logistics Manager	3	6.0%

In Table 5, we pay attention to the distribution of firm size, which is considered as a moderator in this study. As presented in Table 6, 66% of responding firms were classified into the medium firm (10-50 employees) and only 12% of respondents were large firms (more 50 employees). In this situation, we are not able to use firm size as a moderator in the following analysis because of the imbalance group. Thus, we will only conduct the ANOVA analysis to compare the average score of SCC, firm capabilities and performance by the firm size.

Table 5 Respondents' profile – firm size

	Number of respondents	Percentage of samples (%)

Number of employees		
0-10	11	22%
10-50	33	66%
51-200	6	12%

It is worthwhile to note that service provisions of responding firms are different, which is shown in Table 6. Although vehicle management and distribution are the most common service provided by the responding firms, none of them was more than 50%. Furthermore, the value-added service was only provided by 5-10% of respondents. Different service provision may lead to the different criteria to measure the firm performance due to various business process and profit rate.

Table 6 Respondents' profile -scope of business operation

	Number of respondents	Percentage of samples (%)
Service provision		
Customs	3	6%
price negotiation	10	20%
Fulfilling orders	14	28%
Distribution	23	46%
Freight forwarding	7	14%
Order processing	10	20%
After-sales support	3	6%
Cargo insurance	5	10%
Transporter selection	4	8%
Vehicle management	24	48%
Supplier Management	1	2%
Debt recovery	5	10%
Return logistics	13	26%
Contract production	4	8%
Inventory management	8	16%
Storage	9	18%
Packaging and labeling	1	2%

Assembly / installation	4	8%

As presented in Table 7, most of the responding firms ran their business only in Finland (68%). Thus, the results presented in this study will be hard to generalize to other countries. Moreover, 68% of responding firms has an ISO 14000 certificates while there is one respondent did not answer this questions.

Table 7 Respondents' profile – business area and quality certificate

	Number of respondents	Percentage of samples (%)
Business area		
Finland (only)	34	68%
Nordic country (only)	6	12%
Europe	9	18%
South America	1	2%
ISO 14000 certificate[a]		
Yes	34	68%
No	15	30%

[a] Represents 1 respondent did not provide this information.

5. ANALYSIS AND RESULTS

In this Chapter, we will examine the relationships among SCC, logistics service capability, innovation capability and operational performance.

- At first, we investigate the data quality including missing data, outliers and necessary assumptions for further statistical analysis and then present the results of descriptive analysis and ANOVA analysis on firm size.
- After that, we perform EFA to explore the factor structure and spot problematic variables.
- Subsequently, we follow a two-step approach proposed by Anderson and Gerbing (1988).
    - The first step is to apply CFA to assess the validity of the measurement model.
    - In the second step, after the validation of measurement model, a SEM approach is employed to evaluate the good fit of model and summarize the findings of hypothesized relationships among variables.

The following analysis is conducted through the following analysis is conducted through IBM SPSS Statistic 22.0 and IBM SPSS AMOS 22.0.

5.1. Data screening

Before running further statistical analysis, we will screen the data and variables to make sure they are reliable and valid for testing causal theory because the estimation methods we used assume specific conditions, and the violation of these assumptions leads to an inappropriate solution (Kline, 2010). In this section, we will examine the data from two different perspectives: 1) missing data analysis and imputation, and 2) outliers and normality to make the data ready for the following analysis.

5.1.1. Missing data analysis and imputation

In this section, we will determine the level of missing data on a case and variable basis and then select an imputation method based on the results of diagnosing the randomness of the missing data process.

Table 8 contains the percentage of variables with missing data on each case. The results have shown that 36% of the respondents (18 of 50 cases) do not answer all the survey items. Among them, the lowest amount of missing data is 2.3% (1 of 44 variable) while the highest amount of missing data is 27.3% (12 of 44 variables).

Table 8 Missing data on case basis

Case No.	25	15	47	41	49	31	44	50	12
Missing Count	12	9	9	8	8	7	7	6	5
Missing Percent	27.3%	20.5%	20.5%	18.2%	18.2%	15.9%	15.9%	13.6%	11.4%

Case No.	48	11	10	1	4	21	26	27	43
Missing Count	4	3	2	1	1	1	1	1	1
Missing Percent	9.09%	6.82%	4.55%	2.27%	2.27%	2.27%	2.27%	2.27%	2.27%

After examining the missing data on case basis, the missing data on variable basis should also be investigated. Table 9 contains the percentage of cases with missing data on each variable. The results have shown that 59.1% of the survey items (26 of 44 variables) have the missing data. Among them, the lowest amount of missing data is 2 % (1 of 50 case) while the highest amount of missing data is 20% (10 of 50 cases).

Table 9 Missing data on variable basis

Variable No.	Missing Count	Missing Percent	Variable No.	Missing Count	Missing Percent
EC3	10	20.0%	EC1	2	4.0%
EC4	10	20.0%	EC11	2	4.0%
EC5	7	14.0%	EC13	2	4.0%
EC2	6	12.0%	BS8	2	4.0%
EC7	5	10.0%	EP5	2	4.0%
EC6	4	8.0%	EP8	2	4.0%
EC8	4	8.0%	EP9	2	4.0%
EP3	4	8.0%	EP11	2	4.0%
EC9	3	6.0%	EC14	1	2.0%
EC10	3	6.0%	EC15	1	2.0%
EC12	3	6.0%	EC16	1	2.0%
EP4	3	6.0%	BS11	1	2.0%

EP10	3	6.0%	BS15	1	2.0%

a. Little's MCAR test: Chi-Square = 699.890, DF = 706, Sig. = .558

To diagnose the randomness of missing data process, we conduct Little's Missing Completely at Random (MCAR) test to detect whether these missing values are completely at random (Little, 1988). The results of this test are shown at the bottom of Table 9. Since the significant value is greater than 0.05, the null hypothesis that one's missing data are completely at random is supported.

Considering the results of MCAR test and the extent of the missing data (over 20%), the preferred methods by Hair et al. (2009) is the model-based methods. Thus, we decide to use the regression imputation to replace the missing value in this study and the following analysis will be based on the new dataset without any missing values.

5.1.2. Outliers and normality

The outliers in this study could be divided into two different categories: univariate outliers and multivariate outliers (Hair, et al., 2009).

The univariate outliers on variable basis do not exist in this study because Likert-scales are used in our survey, which means all variables were on ordinal scales with seven intervals.

Table 10 Summary of unengaged respondents

Case No.	Standard Deviation	Max	Min
7	0.44	7	5
39	0.59	6	3
9	0.64	5	3
40	0.65	7	4
35	0.68	6	3

The univariate outlier on case basis is the unengaged respondent, which means the respondent will give the same answer to every single survey item (Lowry & Gaskin, 2014). The aim of this step is to identify and remove these unengaged respondents. To detect the unengaged respondents, we calculate the standard deviation of their responses and check whether the result shows a very low standard deviation, in our case, 0.7 on a 7-point scale (Lowry & Gaskin, 2014).

Table 10 shows the respondents whose answers do not show the sufficient variance. Although five respondents are identified as unengaged, we decide to remove Case No. 7 and Case No. 39 only because the standard deviations of the other respondents are very close to 0.7. As a result, we have 48 respondents in our dataset now.

To detect the multivariate outliers, we need to calculate the Mahalanobis distance (independent variables: all survey items, dependent variable: case no.) and then create a line chart based on this distance. Figure 10 presents that the Mahalanobis distance of all cases are in a small region (between 35.00 and 45.00) and we thus conclude that there are no multivariate outliers in our case.

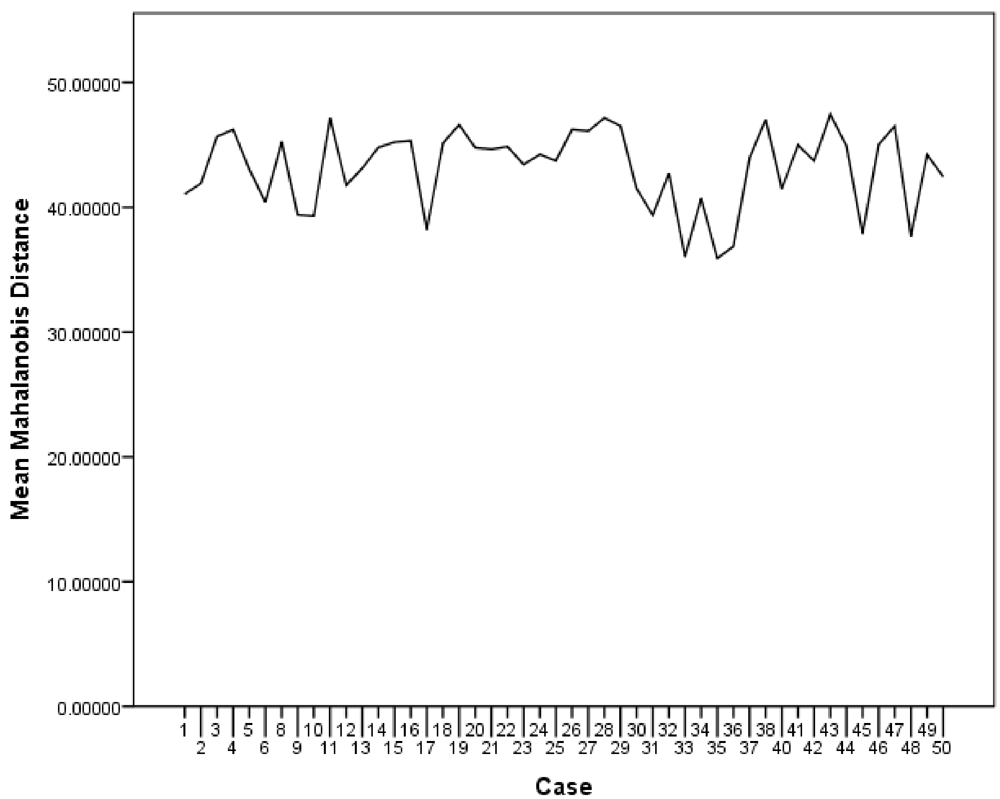

Figure 10 Mahalanobis distances by cases

Next step is to check the normality of the data for a particular variable since the assumption of these data is that they are normally distributed. The normality is measured by two indicators: skewness and kurtosis.

Skewness assesses whether the distribution of responses are heavily concentrated on one end of the scale. Thus, there is no reason to exclude variables based on skewness because all variables in this study are based on Likert-type scales.

Kurtosis is another measure, compared with normal distribution, to check if the distribution is flat or peaked. In statistics, if the absolute value of kurtosis is greater than or less than 1.0, it may indicate potentially problematic variables, for example, lack of sufficient variance. Both data that are tightly distributed or distantly distributed around the mean have kurtosis issues. Sposito, Hand and Skarpness (1983) suggested that if the absolute value of the kurtosis is less than three times the standard error, then there is no kurtosis issue; otherwise, kurtosis issues may exist. Table 11 summarizes the variables that have problematic kurtosis. In this study, the cutoff values was set to 5.0. Thus, we drop the variable BS5, BS7 and BS6 in the EFA and keep the rest of variables that are on borderline to perform further analysis.

Table 11 Summary of possible problematic kurtosis of variables

	BS5	**BS7**	**BS6**	**BS3**	**BS13**	**EC1**
Std. Deviation	1.10	1.06	1.18	1.22	1.17	1.23
Kurtosis	10.37	8.23	5.49	3.43	2.76	2.23

	EC15	**EC10**	**BS2**	**BS8**	**EC14**
Std. Deviation	1.30	1.30	1.18	1.35	1.20
Kurtosis	1.99	1.48	1.45	1.44	1.12

5.2. Descriptive statistics of survey items

To assess the understanding of SCC and the implementation of firm capabilities and performance, respondents were requested to rate the level of agreement regarding SCC or their company's satisfaction level regarding firm capabilities and performance using a seven-point scale (1=Very low satisfaction / Strongly disagree, 4=average and 7=Very high satisfaction / Strongly agree).

In this study, SCC is measured by eight items. Table 12 presented that expectation of long-term relationship and collaboration between suppliers and customers have the highest levels of agreement, followed by definition of supplier-customer relationship as a long-term alliance, and events/change notification (their mean scores were over 5.4). In contrast, frequent and punctual information exchange, and information sharing from customer side were rated as lower in terms of agreement (their mean scores were below 5). The findings indicate that Finnish 3PL providers strongly agree that long-term relationship between supplier and customer is a critical factor in their operation while they do not satisfy the current information sharing mechanism between supply chain partners.

Table 12 Level of agreement with supply chain collaboration (SCC) attributes

Code	Supply chain collaboration (SCC) attributes	Mean	S.D	Rank
BS5	Expectation of long-term relationship	6.25	1.10	1
BS6	Collaboration between suppliers and customers	5.92	1.18	2
BS7	Definition of supplier-customer relationship as a long-term alliance	5.83	1.06	3
BS3	Events and change notification	5.40	1.22	4
BS8	View suppliers and customers as an extensions of our company	5.34	1.35	5
BS4	Frequent face-to-face communication	5.00	1.50	6
BS2	Frequent and punctual information exchange	4.92	1.18	7
BS1	Information sharing from customer side	4.83	1.46	8

Note: Mean: 1=Strongly disagree, 7=Strongly agree and S.D.=standard deviation

For logistics service capability attributes, Table 13 has shown that Finnish 3PL providers are most confident in their ability to provide transportation service (its mean score was over 5) among all the service they provided. However, they provide a lower rating of satisfaction level in their ability to handle customer clearance and value-added service (their mean scores were below 4.5). This finding is very similar as the result provided by Yang, Marlow and Lu (2009). According to this result, Finnish 3PL providers should improve their service capabilities besides the transportation management service.

Table 13 Level of satisfaction with logistics service capability attributes

Code	Logistics service capability attributes	Mean	S.D	Rank
EC1	Capability of transportation management service	5.41	1.23	1
EC2	Capability of inventory and distribution service	4.70	1.40	2
EC4	Capability of customs clearance, import and export service	4.34	1.82	3
EC3	Capability of value added operations such as labeling and packaging	4.23	1.65	4

Note: Mean: 1=Very low satisfaction, 7=Very high satisfaction and S.D.=standard deviation

In reference to innovation capability attributes, the results of Table 14 demonstrated that developing customized process and system through collaboration was regarded as the most satisfactory innovation capability for Finnish 3PL providers, followed by capability of solving problems and developing new ideas, and quality of knowledge transfer and management. The findings indicated that the performance of 3PL providers' innovation capabilities show potential in Finland (their mean scores are all below 5). As a result, Finnish 3PL providers should focus on their innovation activities, specifically, knowledge transferring and customization process.

Table 14 Level of satisfaction with innovation capability attributes

Code	Innovation capability attributes	Mean	S.D	Rank
EC10	Collaboration with customers to develop new/customized processes	4.74	1.30	1
EC11	Ability to solve problems and develop new ideas	4.43	1.44	2
EC12	Quality of knowledge transfer and management	4.14	1.46	3

Note: Mean: 1=Very low satisfaction, 7=Very high satisfaction and S.D.=standard deviation

At last, we will analyze the results of firm performance. Table 15 showed that delivering goods in an undamaged state and sales growth have better performance (its mean score is over 5.5). Additionally, the other attributes of operational performance do not show much difference and these attributes are above average (their mean scores are between 4.7 and 5.0). The findings indicated that Finnish 3PL providers are confident both in their financial and operational performance especially for the sales growth and delivery quality.

Table 15 Level of satisfaction with firm performance attributes

Code	Firm performance attributes	Mean	S.D	Rank
EP2	Sales growth	5.57	0.97	1
EP8	Delivering goods in an undamaged state	5.56	0.97	2
EP1	Gross Profit margin	5.31	1.06	3
EP7	Lowering customer complaints (percentage of total sales)	4.94	0.93	4
EP3	Delivering expedited shipments/speed of delivery	4.93	1.03	5
EP4	Short delivery lead-time.	4.87	0.84	6
EP6	Higher customer satisfaction ratings.	4.75	1.02	7
EP5	On time and accurate delivery	4.74	1.01	8

Note: Mean: 1=Much worse, 7=Much better and S.D.=standard deviation

5.3. Further analysis on firm size

We conduct an ANOVA analysis to examine the impact of firm size on SCC, firm capabilities and performance based on the self-reporting data. According to the number of employees, the respondents' firm are divided into three groups, 11 small firms (1-10 employees), 31 medium firms (11-50 employees) and 6 large firms (51-200 employees).

Table 16 demonstrated that large firms have better logistics service and innovation capabilities on all items than small and medium firms. However, the differences are not statistically significant.

Table 16 Firm capability by firm sizes

Firm capability	Small firms (n=11)		Medium firms (n=31)		Large firms (n=6)		Sig.
	Mean	S.D	Mean	S.D	Mean	S.D	
EC2	4.576	1.783	4.659	1.348	5.167	0.984	0.688
EC3	4.035	1.428	4.025	1.748	5.663	0.516	0.072
EC4	4.309	2.081	4.192	1.873	5.195	0.748	0.476
EC10	4.293	1.362	4.721	1.298	5.667	0.816	0.113
EC11	4.273	1.618	4.375	1.406	5.000	1.414	0.583
EC12	3.919	1.147	4.142	1.510	4.500	1.871	0.744

Table 17 showed that the large firms have higher level of agreement in terms of SCC than small and medium firms do. Furthermore, firm size has a significant effect on the extension view of suppliers and customers (BS8). However, no other significant difference is found.

Table 17 Supply chain collaboration by firm sizes

Supply chain collaboration	Small firms (n=11)		Medium firms (n=31)		Large firms (n=6)		Sig.
	Mean	S.D	Mean	S.D	Mean	S.D	
BS1	4.818	1.168	4.677	1.620	5.667	0.816	0.324
BS2	4.818	0.603	4.903	1.326	5.167	1.329	0.846
BS3	5.455	1.293	5.323	1.275	5.667	0.817	0.811
BS4	5.364	1.629	4.710	1.488	5.833	0.983	0.162
BS8	4.909	1.514	5.236	1.264	6.667	0.516	0.024

Interestingly, the descriptive results of Table 18 are different from the above tables. Among seven items, large firms only have better performance on sales growth (EP2), short lead-time (EP4) and accurate delivery (EP5). Medium firms have better performance on gross profit margin (EP1) and higher customer satisfactions (EP6) while small firms have better performance on lower customer complaints. However, these differences are insignificant.

Table 18 Firm performance by firm sizes

Firm performance	Small firms (n=11)		Medium firms (n=31)		Large firms (n=6)		Sig.
	Mean	S.D	Mean	S.D	Mean	S.D	
EP1	4.182	1.079	4.742	0.965	4.333	1.211	0.258
EP2	4.000	1.000	4.452	1.091	4.500	1.761	0.520
EP4	5.000	0.632	5.221	1.046	5.312	1.240	0.773
EP5	5.360	0.926	5.452	0.850	5.719	0.774	0.707
EP6	5.364	0.924	5.516	0.926	5.500	1.049	0.897
EP7	5.455	1.214	5.323	0.979	5.000	1.265	0.704

In summary, firm size of the respondents does not have significantly impacts on their responses.

5.4. Exploratory factor analysis

We conduct EFA using **Principal Component** with **VARIMAX** rotation to identify whether the groupings of each factor is expected as our questionnaire design, such as firm capabilities and SCC in Finnish 3PL industry.

5.4.1. Item selection

To examine the firm capabilities, a two-factor model was anticipated. Specifically, the first four items (EC1-EC4) are conceptualized as the construct of logistics service capabilities, and the remaining three items (EC5-EC7) are defined as the dimensions of innovation capabilities. In the following analysis, the number of factors are determined by the number of the eigenvalues that are greater than one (Churchill & Iacobucci, 2002).

Table 19 revealed that the first two factors accounted for approximately 72.343% of the total variance and thus they were considered to represent the attributes of firm capabilities we used in the further analysis.

Table 19 Factor analysis for firm capabilities attributes

Code	Firm capability attributes	Factor 1	Factor 2
EC10	Collaborative process development and customization	**0.826**	0.267
EC11	Problem solving and new idea generation	**0.911**	0.200
EC12	Quality of knowledge transfer and management	**0.789**	0.341
EC1	Capability of transportation management service	0.472	**0.557**
EC2	Capability of inventory and distribution service	0.298	**0.800**
EC4	Capability of value added operations such as labeling and packaging	0.225	**0.822**
EC3	Capability of customs clearance, import and export service	0.207	**0.820**
	Eigenvalues	4.060	1.004
	Percentage variance	57.998	14.345

In addition to the eigenvalues criterion, another criterion is introduced from Comrey and Lee (1992). As a result, we extract the variables with loadings of 0.71 or higher, which is labeled as an "excellent" cut-off for interpretative purpose. Thus, EC1 was not be classified into any factors. Two factors we found in Table 12 are described as below:

Factor 1, which was identified as innovation capability, accounted for 58.00% of the total variance. It is consisted of three items, collaborative process development and customization (EC10), problem solving and new idea generation (EC11), and quality of knowledge transfer and management (EC12). Among them, problem solving and new idea generation had the highest factor loading (0.911).

Factor 2, which was identified as logistics service capability, accounted for 14.35% of the total variance. It is also consisted of three items: capability of inventory and distribution service (EC2), capability of value-added operations (EC4), and capability of customs clearance (EC3). The factor loading of these three items are very similar and all over 0.80.

Moreover, factor analysis was applied to identify the crucial attributes of SCC in 3PL providers. Since we removed BS5-7 because of their insufficient variance, we will only use the remaining four items in EFA. The anticipated model was two factors: relationship building (B8) and information sharing (B1, B2, B3 and B4). However, as presented in Table 20, the initial factor analysis resulted in only one factor and it accounted for approximately 61.469% of the total variance. The description of this factor is introduced below:

Table 20 Factor analysis for SCC attributes

Code	SCC attributes	Factor 1
BS3	Events and change notification	0.852
BS1	Information sharing from customer side	0.820
BS8	View suppliers and customers as an extensions of our company	0.775
BS2	Frequent and punctual information exchange	0.739
BS4	Frequent face-to-face communication	0.725
	Eigenvalues	3.073
	Percentage variance	61.469

Factor 1, which was defined as SCC, includes five items, namely, events and change notification (BS3), information sharing from customer side (BS1), view suppliers and customers as an extension of our company (BS8), frequent and punctual information exchange (BS2), and frequent face-to-face communication (BS4). Among them, events and change notification had the highest factor loading (0.852).

Furthermore, in order to simplify the construct of operational performance, we conduct principal component analysis to extract the most important factor of operational performance with loadings of 0.71 or higher (Comrey & Lee, 1992). Thus, as presented in Table 21, EC4-EC7 are classified into the principal component, which is interpreted as below:

Table 21 Factor analysis for operational performance attributes

Code	Operational performance attributes	Factor 1	Factor 2
EP6	Higher customer satisfaction ratings.	**0.861**	0.070
EP5	On time and accurate delivery.	**0.844**	-0.040
EP7	Lowering customer complaints (percentage of total sales).	**0.767**	0.431
EP4	Short delivery lead-time.	**0.745**	-0.459
EP8	Delivering goods in an undamaged state.	0.550	0.696

EP3	Delivering expedited shipments/speed of delivery.	0.626	-0.636
	Eigenvalues	3.291	1.292
	Percentage variance	54.850	21.530

Factor 1, which was defined as operational performance, accounted for 54.850% of total variance. It is consisted of four items such as higher customer satisfaction ratings (EP8), on time and accurate delivery (EP5), lowering customer complaints (EP7) and short delivery lead-time (EP4). Among these items, higher customer satisfaction ratings had the highest factor loading (0.861).

5.4.2. Measure reliability and validity

In this section, we will measure the reliability and validity of the factors and then introduce five-factor structure, including SCC, logistics service capability, innovation capability, operational performance and financial performance, through combining the factors we extracted in the previous section.

5.4.2.1. Reliability test

Before examining the factor structure and the validity, we will measure the reliability of the model, which refers to "the consistency between multiple measurements of a variable" (Hair, et al., 2009). There are various types of reliability. Considering the data collection method, we will only focus on the internal consistency reliability to assess the consistency of response across items within a single factor through three diagnostic measures: corrected item-total correlation, corrected inter-item correlation and Cronbach's alpha statistic.

Table 22 Reliability test

Factor	No. of items	Mean	Alpha	Corrected item-total correlation	Corrected inter-item correlation
Logistics service capability	3	4.426	0.824	0.673–0.694	0.592-0.618
Innovation capability	3	4.435	0.884	0.730–0.807	0.674-0.780
Operational performance	4	5.359	0.833	0.554–0.601	0.358-0.678
Financial performance	2	4.458	0.748	0.597-0.597	0.597-0.597
Supply chain collaboration	5	5.097	0.842	0.577-0.740	0.336-0.612

Table 22 provided the results of both overall and item-specific measures. The explanations and the minimum acceptable value of these measures are given as below:

Corrected item-total correlation is a measure to evaluate whether any item in the dataset is inconsistent with the averaged behaviors. Previous study suggested that the lower limit of this measure is 0.5 (Robinson, et al., 1991). In this study, all values were exceed the lower limit. Thus, the results indicated that items within a single factor correlates very well and no items needed to be dropped.

Corrected inter-item correlation is a measure to assess the correlation among items within a single factor. Previous study suggested that the lower limit of this measure is 0.3 (Robinson, et al., 1991). In this research, all values were well over this minimum acceptable value, which are considered sufficiently high for confirming the reliability.

Cronbach's alpha statistic is the most widely measure to assess the consistency of the entire scale. It is generally agreed that the lower limit of alpha values is 0.7 (Robinson, et al., 1991; Andrews, 1991). In our case, all alpha values were over the lower limit for this measure. Thus, the items within a single factor are highly correlated and interchangeable.

Apart from the results of reliability test, Table 22 provided the level of agreement and satisfaction for each construct such as SCC, firm capability and performance in this study. Among them, the operational performance of 3PL providers had the highest level of satisfaction (its mean score is 5.359), followed by its SCC, which was reached to mildly agreement (its mean score is 5.097). The mean scores of remaining constructs (logistics service capability, innovation capability, financial performance) were all slightly above average (around 4.5).

5.4.2.2. Factor structure and convergent validity

An EFA is performed using the similar extraction method and **PROMAX** rotation method to explore the final factor structure. Since all the factors were already extracted above, the number of the factors is pre-determined (five-factor structure). It is expected that all these factors should demonstrate sufficient convergent validity. In other words, their loadings were all above the recommended minimum threshold of 0.5 from the perspective of practical significance (Costello & Osborne, 2005).

Table 23 showed a problematic pattern matrix because BS4 and EP1 did not load as expected. Thus, we tried to modify the matrix by removing the problematic variables. In our case, BS4 should be removed first due to its low factor loading in the current matrix.

Table 23 Initial solution of pattern matrix

Variables	Logistics service capability	Innovation capability	SCC	Operational performance	Financial performance
EC4	0.938				
EC3	0.729				
EC2	0.639				
EC11		0.990			
EC12		0.759			
EC10		0.723			
BS1			0.925		
BS3			0.839		
BS2			0.752		
BS8			0.536		
BS4			0.504		-0.500
EP6				0.883	
EP5				0.805	
EP4				0.695	
EP7				0.541	
EP1				0.799	
EP2					0.681

The modified pattern matrix is shown in Table 24, which illustrates a very clear factor structure. All variables are classified into the expected factors and most of them shows a sufficient convergent validity (high loadings within factors), except for EP7. However, as a recommended remedy from Hair et al. (2009), we decide to ignore this issue because EP7 is considered to meet "the minimal level for interpretation of structure" (the range from 0.3 to 0.4) while all the significant loadings have been identified. Thus, this issue does not affect the whole factor solution.

Table 24 Modified solution of pattern matrix

Variables	Logistics service capability	Innovation capability	SCC	Operational performance	Financial performance
EC4	0.972				
EC3	0.729				
EC2	0.683				
EC11		0.928			
EC12		0.744			
EC10		0.668			
BS1			0.906		
BS3			0.826		
BS2			0.768		
BS8			0.566		
EP5				0.902	
EP4				0.755	
EP6				0.742	
EP7				0.369	
EP2					0.771
EP1					0.586

In the following section, the validity and reliability of the structure will be examined from different indicators.

5.4.2.3. Adequacy and discriminant validity

Table 25 presented the results of KMO statistics and Bartlett's test for sampling adequacy. The explanation of these results are given below.

KMO statistics is a measure of sampling adequacy for overall models. According to Kaiser (1970), when KMO statistics is less than 0.5, the constructs require remedial actions. Therefore, the current value (0.880) could be considered that factor analysis would be useful for all chosen variables.

Bartlett's test of Sphericity tests the null hypothesis that correlation matrix is an identity matrix implying that all of the variables are uncorrelated (Snedecor & Cochran, 1989). The significant result (0.000) rejected the null hypothesis, which means all chosen variables were correlated adequately for EFA.

Table 25 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.770
Bartlett's Test of Sphericity	**Approx. Chi-Square**	445.085
	df	120
	Sig.	0.000

Another indicator for sampling adequacy is communality, which is defined as percent variance in a certain variable is explained by factors. In general, we may check low values of communalities, for example, the value between 0.0 and 0.4, for removal if the pattern matrix is problematic (Hair, et al., 2009).

However, in our case, the communalities for each variable, as presented in Table 26, were considered good enough because all of these values are above 0.5 and most of them are above 0.7. Thus, we do not need to exclude any variables due to low communalities.

Table 26 Communalities

Factor		**Extraction**	**Factor**		**Extraction**	**Factor**		**Extraction**
Services capability	EC2	0.744	SCC	BS1	0.757	Operational performance	EP4	0.581
	EC3	0.804		BS2	0.683		EP5	0.829
	EC4	0.833		BS3	0.747		EP6	0.786
Innovation capability	EC10	0.831		BS8	0.684		EP7	0.674
	EC11	0.845	Financial performance	EP1	0.777			
	EC12	0.822		EP2	0.814			

The most widely accepted form of validity assessment is discriminant validity, which examines the degree “to which two conceptually similar concepts are distinct” (Hair, et al., 2009). In this situation, a lower correlation (below 0.700) between factors is desired. Table 27 implied that no problematic cross-loadings in the current factor structure since all the correlation were below the threshold. Thus, we could conclude that all the factors show sufficient discriminant validity.

Table 27 Factor Correlation Matrix

Factor	1	2	3	4	5
1	1.000				
2	0.304	1.000			
3	0.311	0.424	1.000		
4	0.409	0.529	0.537	1.000	
5	0.407	0.110	0.199	0.171	1.000

5.5. Confirmatory factor analysis

In this section, we will conduct CFA to examine how well the observed variables represent the constructs by assessing the construct validity and the fit of a measurement model. Additionally, we will show the process of remedy to minimize the discrepancies between the proposed model and the measurement model.

5.5.1. Initial CFA model

Figure 11 illustrated a measurement model based on our proposed model, where five latent constructs composed of sixteen items.

The five constructs in this model, including SCC, logistics service capability, innovation capability, operational performance and financial performance, are inter-related, implying by the two-headed arrows. Moreover, the 16 observed variables are enclosed in squares.

1) Service capability is consisted of three observed variables (EC2–EC4).
    a. EC2: Capability of inventory and distribution service
    b. EC3: Capability of value added operations such as labeling and packaging
    c. EC4: Capability of customs clearance, import and export service
2) Innovation capability is consisted of three observed variables (EC10–EC12).
    a. EC10: Collaboratively develop customized logistic processes/systems with customers
    b. EC11: Solve problems and develop new ideas
    c. EC12: Knowledge transfer and management
3) SCC is consisted of four observed variables (BS1–BS3 and BS 8).
    a. BS1: Customers are provided with any information that might help them

b. BS2: Exchange of information takes place frequently, informally, and/or timely

c. BS3: Keep each other informed about events or changes that may affect other parties

d. BS8: We view our suppliers and customers as an extension of our company

4) Operational performance is consisted of four observed variables (EP4–EP7).

a. EP4: Offering short delivery lead-time

b. EP5: Offering greater proportion of on time and accurate delivery

c. EP6: Providing higher customer satisfaction rating

d. EP7: Lowering customer complaints

5) Financial performance is consisted of two observed variables (EP1 and EP2).

a. EP1: Gross Profit margin

b. EP2: Sales growth

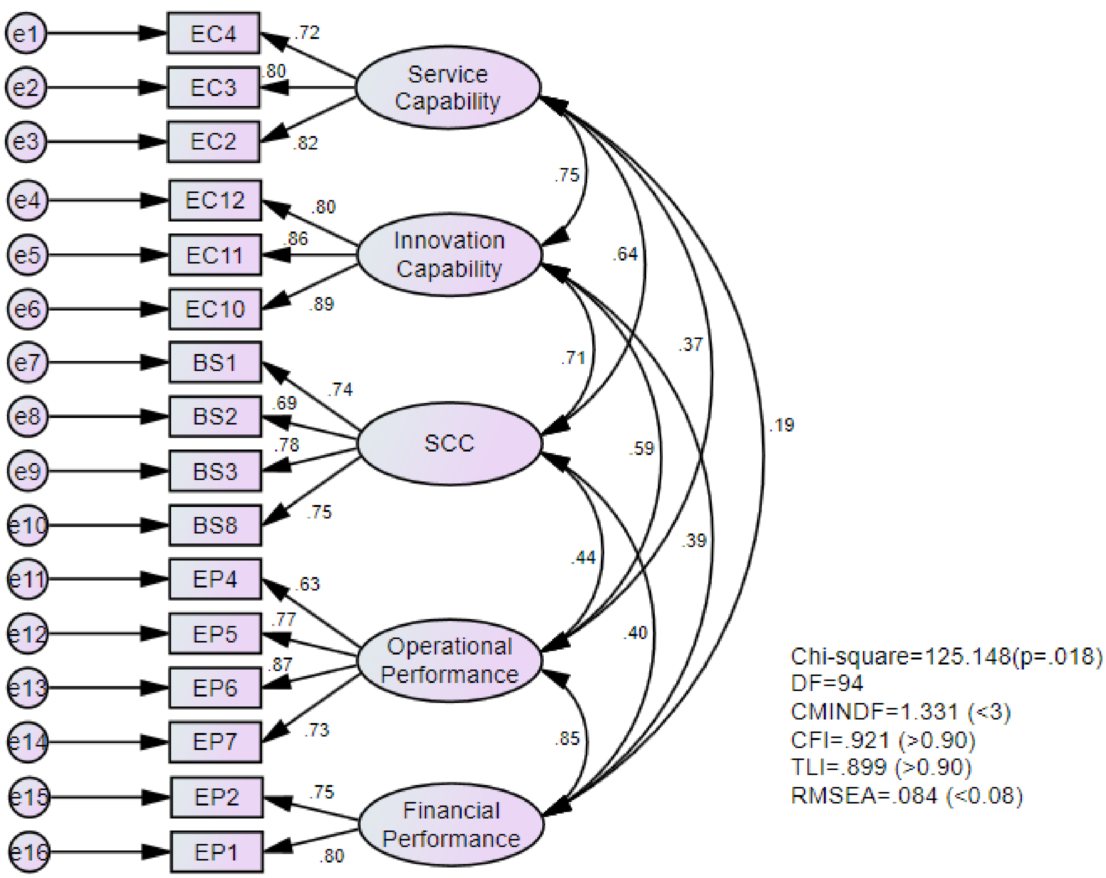

Figure 11 Path diagram of initial CFA model

After obtaining the measurement model, various overall goodness-of-fit measures are conducted to determine the fit of the model. However, it is not sufficient to make any decisions by observing only one statistic. Hair et al (2009) recommended that, in addition to the results of chi-squared test, the researcher should rely on at least one absolute fit index, for example, RMSEA, and one incremental fit index, for example, CFI. Furthermore, Kline (2010) suggested reporting Chi-squared test, RMSEA, CFI and SRMR.

Combining their opinions, we will use six different fit indices to assess the measurement model in this research. The brief introduction of these indices and their corresponding threshold are listed below.

1) Chi-squared test is the most common fit statistic (Byrne, 1998).
    a. $\chi^2 = F * (N - 1)$, where F is the value of fitting function and *N* is the sample size.
    b. Small value of χ^2 is desirable and the null hypothesis is $\chi^2 = 0$. Thus, we want to achieve an insignificant p-value.
    c. The result is seriously affected by the number of observed variables and sample size.
2) Normed chi-square (CMIN/DF) or relative chi-square is an adjusted Chi-squared fit index (Hair, et al., 2009).
    a. CMIN/DF is the ratio between chi-square fit statistic and degrees of freedom.
    b. The acceptable value is between 1.0 and 3.0.
3) Comparative fit index (CFI) compares performance of a specific model to that of baseline model, which assumes no correlation between observed variables (Bentler & Bonett, 1980).
    a. $\text{CFI} = 1 - (\chi_k^2 - df_k)/(\chi_N^2 - df_N)$, where k denotes the proposed model or theory, *N* denotes the baseline model. This fit statistic is normed. Thus, the value ranges from zero to one.
    b. The minimum acceptable value is above 0.90.
4) Tucker Lewis Index (TLI) or non-normed fix index (NNFI), which is adjusted by the degree of freedom, is a modified version of CFI (Hu & Bentler, 1995).
    a. $\text{TLI} = [(\chi_N^2/df_N) - (\chi_k^2/df_k)]/[(\chi_N^2/df_N) - 1]$, where k denotes the proposed model or theory, *N* denotes the baseline model. This fit statistic is not normed. Thus, TLI could be below zero or above one.
    b. The minimum acceptable value is above 0.90.
5) Root mean square error of approximation (RMSEA) is a residual-based index (Chen, et al., 2008).

a. RMSEA $= \sqrt{(\chi_k^2 - df_k)/(N-1)}$, where N is the sample size. Note that if $\chi_k^2 < df_k$, the value of equation is set to zero.
b. The value below 0.08 is considered adequate.

6) Standardized root mean square residual (SRMR) is the standardized version of RMR, which is calculated by the mean absolute value of the covariance residuals. The value below 0.09 is considered adequate (Bagozzi & Yi, 1989).

Table 28 presented the selected fit statistics from initial CFA output and their corresponding thresholds. The p-value of chi-squared test was statistically significant at the 0.05 level (0.018 < 0.05), implying that our proposed model may not fit the observed model. The value for RMSEA is 0.084, which appears slightly greater than the guideline for a model (<0.08). TLI has a value of 0.899, like RMSEA, which is slight below the acceptable value (>0.9). However, CFI (0.921>0.9) and SRMR (0.081<0.09) have values which reflects good model fit.

Table 28 Comparison between metrics of initial CPA output and their acceptable level

Measure	Threshold	Initial CFA model	Conclusion
CMIN / DF	<3	1.331	Passed
Chi-squared (p-value)	>0.05	0.018	Failed
CFI	>0.90	0.921	Passed
TLI	>0.90	0.899	Failed
RMSEA	<0.08	0.084	Failed
SRMR	<0.09	0.081	Passed

5.5.2. Revised CFA model

From the above comparison, the fit of initial model is on the borderline and it indicates that the initial model needs to be modified. From the suggestions offered by Hair et al (2009) and Min (2004), model modification (Appendices B.1), standardized residual matrix (Appendices B.3), and fit indices are chosen as the criteria for model improvement.

First, the value of standardized residual matrix results show no pairs exceed the criterion, the absolute value of 2.58 (Hair, et al., 2009). Thus, we do not have hints to drop a specific pair from this step. Second, the modification indices indicate that no acceptable covariances between error terms within a single construct could be added directly.

However, after examining all the covariance, we find that removing BS3 might be an option to improve this model because, in modification indices table, BS3 is the only one in a construct consisted of five items. At last, the revised CFA model is shown in Figure 12.

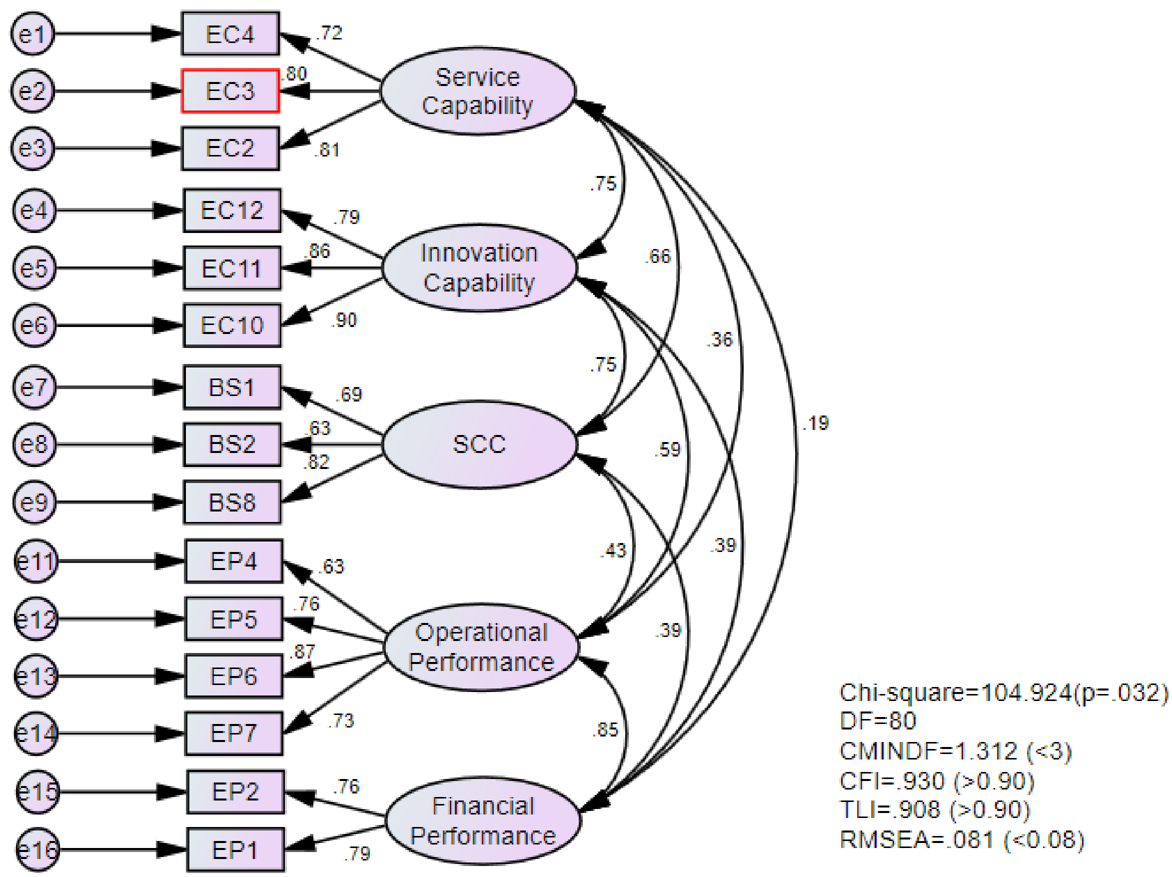

Figure 12 Path diagram of revised model

As shown in Table 29, most of the fit statistics of revised model have been improved and passed, except the p-value of Chi-squared test, which was on the borderline (0.032<0.05)., Additionally, all the variables have good factor loading (greater than 0.5). Since we do not have any hints to improve the CFA output and, considering the model complexity, the goodness of fit for current model is sufficient, we can conclude that revised CFA model was acceptable.

Table 29 Comparison between metrics of revised CPA output and their acceptable level

Measure	Threshold	Revised CFA model	Conclusion
CMIN / DF	<3	1.331	Passed
Chi-squared (p-value)	>0.05	0.032	Failed

CFI	>0.90	0.930	Passed
TLI	>0.90	0.908	Passed
RMSEA	<0.08	0.081	Almost passed
SRMR	<0.09	0.078	Passed

5.5.3. Validity and reliability

After obtaining the path diagram of revised CFA outputs, we will perform the following analysis to assess the validity and reliability of this measurement model. The results of the assessment and the threshold are illustrated below.

1) Convergent validity refers to the degree that measurement items within the same construct are related to each other. To test for convergent validity, we calculate the critical ratio (C.R.) and item reliability (R^2), which could be obtained from AMOS text output.
    a. C.R. refers to dividing the estimate of unstandardized factor loadings by the estimate of its standard error (Hair, et al., 2009). If C.R of a measurement item is 3.0, it means the estimate of factor loading is 3.0 standard error far from zero.
        i. The acceptable value of C.R. is greater than the absolute value of 2.00.
        ii. As presented in Table 30, all C.R. values exceeds the acceptable value and are significant at the 0.001 level.
    b. R^2 (or squared multiple correlations in AMOS) could be used to test the convergent validity through measuring the reliability of a measurement item (Hair, et al., 2009). It is estimated the percent of variance that can be explained by a particular item. For example, if R^2 of an item X is 0.7, it means X can explain 70% of its variance.
        i. The acceptable value of R^2 is 0.3.
        ii. As presented in Table 30, all R^2 values are above the acceptable value and even the smallest one is close to 0.4.
    c. Thus, the convergent validity are supported by C.R. and R^2 as expected.

Table 30 Parameter estimate, standard errors, critical ratios, and R^2 for the revised model

Latent variable / items	Unstandardized factor loading	standardized factor loading	S.E.[a]	C.R.[b]	$R^{2\ d}$
Operational performance					
EP6	1.000	0.871	-[c]	-	0.758
EP5	0.807	0.765	0.134	6.036	0.585
EP4	0.765	0.627	0.166	4.618	0.394
Service capability					
EC2	1.000	0.808	-	-	0.653
EC3	1.165	0.803	0.212	5.498	0.645
EC4	1.164	0.724	0.234	4.964	0.524
Innovation capability					
EC10	1.000	0.897	-	-	0.804
EC11	1.059	0.858	0.135	7.840	0.736
EC12	0.988	0.790	0.145	6.811	0.623
Financial performance					
EP1	1.000	0.789	-	-	0.623
EP2	1.077	0.756	0.228	4.729	0.572
EP7	0.965	0.735	0.169	5.706	0.540
Supply chain collaboration					
BS8	1.000	0.816	-	-	0.665
BS2	0.682	0.633	0.167	4.070	0.401
BS1	0.917	0.688	0.208	4.415	0.473

[a]S.E. is an estimate of the standard error of the covariance

[b]C.R. is the critical ratio obtained by dividing the estimate of the covariance by its standard error.

[c]value exceeding 1.96 represents a level of significance of 0.05.

[d]Indicates a parameter fixed at 1.0 in the original solution

[e]R^2 is squared multiple correlation

2) Reliability, as we mentioned before, is to measure overall consistency. In our case, we focus on reliability of internal consistency, which evaluates the results across items. To test for this, we calculate the composite reliability (CR) and average variance extracted (AVE), which are

estimated with the assistance of AMOS and a third party excel stats tool (Lowry & Gaskin, 2014).

a. CR is a measure of scale reliability to evaluate the internal consistency of the items. A high CR value means the measurement items are all measuring the same construct (Bacon, et al., 1995).
    i. The acceptable value of CR is 0.70.
    ii. As presented in Table 31, all CR values are above the acceptable value and the smallest one is close to 0.75.
b. AVE is defined as "the average percentage of variation explained among the items of a construct" (Hair, et al., 2009). A high AVE value means the measurement items are representative of the construct (Fornell & Larcker, 1981).
    i. The recommendation level of AVE is 0.50.
    ii. As presented in Table 31, all AVE values are much higher than the recommendation level and the smallest one is close to 0.75.

Table 31 Composite reliability, average variance extracted, and discriminant validity

Measures	CR[a]	AVE[b]	Innovation capability	Operational performance	SCC	Service capability	Financial performance
Innovation capability	0.886	0.722	0.849				
Operational performance	0.839	0.569	0.590	0.755			
Supply chain collaboration	0.758	0.513	0.750	0.427	0.716		
Service capability	0.822	0.607	0.747	0.364	0.664	0.779	
Financial performance	0.748	0.597	0.389	0.847	0.389	0.186	0.773

[a]CR = Composite reliability

[b]AVE = Average variance extracted

At last, we will check the discriminant validity by comparing the square roots of the AVE, which are presented on the diagonal of Table 31, with the inter-correlations between constructs. Except for SCC and financial performance, all the other factors indicated a sufficient discriminant validity because, for each row, the diagonal values are greater than the correlations (Fornell & Larcker, 1981).

In a summary, the proposed model in this study is strongly supported by assessing the validity and reliability of the measurement model.

5.6. Structural models

After confirming the CFA model, we will apply a SEM approach to assess the fit of a structural model and then validate the research hypotheses.

5.6.1. Path diagram and fit of overall model

To be more convenient to express the relationship in the following analysis, the visual form of the structural model is shown in Figure 13.

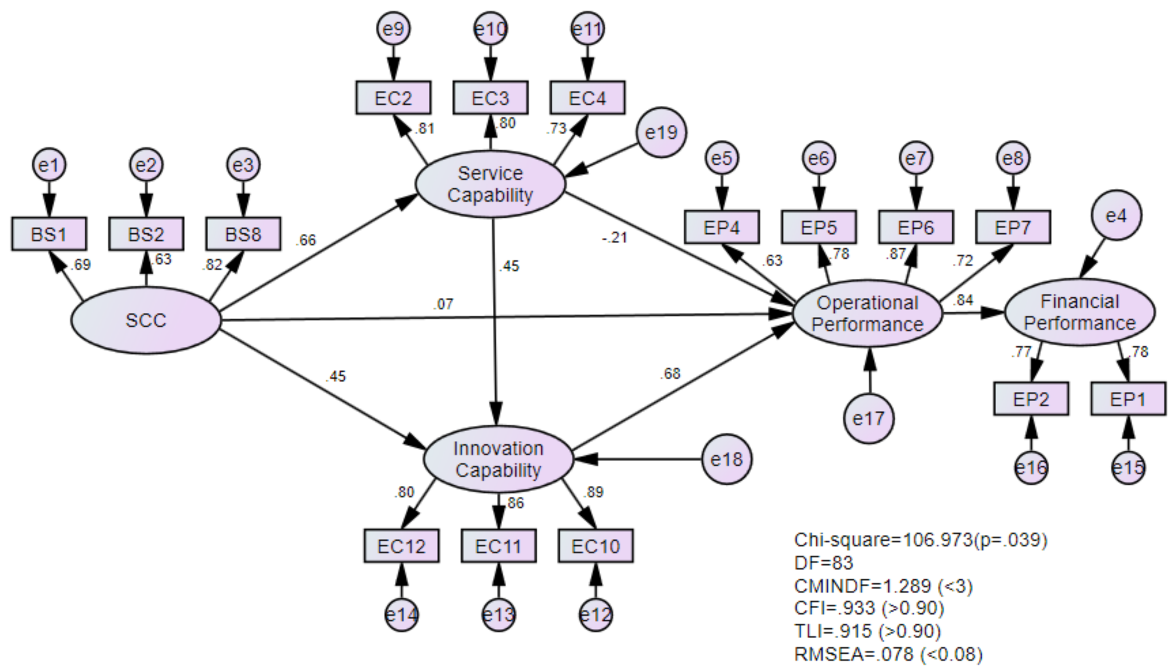

Figure 13 Visualization of structural equation modeling

As we mentioned in 4.1.2, we should determine whether the entire model is acceptable before proceeding any further tests on the hypothesized relationships in the structural model. The selected fit statistics of the overall model are same as we used in the assessment of the measurement model. The results of these fit indices are described in Table 32.

Table 32 Comparison between metrics of SEM output and their acceptable level

Measure	Threshold	SEM model	Conclusion
CMIN / DF	<3	1.289	Passed
Chi-squared (p-value)	>0.05	0.039	Failed
CFI	>0.90	0.933	Passed
TLI	>0.90	0.915	Passed
RMSEA	<0.08	0.078	Passed
SRMR	<0.09	0.080	Passed

Although the p-value of Chi-squared test (χ^2 =106.973, df = 83, p=0.039) is significant at the 0.05 level, it is expected due to small sample and complex model (Marsh, et al., 2004). Apart from the chi-squared statistics, the other five fit indices (normed χ^2, GFI, TLI, RMSEA and SRMR) are all well above the minimum acceptable level, implying that the entire model are adequately supported by the data we collected.

5.6.2. Results of hypotheses testing

In SEM, the good fit of model alone is insufficient to validate our theoretical model. Thus, we will examine the parameter estimates (Appendices, B.2), which represent the hypothetical relationships.

Table 33 Structural equation modeling results: proposed model

Paths	Results		
	Standardized estimates	CR	P
H1: Logistics service capability → Operational performance	-0.208	-0.762	0.446
H2: Logistics service capability → Innovation capability	<u>0.448</u>	2.321	0.020
H3: Innovation capability → Operational performance	<u>0.676</u>	1.999	0.046
H4: Supply chain collaboration → Logistics service capability	<u>0.663</u>	3.314	0.000

H5: Supply chain collaboration → Innovation capability	<u>0.453</u>	2.224	0.026
H6: Supply chain collaboration → Operational performance	0.066	0.233	0.816
H7: Operational performance → Financial performance	<u>0.838</u>	3.760	0.000

Model fit: Chi-square/df=1.289; CFI=0.933;RMSEA=0.078;TLI=0.915

As presented in Table 33, the results of the hypotheses testing indicated that most of the hypothesized relationships were significant at the 0.05 level and were in the predicted direction. The exceptions are paths from SCC and operational capability to operational performance, which were insignificant in this study. Again, considering the small sample and complex model, the structural model we proposed in this study is acceptable because of good model fit and five of seven hypothesis supported.

6. DISCUSSIONS

In this Chapter, we will first discuss the key findings and then provide the implications and contribution to theory and practice. After that, we will point out the limitation of this study and suggest the future research agenda.

6.1. Discussion of findings

SCC has been recognized as a critical role to achieve collaborative advantage and better firm performance (Cao & Zhang, 2011). This study combined SCC with firm capabilities to develop a theoretical framework, which is shown in Figure 14, for assessing the relationships among SCC, logistics service capability, innovation capability, firm operational performance and financial performance in the context of Finnish 3PL industry.

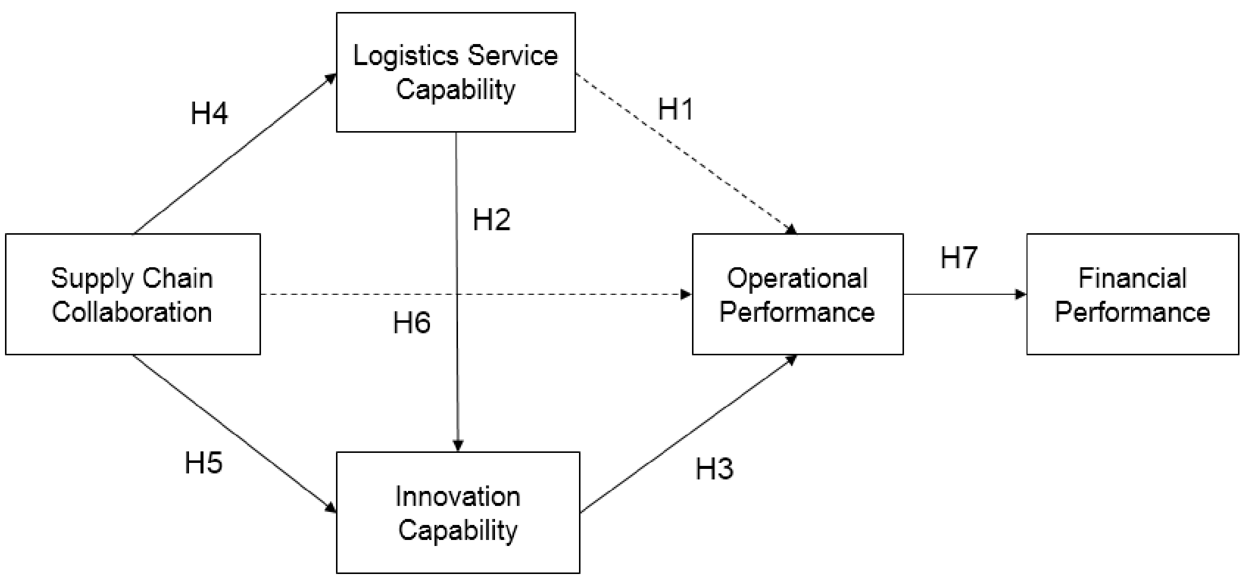

Figure 14 Final theoretical model

The main findings are illustrated as below:

First, from descriptive analytics, we found that Finnish 3PL providers strongly agreed that long-term relationship of supply chain partners played a vital role in their business while they had different attitude toward the information sharing mechanism between partners. The results of logistics service and innovation capabilities indicated that 3PL providers in Finland were good at transport management service, and needed to improve their value-added service and innovation activities. Additionally, these providers were very confident in their financial and operational performance.

Considering the firm size, large firms had better firm capabilities on all items than small and medium firms. Furthermore, large firms had higher level of agreement in terms of SCC than small and medium firms do. Interestingly, we did not find a specific group of firm size had better performance on all items than the other groups. Although the results of data description showed mean differences on different measurement items, the moderating effect of firm size was insignificant for most of the measurement items, except for the extension view of suppliers and customers. As a result, we were not able to use firm size as a moderator in this study.

Second, we conducted an EFA to identify five constructs extracted from survey responses and found that the following groups of measurement items are expected as our questionnaire design.

- Innovation capability is consisted of three measurement items: 1) collaborative process development and customization, 2) problem solving and idea management, and 3) quality of knowledge transfer and management.
- Logistics service capability is consisted of three measurement items: 1) capability of inventory and distribution service, 2) capability of value-added operations, and 3) capability of customs clearance.
- Operational performance is consisted of four measurement items: 1) higher customer satisfaction ratings, 2) on time and accurate delivery, 3) lowering customer complaints and 4) short delivery lead-time.
- Financial performance is consisted of two measurement items: 1) gross Profit margin and 2) sales growth.
- SCC is consisted of five measurement items: 1) events and change notification, 2) information sharing from customer side, 3) extension view of suppliers and customers, 4) frequent and punctual information exchange, and 5) frequent face-to-face communication.

The five-factor model, including SCC (dropping the measurement item: frequent face-to-face communication), logistics service capability, innovation capability, operational performance and financial performance, has been confirmed though the assessment of convergent validity, discriminant validity and reliability.

Third, a CFA was performed to examine the discrepancies between the proposed model and the measurement model by various fit statistics. After model modification (dropping the measurement item: events and change notification), the proposed model are strongly supported by assessing the validity and reliability of the measurement model.

Fourth, a SEM approach was applied to assess the fit of a structural model and validate the hypothesized relationships among SCC, logistics service capability, innovation capability, operational performance and financial performance. As is shown in Table 32, the good fit indices indicated that the structural model are adequately supported by the data we collected. Furthermore, as presented in Table 33, the results empirically confirm that

- Logistics service capability is positively associated with innovation capabilities in Finnish logistics industry (H2).
- Innovation capabilities is positively associated with firm operational performance in Finnish logistics industry (H3).
- Supply chain collaboration is positively associated with logistics service capabilities in Finnish logistics industry (H4)
- Supply chain collaboration is positively associated with firm innovation capabilities in Finnish logistics industry (H5).
- Firm operational performance is associated with firm financial performance in Finnish logistics industry (H7).

All these findings are consistent with previous studies (Cao & Zhang, 2011; Yang, et al., 2009; Simatupang & Sridharan, 2005).

However, there was a lack of support for the effect of logistics service capability on operational performance (H1). As we mentioned in 4.4, this is not a suspiring result because the service provision of the responding firms are quite different. Thus, it is difficult to measure the operational performance with the same criteria. Once again, instead of a direct effect, logistics service capability had an indirect impact on operational performance mediated by innovation capability. The finding was inconsistent with previous study. In the research of Yang et al.

(2009), a study based on the data collected from Taiwan shipping service industry, they reported an opposite result that, innovation capability had an indirect effect on firm performance mediated by logistics service capability. Intuitively, the inconsistency may be caused by the different countries or different phase of industry life cycle. Another possible reason is that the measurement items of logistics capability are different. They designed more measurement items related to employee reward system in their questionnaire, which are not included in our survey. Naturally, a further analysis will be needed to clarify this inconsistency,

Another unexpected result is that SCC had no positive association to operational performance (H6), which indicated that information sharing and relationship building between supply chain partners did not influence operational performance directly. Interestingly, this finding is also consistent with the previous study of Yang et al (2009). They reported that firm resources did not influence firm performance directly. The reason is that operational and financial performance could be affected by too many external factors such as business cycle and market competition while firm resource is only one of the factors. This explanation could be applied to our study. The only difference is that we used SCC, which could be regarded as one of supply chain resource, instead of firm resource in our proposed model. Although SCC had no direct effect on operational performance, we found that SCC had an indirect effect on operational performance through innovation capability.

6.2. Theoretical contribution

From a theoretical perspective, this study contributes to RBV, RV and ERBV by integrating the capabilities-performance relationship and SCC research.

Traditional capabilities-performance research, based on RBV, focused on achieving and sustaining competitive advantages by exploiting and utilizing capabilities within a single organization (Yang, et al, 2009). Although this view helps researchers identify the dimensions of firm capabilities and performance at a very detailed level, these studies obviously underestimate the importance of collaboration through supply chain partners, which have great potential to improve firm performance (Wong, et al., 2011). SCC research, based on RV and ERBV, argues that supply chain partners can deploy and share the capabilities to gain collaborative advantage that cannot be generated by either collaborative partners. In other words, organizations are able to achieve competitive advantage through the resources that they do not fully own or control.

One of the theoretical contribution of this study is to investigate the dimensions of firm capabilities and performance in the context of SCC research. This is different from previous study (Cao & Zhang, 2011), which conceptualized firm capabilities and performance as unidimensional constructs. Through CFA and EFA, the composition of constructs are investigated very carefully. Thus, the design of multidimensional capabilities and performance constructs facilitates further conceptual development of framework based on ERBV and RV. The clear factor structure also showed the survey we used in this study has the potential to collect data in the similar topics.

Another important contribution is the development of a comprehensive theoretical model and validation the hypotheses that identify the relationship among SCC, firm capabilities and performance. In addition to the good fit of the model, the theoretical propositions of the research are largely confirmed by survey responses.

Moreover, the empirical evidence that SCC had a direct impact on firm capabilities and an indirect impact on firm performance supports the RBV, RV and ERBV theory. Thus, this study confirms these theories could provide theoretical foundations for explaining and illustrating how firm capabilities (logistics service and innovation) affect the operational performances and how operational performance affects the financial performance in the context of 3PL industry from the view of SCC.

6.3. Practical contribution

The development of conceptual framework and the results of empirical evidences presented in this study not only advance the understanding of SCC, but also provide an instructive guidance for supply chain managers to improve outcomes of the collaboration through forming better partnerships. For example, when these professionals make a decision to improve the firms' operational performance through strengthening innovation and operational capabilities, they have an analytical framework to explain why their investments are not able to achieve desirable outcomes.

Although many advantages of collaboration are discussed in this study, the disadvantages of collaboration cannot be neglected.

Das, Narasimhan and Talluri (2006) found that collaboration might lead to the extra cost of coordination and process inflexibility while Laive (2006) argued firms might internalize their partners' capabilities and resources to improve their own performance, which would cause the leakage of the supply chain benefits. Thus, supply chain managers need to strike the balance between the cooperation and competition, and seek to an appropriate level of SCC.

To handle the potential failures of collaboration through supply chain members, the constructs of SCC, firm capabilities and performance in this study are regarded as a complete package of tools for firms to form the alliance as needed. These tools will also assist firms in minimizing the effects of collaboration risks by identifying key dimensions.

Furthermore, the further understanding of SCC can also help senior management adjust their current actions or strategies to improve shared systems or processes that benefit all partners (Wong A. , 1999).

6.4. Limitation and future research

Although we made many contributions to theory and practice, we should consider the following limitations of the data collection when we are explaining the conclusion based on this study.

First, the data collection was limited to a particular industry and a particular nation, in our case, logistics industry in Finland. Thus, the results presented in this study cannot be generalized to other industry or other countries.

Second, the sample size is merely at the minimum acceptable level (close to 50). To robust the results, new data are needed to revalidate the measurement and structural model.

Third, in this study, the respondents were required to evaluate the capabilities and performance of their own companies. This data collection method may lead to illusory superiority or "above average effect", which is a cognitive bias that respondents overestimate own abilities, compared with other firms (Hoorens, 1993).

At last, some suggestions are given below for the future research.

First, the firm size seems to be a potential moderator although it is not significant in this study due to small sample. According to Cao and Zhang (2011), large firms and small firms play different roles in SCC. Thus, exploring the moderating effects of firm size on the relationship between SCC, firm capabilities and performance will be an interesting topic.

Second, SCC is conceptualized as a unidimensional construct, which is consisted of information sharing and relationship building, in this study. However, SCC could be measures as more features such as five key features (Simatupang & Sridharan, 2005) or seven key features (Cao & Zhang, 2011). Therefore, the future research may examine the relationship between SCC and firm performance at a dimension level.

Third, it is insufficient to collect data from supplier's perspective when the objective is to investigate the attributes of supply chain. Thus, collect data from customer's perspective to evaluate the effectiveness of SCC might be an option for further analysis.

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APPENDICES

A. Instruments

The following survey is developed by the researchers of Logistics Department, Aalto University School of Business.

A.1. Financial performance

The respondents are requested to rate their companies' financial performance, compared with the industry average, using a seven-point scale (1=Much worse, 4=average and 7=Much better).

Items	Descriptions	Citation
EP1	Gross Profit margin	(Liu & Lyons, 2011)
EP2	Sales growth	

A.2. Operational performance

The respondents are requested to rate their companies' operational performance, compared with the industry average, using a seven-point scale (1=Much worse, 4=average and 7=Much better).

Items	Descriptions	Citations
EP3	Delivering expedited shipments/speed of delivery.	(Liu & Lyons, 2011)
EP4	Offering short delivery lead-time.	
EP5	Offering greater proportion of on time and accurate delivery.	
EP6	Providing higher customer satisfaction ratings.	
EP7	Lowering customer complaints (percentage of total sales).	
EP8	Delivering goods in an undamaged state.	

A.3. Service capabilities

The respondents are requested to rate the satisfaction level of their companies' service capabilities, compared with the industry average, using a seven-point scale (1=Very low satisfaction, 4=average and 7=Very high satisfaction).

Items	Descriptions	Citations
EC1	Capabilities related to transportation management processes	(Liu & Lyons,
EC2	Capabilities related to inventory and distribution processes	

EC3	Capabilities related to value added operations	2011)
EC4	Capabilities related to customs clearance, import and export processes.	

A.4. Innovation capabilities

The respondents are requested to rate the satisfaction level of their companies' innovation capabilities, compared with the industry average, using a seven-point scale (1=Very low satisfaction, 4=average and 7=Very high satisfaction).

Items	Descriptions	Citations
EC10	Collaborating with customers to develop customized logistic processes and systems	(Liu & Lyons, 2011)
EC11	Capabilities related to solving problems and developing new ideas	
EC12	Capabilities related to knowledge transfer and management	

A.5. Information sharing

The respondents are requested to rate the level of agreement regarding information sharing using a seven-point scale (1=Strongly disagree, 4=average and 7= Strongly agree).

Items	Descriptions	Citations
BS1	Customers are provided with any information that might help them	(Prajogo & Olhager, 2012; Chen & Paulraj, 2004)
BS2	Exchange of information takes place frequently, informally, and/or timely	
BS3	Keep each other informed about events or changes that may affect the other party	
BS4	We have frequent face-to-face planning/communication with our customers	

A.6. Relationship building

The respondents are requested to rate the level of agreement regarding relationship building using a seven-point scale (1=Strongly disagree, 4=average and 7= Strongly agree).

Items	Descriptions	Citations
BS5	We expect our relationship with key suppliers and customers to last a long time	(Prajogo & Olhager, 2012; Chen & Paulraj, 2004)
BS6	Collaborate with other parties to improve their services and products in the long run	
BS7	Suppliers and customers see our relationship as a long-term alliance	
BS8	We view our suppliers and customers as an extension of our company	

B. Text output in AMOS

B.1. Modification indices in initial CFA

			M.I.	Par Change
e4	<-->	e15	5.875	0.29
e5	<-->	e16	4.651	-0.196
e6	<-->	e15	4.498	-0.188
e1	<-->	SCC	4.435	-0.383
e3	<-->	e4	4.021	0.268

B.2. Parameter estimate in SEM

			Estimate	S.E.	C.R.	P
Logistics_capability	<---	SCC	0.752	0.227	3.314	***
Innovaiton_capability	<---	Logistics_capability	0.457	0.197	2.321	0.02
Innovaiton_capability	<---	SCC	0.524	0.236	2.224	0.026
Operational_performance	<---	Innovaiton_capability	0.359	0.18	1.999	0.046
Operational_performance	<---	SCC	0.04	0.173	0.233	0.816
Operational_performance	<---	Logistics_capability	-0.113	0.148	-0.762	0.446
Financial_performance	<---	Operational_performance	1.083	0.288	3.76	***
EP4	<---	Operational_performance	1			
EP5	<---	Operational_performance	1.069	0.247	4.325	***
EP6	<---	Operational_performance	1.302	0.281	4.639	***
EP7	<---	Operational_performance	1.234	0.302	4.091	***
EC2	<---	Logistics_capability	1			
EC3	<---	Logistics_capability	1.151	0.21	5.481	***
EC4	<---	Logistics_capability	1.161	0.232	4.992	***
EC10	<---	Innovaiton_capability	1			
EC11	<---	Innovaiton_capability	1.062	0.137	7.762	***
EC12	<---	Innovaiton_capability	0.999	0.146	6.849	***
EP1	<---	Financial_performance	1			
EP2	<---	Financial_performance	1.115	0.241	4.619	***
BS1	<---	SCC	1			
BS2	<---	SCC	0.737	0.201	3.675	***
BS8	<---	SCC	1.098	0.25	4.392	***

B.3 Standardized residual matrix in initial CFA

	BS1	BS2	BS8	EP7	EP2	EP1	EC12	EC11	EC10	EC4	EC3	EC2	EP4	EP5	EP6
BS1	0														
BS2	0.537	0													
BS8	0.013	-0.295	0												
EP7	0.078	-0.16	0.48	0											
EP2	-0.277	0.15	0.752	-0.142	0										
EP1	-0.139	-0.691	-0.193	-0.182	0	0									
EC12	-0.338	0.226	-0.206	1.543	1.516	-0.187	0								
EC11	-0.453	0.147	0.126	0.894	0.732	-1.045	0.135	0							
EC10	-0.569	-0.044	0.475	0.801	0.044	-0.227	-0.188	0.059	0						
EC4	-0.662	-0.783	-0.824	1.764	0.364	0.348	0.006	-0.439	0.131	0					
EC3	0.645	0.211	0.112	0.168	-0.955	-0.683	0.304	-0.443	0.188	0.066	0				
EC2	0.048	0.123	0.367	1.486	1.067	0.118	0.873	-0.133	-0.195	0.21	-0.179	0			
EP4	-0.34	-0.505	-0.136	-0.639	0.504	0.049	-0.472	-0.34	-0.236	0.057	-1.282	0.432	0		
EP5	-0.393	-0.125	1.03	0.003	-0.117	-0.432	-0.043	-0.571	0.241	-0.633	-0.731	-0.455	0.525	0	
EP6	-0.355	-1.061	0.202	-0.056	-0.014	0.277	-0.238	-0.329	-0.301	0.286	-0.798	0.379	-0.034	0.071	0