Risk Management in International Container Logistics Operations:

Risk Analysis and Mitigating Strategies

by

Dong-Wook Kwak

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy of Cardiff University

Logistics and Operations Management Section
Cardiff Business School
Cardiff University, UK

September 2014

Declaration

This work has not been submitted in substance for any other degree or award at this or any other university or place of learning, nor is being submitted concurrently in candidature for any degree or other award.

Signed ……………………………… (Dong-Wook Kwak)   Date ………………………

STATEMENT 1

This thesis is being submitted in partial fulfillment of the requirements for the degree of PhD.

Signed ……………………………… (Dong-Wook Kwak)   Date ………………………

STATEMENT 2

This thesis is the result of my own independent work/investigation, except where otherwise stated.
Other sources are acknowledged by explicit references. The views expressed are my own.

Signed ……………………………… (Dong-Wook Kwak)   Date ………………………

STATEMENT 3

I hereby give consent for my thesis, if accepted, to be available for photocopying and for inter-library loan, and for the title and summary to be made available to outside organisations.

Signed ……………………………… (Dong-Wook Kwak)   Date ………………………

STATEMENT 4: PREVIOUSLY APPROVED BAR ON ACCESS

I hereby give consent for my thesis, if accepted, to be available for photocopying and for inter-library loans **after expiry of a bar on access previously approved by the Academic Standards & Quality Committee.**

Signed ……………………………… (Dong-Wook Kwak)   Date ………………………

Abstract

Purpose: The aim of this thesis is to investigate risk management strategies for international logistics operations that can minimise the occurrence and/or the impact of risks in order to achieve a desirable logistics network. For this purpose, international logistics risks were analysed to find out critical risk areas, and then strategies to mitigate those risks were developed and validated in relation to organisational orientations and outcomes.

Methodology: Risk identification, risk clustering and risk analysis were conducted by using focus group research and Interpretive Structural Modelling (ISM) to investigate risk areas that should be mitigated. A risk management strategy model was developed using Information Processing Theory, a review of extant supply chain risk management studies and interviews with logistics practitioners. The model was empirically tested with questionnaire survey data using descriptive statistics, ANOVA and Partial Least Square Structural Equation Modelling (PLS-SEM).

Findings: International logistics risks consists of value streams; information and relationships; logistics activities; and the external environments. Among these, information and relationships risks were found to generate self-enhancing risk loops, thereby creating subsequent risk impacts after disruptions. To mitigate these risks, firms involved in international logistics implemented strategies, such as building a stable logistics network, leveraging logistics information, leveraging outsourcing contracts and developing logistics collaboration, although the level of implementation depends on the business context. Among the four strategies, building a stable logistics network and developing logistics collaboration strategies were most effective in strengthening both robustness and resilience in the logistics network. Customer orientation had positive impacts on all four strategies, but disruption orientation and quality orientation influenced certain types of strategies.

Research Implications: This is the first study which has applied a three-phase risk management process to international logistics operations, thereby highlighting distinctive features of international logistics risks. This thesis empirically develops and validates a risk management strategy model which embraces both strategies and relevant tactical/operational initiatives. The antecedents and outcomes of risk management strategies were also investigated and conceptualised for future research.

Practical Implications: The profile of risks, risk sources, loss types and risk levels provide a guideline for logistics managers to anticipate and proactively deal with potential risks. Also, they can evaluate the current status of risk management efforts and can benchmark suggested strategies and practices in consideration of the strategic fit to their organisations.

Acknowledgement

"Give thanks to the LORD, for he is good; his love endures forever (Psalm 107:1)."

Despite all the troubles and sufferings during my four-year PhD course, I have finally reached the moment for which I have desired. Since it was a long journey, intellectually and emotionally, I would not have stood here without kind help and supports from the people around me. In particular, I would like to express my sincere gratitude to:

- **Prof Anthony Beresford**, **Dr Stephen Pettit** and **Dr Robert Mason** for providing me with insightful advice and encouraging me to keep going with confidence;
- **Prof John Dinwoodie** and **Dr Irina Harris** for examining my thesis and providing valuable comments to significantly improve the quality of this thesis;
- **Prof Hee-Seok Bang**, **Prof Su-Han Woo** and **Prof Peter Marlow** for leading me to Cardiff University and motivating me to become a good researcher;
- **Dr Saeyoun Roh**, **Prof Hee-Yong Lee**, **Dr Young-Joon Seo** and **Dr Keunsik Park** for being my friends whom I can lean on during the PhD course;
- **Dr Vasco Sanchez-Rodrigues** and **Dr Jeong-Yang Park** for contributing their knowledge and time to the quality of my thesis;
- **Ms Lainey Clayton**, **Ms Elsie Phillips**, **Ms Elaine Adams** and **Ms Penelope Smith** for their administrative supports and kind words all the time;
- **Ms Jungran Kim**, **Mr Wee-Sung Rhee**, **Mr Ja-Hee Lee**, **Mr Manki Jeon**, **Mr Joongkwon Kim**, **my ex-colleagues in Hanjin Shipping** and **my ex-customers** for helping me to collect research data from the industry;
- **My colleagues in D46** and **members of the Cardiff Korean Church and the Korean Society** for giving me wonderful times at Cardiff;
- **Dr Mohammad Ali** and **Colleagues at Coventry University** for providing me with confidence and a clear target to finish this thesis;
- **My parents**, **parents-in-law**, **sister** and **brother-in-law** for their prayers and supports which strengthen me all the time.

Lastly, but not least by no means, I would like to express my special gratitude to my wife, **Eun Young**, and my son, **Seungjoon**, for their endurance through the toughest time in our lives. In particular, without my wife's sacrifices and unwavering supports, I was not able to have come this far. I wish that my son in Heaven, **Joonhu**, would be proud of what his dad has done.

"But we also rejoice in our sufferings, because we know that suffering produces perseverance; perseverance, character; and character, hope (Romans 5:3-4)."

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Abbreviations

3PL	Third-Party Logistics
AHP	Analytic Hierarchy Process
ANOVA	Analysis of Variance
AVE	Average Variance Extracted
B/L	Bill of Lading
BAF	Bunker Adjustment Factor
CAF	Currency Adjustment Factor
CB-SEM	Covariance-Based Structural Equation Modelling
CIMO	Context-Intervention-Mechanism-Outcome
CMO	Context-Mechanism-Outcome
CO	Customer Orientation
CR	Composite Reliability
CSR	Corporate Social Responsibility
CY	Container Yard
DO	Disruption Orientation
FEU	Forty-foot Equivalent Unit
FX	Foreign Exchange
GPS	Global Positioning System
GRI	General Rate Increase
HFLI	High-frequency-low-impact
H/P	Hypothesis
ICC	Institute Cargo Clause
ICT	Information and Communication Technology
ILRM	International Logistics Risk Management
INCOTERMS	ICC rules for the use of domestic and international trade terms
IPT	Information Processing Theory
ISM	Interpretive Structural Modelling
JIT	Just-in-time
KIFFA	Korea International Freight Forwarder Association
KILA	Korea Integrated Logistics Association
KOIMA	Korea Importers Association
L/C	Letter of Credit

L/G	Letter of Guarantee
LC Strategy	Developing Logistics Collaboration Strategy
LFHI	Low-frequency-high-impact
LI Strategy	Leveraging Logistics Information Strategy
LSP	Logistics Service Provider
MANOVA	Multivariate Analysis of Variance
MCDM	Multi-Criteria Decision Making
MICMAC	The Impact Matrix Cross-Reference Multiplication Applied to a Classification (in French)
OB/L	Original Bill of Lading
OC Strategy	Leveraging Outsourcing Contracts Strategy
OD	Origin-Destination
PLS-SEM	Partial Least Squares Structural Equation Modelling
POD	Port of Discharging
POL	Port of Loading
PSC	Peak Season Charge
QCD	Quality, Cost, Delay
QO	Quality Orientation
RB	Robustness
RFID	Radio-Frequency Identification
RS	Resilience
SCRM	Supply Chain Risk Management
SEM	Structural Equation Modelling
SKU	Stock-keeping unit
SL Strategy	Building a Stable Logistics Network Strategy
SSIM	Structural Self-Interaction Matrix
TEU	Twenty-foot Equivalent Unit

Chapter 1

International Logistics Risk Management:

Why and How

1.1. Background

Global supply chain management involves great challenges for individual firms because logistics operations at the global level entail economic, political, competitive, cultural, operational and infrastructural uncertainties (Flint 2004; Meixell and Gargeya 2005; Manuj and Mentzer 2008b). It is evident that globalisation provides firms with opportunities to exploit cheap labour and raw materials, large product markets and a package of benefits which a host government may offer to induce foreign capital investment (Manuj and Mentzer 2008a). However, global supply networks are inseparable from complexities and uncertainties since they encompass diverse flows, nodes, entities, and transits between nodes, as well as potential long lead times (Craighead *et al.* 2007). The disruptions to material, information and financial flows of a firm's supply chain have become the norm, because globalisation has inevitably generated complex and tightly coupled inter-organisational networks (Bode *et al.* 2011) where a disruption at one link of the chain diffuses across the entire chain. As Rao and Young (1994) argued, complexity in global supply chains can significantly affect logistical risk management and the management decisions of companies involved in international trade.

From the perspective that a supply chain is an integrated set of relationships among various entities (Beamon 1998), global supply chains are much riskier than their domestic counterparts because of the links interconnecting an international network of companies involved in the process (Manuj and Mentzer 2008a). The globalised business environments represented by long lead times and complexities have led to a high level of supply chain risk, particularly when it is coupled with firms' emphasis on efficiency (Blackhurst *et al.* 2011). Most companies have strived to improve their financial performance by taking initiatives to reduce costs and assets such as JIT, single-sourcing, vendor-managed inventory, lean operations, reduced supply base and outsourcing. Many researchers, however, have warned that these powerful and effective initiatives, implemented during a period of a stable business environment, can suddenly turn into vulnerabilities by creating longer and more complex global supply chains (Zsidisin *et al.* 2000; Chopra and Sodhi 2004; Giunipero and Eltantawy 2004; Faisal *et al.* 2006; Tang 2006). According to Jüttner *et al.* (2003), examples of the risk drivers that have changed the structure of supply networks by increasing complexity or by enhancing supply chain integration, can be specified as: (1) a focus on efficiency, (2) globalisation of supply chains, (3) centralised factories and distribution, (4) outsourcing and (5) supplier base reduction. In addition to these, any unexpected events, such as terrorist acts, labour strikes, fires and natural disasters, can also badly affect the global supply chain (Chopra and Sodhi 2004; Manuj and Mentzer 2008b).

There have been many examples of when a disruption has paralysed the global supply chain. A fire which lasted for only 10 minutes in a Philips plant disrupted Ericsson's delivery of microchips for more than a month, whose losses then amounted to $400 million (Latour 2001; Chopra and Sodhi 2004). The bankruptcy of a UK-based supplier, UPF-Thompson, forced Land Rover to make 1,400 workers redundant (Chopra and Sodhi 2004; Tang 2006). An earthquake which damaged one auto-part supplier's facilities led to the entire production lines of Toyota to shut down, delaying the production of 55,000 vehicles (Pettit *et al.* 2010). It is still possible to recall how the 9/11 terror attack and the longshoremen's strike in California have uniquely changed the shape of logistics operations to and from the US.

According to a survey in 2003, the daily cost of a supply chain disruption was estimated by US firms to amount to between US $50 million and $100 million (Rice and Caniato 2003) - the current cost will be much greater. Indeed, the aggregate cost of Hurricane Sandy in the US in 2012 topped US $70billion, and Thailand's floods in 2012 led to closure of more than 1,000 factories and US$ 20 billion losses in total (World Economic Forum 2013). In this regard, the analysis of global supply chain risks is becoming more imperative to the firms which pursue effectiveness and values in supply chain operations. This is because risk management is the consequence of recognising increasing risks and the need for responses to manage them (Christopher and Lee 2004). In the current business environment, risk management is regarded as a critical contributor to successful business management (Ritchie and Brindley 2007b).

Due to the growing number of disruptive cases with negative consequences on firms' performance and operations, the interest in supply chain risk management has also increased (Blackhurst *et al.* 2011). For the last decade, Supply Chain Risk Management (hereinafter, SCRM) has been studied extensively (Colicchia and Strozzi 2012; Ghadge *et al.* 2012). Despite some variations, the SCRM process, in essence, consists of risk identification, risk assessment and risk mitigation (Hallikas *et al.* 2004; Kleindorfer and Saad 2005). SCRM studies cover at least one of these processes to investigate supply chain risks and their management while taking various supply chain contexts into account.

As SCRM encompasses the entire supply chain network from sourcing to delivery, each study has its own research scope. For instance, some studies focus on the upstream supply chain (Smeltzer and Siferd 1998; Zsidisin 2003; Zsidisin and Ellram 2003; Giunipero and Eltantawy 2004; Svensson 2004; Zsidisin *et al.* 2004; Zsidisin *et al.* 2005; Blackhurst *et al.* 2008; Ellegaard 2008; Deane *et al.* 2009; Zsidisin and Wagner 2010; Blackhurst *et al.* 2011; Christopher *et al.* 2011; Cheng *et al.* 2012; Kern *et al.* 2012), while others pay attention to the downstream supply chain (Milgate 2001; Sodhi 2005; Serangi and Srivatsan 2009; Sodhi and Tang 2009). Moreover, whereas the majority of research mainly concentrates on risk management from a manufacturer's perspective, some studies (Hallikas *et al.* 2002; Harland *et al.* 2003; Hallikas *et al.* 2004; Sanchez-Rodrigues *et al.* 2008; Trkman and McCormack 2009; Klibi *et al.* 2010; Sanchez-Rodrigues *et al.* 2010) explicitly examine a supply chain network that embraces complexity and uncertainties in the interplays of various entities.

There are a small number of studies specifically focused on the global supply chain (Barry 2004; Manuj and Mentzer 2008a; Manuj and Mentzer 2008b; Deane *et al.* 2009) and on logistics (Sanchez-Rodrigues *et al.* 2008; Tsai *et al.* 2008; Sanchez-Rodrigues *et al.* 2010; Vilko and Hallikas 2012). This is mainly because most researchers think that a global supply chain is a subset of a general supply chain, and that logistics is a subset of a supply chain (Larson and Halldórsson 2004). However, the risks and uncertainties in international logistics networks have not yet been fully explored. This is partly because of the 'unionist view', which is of the opinion that logistics is a subset of supply chain management (Larson and Halldórsson 2004). From this perspective, logistics can be underestimated as a miscellaneous topic when compared to production management, inventory management or demand forecasting. Additionally, another reason can be attributed to the industry's emphasis on the responses to recurrent risks (Chopra and Sodhi 2004; Faisal *et al.* 2006). International logistics risks with low-frequency but high-impact characteristics are easily overlooked by companies, and this arrangement may have influenced SCRM research. To this end, the findings of previous SCRM research provide valuable insights, but have limited applications for international logistics. This research gap is critical in that globalisation, long lead-times, increases in logistics outsourcing and the surge of abrupt natural/man-made disasters around the world are forcing companies to pay attention to managing international logistics risks.

In addition to the deficiency of research on international logistics risks, SCRM studies appear to have demonstrated less empirical attention to: (1) a holistic and systematic risk analysis, (2) risk management at a strategic level, (3) contexts and mechanisms of risk management strategies, and (4) the relationship between risk mitigation and its outcome. These issues will be further discussed in the literature review in Chapter 2 and will be addressed in this thesis.

1.2. Research Objectives and Questions

The main aim of this thesis is to investigate risk management strategies for international logistics that can minimise the occurrence and/or impact of risks and achieve a desirable logistics network. For this purpose, appropriate identification and analysis of international logistics risks must proceed. In addition, risk management strategies which can mitigate those risks must be defined. Moreover, the antecedents that stimulate the implementation of the strategies and desirable outcomes of those strategies should also be explored.

This thesis follows the three-phase SCRM process of risk identification, risk analysis and risk mitigation (Kleindorfer and Saad 2005; Waters 2007; Zsidisin and Wagner 2010) while expanding the risk mitigation phase to include not just the risk mitigation strategies but also their antecedents and outcomes. Each phase of the SCRM process is interrelated, thus the focus on a certain phase often generates disintegrated findings that are only applicable to certain circumstances - this is the reason why this thesis embraces all three phases, despite the combination of diverse research questions and methods which may, at a glance, look complicated.

The research enquiry therefore can be divided into two main questions. The first research question is associated with risk identification and analysis; it is focused on identifying critical risk areas which must be managed. The holistic structure of international logistics risks, which demonstrates the interconnections and the interactions of these risks, is important because it can indicate the risk areas where risk management strategies must target. Risk structure is predetermined by elements that can adequately reflect the risk factors in international logistics. The identification of individual risks and the subsequent categorisation of those risk events will provide the elements for the risk structure. To this end, the first research questions can be defined as:

RQ1: What are the risk areas to be managed in international logistics?

RQ1a: What are the risks in international logistics operations?

RQ1b: How are these risks understood by using clustering?

RQ1c: How are these risk clusters interacting with each other?

The second research question focuses on risk mitigation strategies are aimed at effective management of the critical risks found in the previous research question. It comprises sub-questions addressing risk management strategies, the antecedents of strategic implementation and the outcomes of the strategies, respectively. In particular, it aims to empirically develop and validate the strategies, because most SCRM studies pay more attention either to mitigation measures at the operational/tactical levels, or to conceptual frameworks without empirical validation.

RQ2. How can a firm effectively manage risks in international logistics?

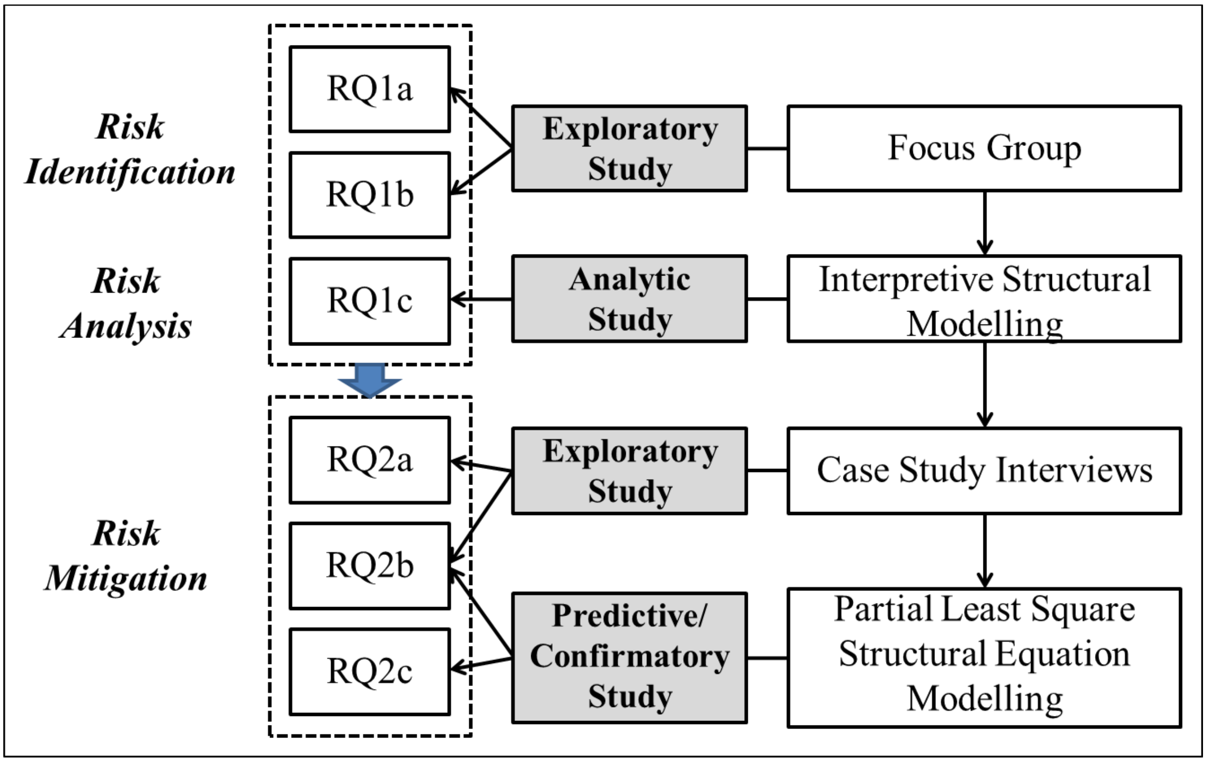
RQ2a. What are the main risk management strategies to be considered?

RQ2b. Which factors can facilitate implementation of these risk management strategies?

RQ2c. Can these strategies generate positive outcomes for the logistics network?

These research questions will be addressed by multiple research methods fit for purpose. Eventually, the findings are expected to help understand 'what international logistics risk is' and 'how it should be managed.'

Figure 1-1: Research Framework



1.3. Research Framework

Risk management consists of several phases including risk identification, risk analysis and risk mitigation. Identified risks become the subjects of analysis, and the critical risks derived from the analysis become the subjects of mitigation. The methodological challenge lies in how these subsequent relationships can be captured and investigated in one study. Due to this challenge, most research focuses on one or two phases that can be studied by one research method. From a holistic perspective which embraces the entire range of risk management processes, this thesis adopts a multi-phase mixed method approach comprising of four data collection techniques and four analysis techniques. All of them are based on empirical data, but their approaches to data analysis vary in contextualising risk management for international logistics operations. Figure 1-1 shows the research framework in more detail.

(1) Exploratory Study for RQ1

RQ1 begins with an exploratory study by using focus groups as a data collection and analysis technique, which provides risk elements in international logistics. Focus groups of logistics experts will be used to identify, debate and discuss the risks inherent in international logistics operations; and the research will be designed so that the various risks and risk clusters should emerge.

(2) Analytic Study

In the subsequent analytic study, the inter-relationships of these risk clusters are reviewed by panels and analysed by an interpretive structural modelling (ISM) technique. This produces a risk structure that demonstrates the interconnections and hierarchies within the risk elements.

(3) Exploratory Study for RQ2

As the risk structure highlights the critical risk areas that must be managed in international logistics, a strategy framework to manage these risk areas will be developed by information processing theory, which will then be populated by using case study interviews as well as a literature review. In addition, the antecedents for implementing those strategies will also be presented in this research phase. These findings will lead to a research model comprising of strategy antecedents, risk management strategies and their desired outcomes.

(4) Predictive/Confirmatory Study

The research model will be validated from a questionnaire survey with logistics practitioners in the industry. Descriptive statistics of the data will be presented to understand the degree of strategic implementation to tackle international logistics risks. The analysis of variance (ANOVA) technique will also highlight the differences in the implementation level given the circumstances of a firm. Finally, the survey data will be analysed by Partial Least Squares Structural Equation Modelling (PLS-SEM) to validate the research model proposed beforehand.

1.4. Research Scope

As supply chain risk management is a broad topic encompassing various perspectives from which to look at the supply chain, it is a pre-requisite to set the boundaries of the study at an early stage in order to develop meaningful insights.

Firstly, the context of this thesis is confined to international logistics risk management. Although this research borrows theories and research conducted in the contexts of supply chain management, supply chain risk management, organisational studies and other general management disciplines - its main focus is how to manage risks occurring from the international cargo movement between an exporter's warehouses in country A, to an importer's warehouse in country B. More specifically, it presumes that the cargo movement takes place using multimodal transport whose main leg is in maritime container transport.

Secondly, the unit of analysis of this thesis assumes a logistics network of diverse entities which are involved in international logistics. When adapting the logistics triad by Bask (2001), this research considers a logistics network which encompasses exporters, importers (asset-based), logistics service providers (asset-based) and (non-asset-based) logistics intermediaries. It looks at activities within the interactions of these entities in association with material, finance and information flows.

Thirdly, the geographical focus of this thesis is South Korea. This country provides a good sample for the research relating to international logistics, because it has been developed with an export-driven policy and its economy depends largely upon international trade. As effective international logistics is a pre-condition to achieve successful international trade, South Korea has invested substantial finance and human resources into creating international logistics networks. As a result, South Korea is now the fourth largest country in terms of international container transport volume (World Shipping Council 2011) and the seventh largest in terms of international merchandise trade amount (WTO 2013). In addition, it has the world's fifth largest container port, Busan, whose annual traffic reached 17 million TEU in 2012 (World Shipping Council 2013). When the scale of international logistics is taken into account, the international logistics practices in South Korea are expected to provide valuable and potentially generalisable insights to address the research questions.

1.5. Thesis Structure

This thesis comprises of seven chapters.

Chapter 1 introduced the research background, research objectives and questions, research framework, research scope and structure of this thesis. It briefly mentioned the requirement for this research and outlined how the research will be conducted.

Chapter 2 discusses extant studies in association with supply chain risk management to define the position of this thesis. It will propose a research framework to overview previous

SCRM research, assess the current knowledge on SCRM and then find out the research gaps, particularly relating to international logistics risks.

Chapter 3 explains the methodology which will be applied to this thesis. After defining the overall research design, it endeavours to justify the methodological choices to address the research questions by outlining the application of data collection and analysis techniques.

Chapter 4 focuses on the identification and analysis of risks in international logistics. According to the sub-questions in RQ1, it firstly explores various risks and then creates clusters to understand those individual risks more comprehensively. The clusters are used for risk elements to constitute a risk structure which will highlight the interactions between international logistics risks.

Chapter 5 illustrates the development of the risk management strategy model which is conceptualised by an organisational theory and then populated by case study interviews and a literature review. It also conceptualises organisational orientations that stimulate risk management and the desired outcomes from a risk management perspective. These three groups of constructs will constitute a research model by the development of hypotheses and measuring scales.

Chapter 6 presents the results from statistical analyses of survey data. The implementation level of risk management strategies will be captured by the descriptive statistics of survey data. Additionally, the differences in strategies given a firm’s circumstances will be highlighted by ANOVA. Last but not least, the measurement and structural model suggested in Chapter 5 will be validated by PLS-SEM technique so as to shed light on the influences of organisational orientations on risk management strategies, as well as on the positive impacts of risk management strategies on building more robust and resilient logistics networks.

Chapter 7 summarises the findings in previous chapters, and draws upon theoretical and managerial implications. It will also suggest the limitations of this thesis and future research agenda.

1.6. Concluding Remarks

This chapter argued the growing importance of international logistics risk management in practice, and suggested relevant research areas which have not been fully explored. Based on the research gaps, it proposed the research objective to investigate risk management strategies for international logistics that can minimise the occurrence and/or impact of risks and achieve a desirable logistics network. The objective led to two research questions as to how the international logistics risks are understood, and as to how a firm can effectively manage risks in international logistics. To address the research questions, a research framework consisting of two exploratory studies, one analytic study and one predictive/confirmatory study, were explained. This chapter also set up the research boundary, such as international logistics operations, a logistics network of various entities and South Korea as the country where this research will be conducted. In addition, the structure of the entire thesis was outlined. In sum, this chapter proposed why the research on international logistics risk management is required and how it can be executed to understand international logistics risks and their management.

The next chapter will investigate extant supply chain risk management studies to identify the theoretical and methodological implications on international logistics risk management. In particular, it will seek some research agenda which has not been covered by the previous studies, and then will derive research questions as a consequence.

Chapter 2

The Concept of Risk Management:

A Literature Review

Supply chain risk management (SCRM, hereafter) has been the focus of much attention from academics and practitioners, thus, it has been rigorously studied from various perspectives for the last 15 years (Ghadge *et al.* 2012). As a result, SCRM is now a rapidly growing research area favoured by many researchers (Rao and Goldsby 2009; Colicchia and Strozzi 2012). This research trend is largely dependent upon the transformed structure of supply chain networks with a focus on efficiency, globalisation of supply chains, centralised factories and distribution, outsourcing and the supplier base reduction, which has significantly heightened the level of risk in supply chains (Jüttner *et al.* 2003). Moreover, the catastrophic impacts of natural and man-made disasters, such as terrorist attacks, SARS, earthquakes, tsunamis and industrial action, have provided the momentum to consider risk management as one of the strategic priorities in supply chain management (Jüttner 2005). Extant research has so far developed and proposed various risk management models and strategies because supply chain disruptions are associated with diverse types of risks (Tang 2006a).

This chapter reviews previous research on SCRM and identifies the research gaps, particularly with respect to international logistics risk management. Due to the lack of in-depth studies on international logistics risks, the exploratory nature of this research leads this literature review to focus on how SCRM knowledge has been built up in order for the findings to be applied to international logistics contexts. To understand the existing body of literature, the definition of 'risk' in the context of supply chains is presented, and then a SCRM research framework is proposed to illustrate the structure of current knowledge on SCRM as well as to synthesise the knowledge in a structured manner. The elements in the framework will be further discussed in the later sections so that it provides a theoretical guide to understanding SCRM studies and also highlights underdeveloped research areas therein, thus a future research agenda can be derived from the research gaps identified.

2.1. What is Supply Chain Risk?

Before starting the review of SCRM research, one basic question needs to be addressed first. The question is "what is supply chain risk?"

2.1.1. Risk

Risk, in general, is defined as "the probability of variance in an expected outcome" (Spekman and Davis 2004) or "the chance, in quantitative terms, of a defined hazard occurring" (Royal Society 1992 p. 4). However, the concept of 'risk' has varying definitions and usage across disciplines and contexts according to the understanding of the nature of risks (Norrman and Jansson 2004). Baird and Thomas (1990) even suggested eight different perspectives in defining risk, showing that it is a multi-dimensional construct that can be perceived differently by business sectors. In classical decision theory, for instance, risk is "the variation in the distribution of the probability distribution of possible gains and losses associated with particular alternative" (March and Shapira 1987, p. 1404). On the other hand, the capital asset pricing model conceives risk as the element to understand financial markets, comprising the systematic risk and specific risk (Gibbons 1982). The scope of risk has been expanded from pure mathematical models to human behaviour and psychology-based approaches to be applicable to strategic decisions (Rao and Goldsby 2009).

However there are roughly two main streams, given the perspectives on the characteristics of risks, in defining what risk is: (1) both danger and opportunity and (2) pure danger (Mitchell 1995; Wagner and Bode 2006).

(1) Risk is perceived, especially by decision theorists, as the possibility whose outcome is

higher or lower than expected (Norrman and Jansson 2004). This notion is largely contributed by the fact that the first systematic study on risk is known to have initiated from the application of mathematical models to gambling (Khan and Burnes 2007) which can expect gains as well as losses. In business disciplines, one of the seminal works about risk was the investment portfolio model by Markowitz (1952) which explained the way investors balance risk and reward. Specifically, decision-making under risk delineates the selection process of options with different outcomes and different probabilities (Kahneman and Tversky 1979). Likewise, the portfolio management discipline considers risk as the chance of return by examining the attitude of investors to assessing risk and return. One of the golden rules in investment, “high risk, high return” may describe this notion of risk very appropriately. March and Shapira (1987, p. 1404), therefore, define risk as the “variation in the distribution of possible outcomes, their likelihoods, and their subjective value.”

(2) In the social science and management field, however, risk is interpreted solely as the downside effects from uncertain events. Researchers with this view highlight the losses (Yates and Stone 1992; Chiles and McMackin 1996; Mitchell 1999), adverse effects (Lawrance 1980) and unwanted negative consequences (Rowe 1980) arising from risk rather than the gains from taking risk. In this perspective, risk is an unwanted negative effect (Rowe 1980) which inevitably entails the concept of ‘loss’ (Chiles and McMackin 1996, Yates and Stone 1992). Mitchell (1995) developed this idea further and stated that risk is a function of the probability of a certain type of loss and the impact of the loss. Risk as a loss has several facets: Yates and Stone (1992) emphasised the elements of loss, the significance of loss and the uncertainty associated with loss while MacCrimmon and Wehrung (1986) highlighted the magnitude and chance of loss as well as the potential exposure to loss.

2.1.2. Supply chain risk

In the context of supply chains, authors tend to agree that risk is related to negative consequences (Christopher and Lee 2004; Spekman and Davis 2004; Wagner and Bode 2006; Tang and Musa 2011). Should the supply chain risk be defined based on risk characteristics (Zsidisin 2003), the emphasis on its negative impact becomes clearer because there are few supply chain risk features to expect a chance of gain. In the supply chain context, risk is defined as "a chance of danger, damage, loss, injury or any other undesired consequences" (Harland *et al.* 2003, p. 52) or as "the negative deviation from the expected value of a certain performance measure, resulting in undesirable consequences" (Wagner and Bode 2008, p. 309), all of which highlight the adverse effects of risks. Empirical studies illuminate that supply chain managers' perspectives of risks are particularly inclined to downside impacts:

"*Risks are all those things that keep you away from the perfect path and perfect outcomes*." (Manuj and Mentzer 2008b, p. 196)

"*Risk is the danger that events or decisions will obstruct the company's achievement of its objectives*." (Zsidisin 2003, p. 220)

The two main components of supply chain risks are impact and likelihood (Norman and Jansson 2004; Faisal *et al.* 2006; Colicchia and Strozzi 2012). Suggesting potential losses and their likelihood as two basic components of risk, Manuj and Mentzer (2008b, p. 196) describe risk as "the expected outcome of an uncertain event." According to Tang and Musa (2011, p. 26), supply chain risk is "the event with small probability but occurring abruptly which brings substantial negative consequences to the system." The system here encompasses "information and material and product flows from original supplier to the delivery of the final product for the end user (Jüttner *et al.* 2003)."

Supply chain risk is often specified into operational risks and disruption risks, built upon the characteristics of the risks (Tang 2006a). In this sense, operational risks refer to inherent uncertainties from supply, demand and cost, whose frequency is high while impact is low. On the contrary, disruption risks indicate major natural and man-made disasters whose impact is much greater than operational risks but the likelihood is slim. In a similar vein, some researchers distinguish low-frequency-high-impact (LFHI) risks from high-frequency-low-impact (HFLI) risks (Sheffi and Rice 2005; Oke and Gopalakrishnan 2009; Sodhi *et al.* 2012). When it is considered that LFHI risks emanate from the randomness of events by timing, duration, location and intensity, management of LFHI risks should be different from HFLI risk management.

2.1.3. Risk, uncertainty and vulnerability

Due to the diversity in defining risk, researchers are sometimes unclear (Manuj and Mentzer 2008b) as they use adjoining and interchangeable terms like uncertainties (Sanchez-Rodriguez *et al.* 2008), vulnerabilities (Svensson 2004; Peck 2005; Berle *et al.* 2011) and disruptions (Peck 2005) along with risk. This would aggravate the difficulties of understanding risks in supply chains (Manuj and Mentzer 2008b).

According to Sanchez-Rodrigues *et al.* (2008, p. 390), supply chain uncertainty is a "decision making situation in the supply chain in which the decision maker does not know definitely what to decide." Uncertainty stems from a total absence of awareness or information about the occurrence of a certain event (Ritchie and Brindley 2007a). It therefore entails the inability to forecast some events (Milliken 1987) because the probability or outcome of the uncertain events cannot be estimated while risk can be measured by a function of known probability and outcome (Norrman and Jansson 2004). However, it is also acknowledged that risk and uncertainty are used interchangeably in the supply chain research regardless of the differences (Tang and Musa 2011; Colicchia and Strozzi 2012). Ritchie and Brindly (2007b, p. 306) suggested it is because supply chain risk is located "somewhere in the middle of risk-uncertainty spectrum."

Vulnerability refers to a situation put under risk due to managerial decisions, industry trends, task complexity, regulatory changes and external shock (Peck 2005). Particularly, managerial decisions to improve performance such as outsourcing, JIT, network redesign and IT upgrades can have an adverse impact on the supply chain making it vulnerable. More specifically, Svensson (2000) defined vulnerability as "the existence of random disturbances that lead to deviations in the supply chain from normal, expected or planned activities, all of which cause negative effects or consequences." In this regard, vulnerability is a multidimensional construct composed of various supply chain characteristics (Wagner and Bode 2006). Peck (2005) describes four distinct levels of vulnerability: (1) value stream/product process, (2) assets and infrastructure dependencies, (3) organisations and inter-organisational networks and (4) the environment.

The term 'risk' is used with various meanings and at different hierarchies because risk sometimes refers to sources of risk while it can also mean consequences of risk at other times

(Jüttner *et al.* 2003). One reason for such confusion may lie in the characteristic of risk as a multidimensional construct (Zsidisin 2003). Some researchers insist the term 'risk' is so confusing that the separate concepts of risk sources and risk consequences are more appropriate to use (Harland *et al.* 2003; Jüttner *et al.* 2003; Tang and Musa 2011). Even Wagner and Bode (2006, p. 303) make a distinction between supply risk sources and supply disruptions (risk events) with the latter described as "unintended, untoward situations which leads to supply chain risk" that can be replaced by terms like "glitch, disturbance or crisis." Risk sources are classes for risk events, which were developed by many researchers in the form of typologies or taxonomies (Wagner and Bode 2006) to identify and understand numerous risk events in supply chains more comprehensively. Risk consequence is the effect of materialised risk events; thus risk events and risk consequence should be mediated by risk occurrence (materialised risk).

Although these concepts are very inter-related, uncertainty determines risk sources and events but vulnerability is rather associated with the risk occurrence and consequences which stem from failures in risk preparation and mitigation, in essence. Sanchez-Rodrigues *et al.* (2008) argued that internal and external uncertainties can augment the risk within supply chains. Uncertainty is one of the main drivers causing risk occurrence in the future because it denotes the situation where unexpected or risky events might occur (Waters 2007). It directly affects risk sources and risk events with broad categories of risk and risk events. That can be the reason why uncertainty is sometimes used interchangeably with risk because uncertainty is strongly correlated with risk sources and events. Uncertainty also has an indirect impact on risk occurrence and risk consequence by augmenting the level of vulnerability. Vulnerability, in this sense, is the factor that makes an organisation exposed to risk occurrence and risk consequences because vulnerable supply chains will face difficulties in preventing the risk and in mitigating the effect of materialised risk. In line with this, Jüttner *et al.* (2003, p. 200) delineates supply vulnerability as "the propensity of risk sources and risk drivers to outweigh risk mitigation strategies, thus causing adverse supply chain consequences."

2.2. SCRM Research Framework

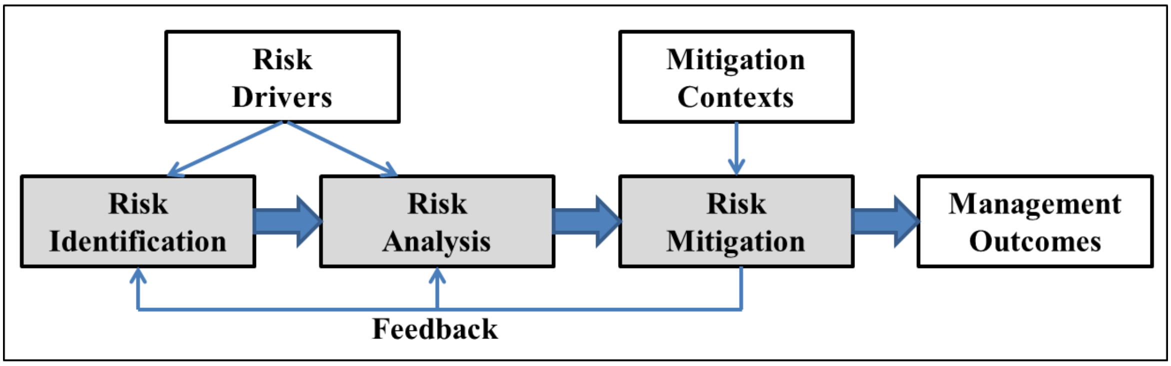
According to Jüttner (2005, p. 124), supply chain risk management is defined as "the identification and management of risks for the supply chain, through a co-ordinated approach amongst supply chain members, to reduce supply chain vulnerability as a whole." In a similar vein, Manuj and Mentzer (2008b, p.205) delineated SCRM as "the *identification* and *evaluation* of risks and consequent losses in (the global) supply chain, and *implementation of appropriate strategies* through a coordinated approach among supply chain members ... for supply chain outcomes that in turn lead to close matching of actual cost savings and profitability with those desired." From this definition, Manuj and Mentzer (2008a) suggested five steps of risk management: (1) risk identification, (2) risk assessment and evaluation, (3) selection of appropriate risk management strategies, (4) implementation of supply chain risk management strategies and (5) mitigation of supply chain risks. Other SCRM researchers have also proposed a variety of risk management steps. For example, Pettit *et al.* (2010) added one more step, supervise and review, to the idea of Manuj and Mentzer (2008a). This is in line with Zsidisin and Wagner (2010) who synthesised the risk management process suggested by previous research (Hallikas *et al.* 2004; Sheffi and Rice 2005; de Waart 2006) into four stages: (1) risk identification; (2) risk analysis (assessment and classification); (3) risk management in a narrow sense; and (4) risk monitoring. Tang (2006b) rather divided the risk assessment phase into estimating the likelihood of risks and assessing potential loss from the risks, and summed up the later step as finding strategies to mitigate the risks. Despite the variability in the SCRM steps, the core processes that all researchers agree are (1) risk identification, (2) risk analysis and (3) risk mitigation (Kleindorfer and Saad 2005; Wagner and Bode 2009).

Together with the main SCRM process, some studies focused more on the contexts and mechanisms that decide supply chain risks and risk mitigating strategies. Jüttner *et al.* (2003) conceptualised supply chain risk management with four constructs, which are (1) risk sources, (2) risk consequences, (3) supply chain risk drivers and (4) supply chain risk mitigating strategies. Their conceptual model asserts that the influence of risk sources on risk consequences is moderated by supply chain risk drivers and supply chain risk mitigating strategies. There are diverse attributes that were found to stimulate supply chain risks and to affect the decision on risk mitigating initiatives, which can be roughly grouped into four factors. The first is the supply chain complexity stemming from globalisation. The complexities within the network, process and product become aggravated by globalised supply chain operations (Rao and Young 1994; Craighead *et al.* 2007; Hofer and Knemeyer 2009; Blackhurst *et al.* 2011). The second is intra-organisational factors, such as company size, outsourcing level (Mitchell 1995), temporal focus (Manuj and Mentzer 2008b) and organisational structure (Ellis *et al.* 2011). The third is inter-organisational factors that can be characterised by supplier-customer relationship (Mitchell 1995; Trkman and McCormack 2009), dependence and power issue (Lonsdale 1999; Svensson 2002; Ojala and Hallikas 2006; Craighead *et al.* 2007; Bode *et al.* 2011) and the level of communication (Ojala and Hallikas 2006), to name a few. The last is personal or decision-maker factors (Ritchie and Brindley 2007a), whose job function, experience, knowledge and risk attitude (Mitchell 1995) matter.

Colicchia and Strozzi (2012) analysed SCRM with the logic of contexts, mechanisms, interventions and outcomes. In reflection of this CIMO-logic, SCRM can be evaluated as "under what conditions (C) do supply chain management practices (I) influence the performance of the supply chain (O)? What mechanisms (M) influence supply chain management practices (I) on the performance of the supply chain (O)?" (Denyer and Tranfield 2009). With this logic, they conceptually distinguished the themes of SCRM research by complexity and uncertainty (C), practices and tools for SCRM (I), organisation of SCRM process (M) and increased SC resilience and robustness (O). Although this logic provides a framework to analyse SCRM studies, SCRM consists of more complex interactions of various factors that cannot be simply delineated by this logic.

The SCRM research frameworks proposed in this thesis reflect the research focuses and the relationships between the focuses. The basic elements in this framework are the three SCRM phases, namely risk identification, risk analysis and risk mitigation. Risk drivers, risk mitigation contexts and management outcomes need to be added to the basic framework because they determine the risk profiles, the significance level of each risk, the way a firm selects specific risk management strategies and the effectiveness of implementing the strategies. Figure 2-1 demonstrates the SCRM research framework based on these six research focuses and their relationships. The shaded constructs indicate the risk management phases consisting of risk identification, risk analysis and risk mitigation. The constructs without shade are the antecedents and outcomes of these risk management phases.

Figure 2-1: SCRM research framework



(Source: Author)

The SCRM process comprises sequential steps to reach the best mitigation responses that are applicable to every company. Kern *et al.* (2012) have empirically demonstrated that a company's endeavour of risk identification can augment the level of risk analysis, which in turn increases the level of risk mitigation. According to Waters (2007), these three steps are delineated as follows:

*"**Risk Identification** produces a list of the risks that are likely to affect the supply chain hence the broader organisation (p. 97)."*

*"The aim of **risk analysis** is to give a prioritised list of risks. This identifies the most significant risks that need positive attention, and the less significant ones that can be ignored (p. 129)"*

*"The aim or **risk response (mitigation)** is to define the most appropriate way of dealing with all risks to the supply chain. Then actions are needed to implement the responses (p. 149)."*

Risk drivers influence both risk identification and risk analysis: they add new risk profiles that can be identified while augmenting the level of risks that are critical to risk analysis. Mitigating contexts, on the other hand, have a linkage with the risk mitigation phase with affecting the selection of mitigating strategies and measures. The outcomes may be capability or performance that risk management can result in. They are not universal to every organisation and supply chains, rather very specific and contextual to a certain entity. In the CIMO-logic by Colicchia and Strozzi (2012), contexts (C), mechanisms (M) and outcomes (O) of SCRM can be matched with risk drivers, mitigating contexts and risk management outcomes in the framework. Ritchie and Brindley (2007b) also used risk context and drivers, risk management influencers and performance outcomes in order to delineate those three aspects.

The following sections will discuss the existing SCRM studies which use this framework. They begin with the three risk management processes and then explain the antecedents and outcomes.

2.3. Risk Identification

In any of the SCRM studies, risk identification is the foremost and indispensable stage in risk management. Without risks being identified appropriately, management strategies and measures may be ineffective in spite of the money and efforts expended.

At a glance, risk identification denotes a process to produce a full list of risks that can possibly influence supply chains (Waters 2007). In this respect, the initial stage for risk identification should aim at finding out as many risks as possible that can directly or indirectly disrupt supply chain operations. Once there was a remark that risks in supply chains have not been fully investigated (Kouvelis *et al.* 2006), but now it seems that quite a number of empirical studies have been conducted to find out risks across various industry sectors. Supply chain risks which are generally applicable were empirically sought by studying varied sectors at a time (Zsidisin *et al.* 2004; Peck 2005; Christopher *et al.* 2011) while the risks specific to a specific industry sector, such as car manufacturing (Svensson

2004; Blos *et al.* 2009; Lin and Zhou 2011), logistics and transportation (Nilsson 2006; Sanchez-Rodrigues *et al.* 2010; Berle *et al.* 2011; Vilko *et al.* 2012), electronics (Hallikas *et al.* 2002; Sodhi and Lee 2007), machinery and equipment (Schoenherr *et al.* 2008), food (van der Vorst and Beulens 2002) and chemical industry (Adhitya *et al.* 2009), have also been investigated. When it comes to the methods to identify individual risks, the majority of research uses case studies but some studies apply more systematic methods such as HAZOP (Adhitya *et al.* 2009), event process chain modelling (van der Vorst and Beulens 2002) and failure mode analysis (Berle *et al.* 2011).

Risk identification stage, however, does not end simply by creating a lengthy list of risks and/or risk events, but requires a classification of those risks because the list has some drawbacks. Firstly, the long list may lead researchers and practitioners to create numerous risk mitigation measures to tackle all the risks but some of them can be contradictory with one another and thus nullify the effects of other measures. Secondly, the list is too dedicated to details of risk to provide a comprehensive understanding of risks required to figure out an effective strategy to tackle those risks. Thirdly, the findings normally have risks and risk events mixed up despite their different causal hierarchy and this often confuses practitioners when prioritising mitigation measures and strategies. Against this backdrop, researchers devised several types of risks by categorising risks and this typology and/or taxonomies helps the characteristics of supply chain risks to be more clearly demonstrated.

The risk categorisation, as the second phase of risk identification, aims to find out types of risks that are triggered by risk events in order to mitigate those risk types strategically. A structured literature review of SCRM studies has been conducted to understand different types of risk categorisation. Firstly, existing SCRM studies were divided into risk identification, risk analysis and risk mitigation studies although some research covered more than one phase. Secondly, among the risk identification studies, the research which used any kind of risk categorisation was selected for further analysis. This process excluded the research which simply listed diverse risk events without any effort for categorisation. Thirdly, 36 studies which met the previous criteria were scrutinised to find out the similarities in the categorisation. In this process, it was found that some research has used more than one type of categorisation. Lastly, similar groups of categorisation were labelled to best explain such taxonomies. As a result, four major types in classifying risk events occurring in supply chain operations have emerged, whose details are as follows.

2.3.1. General risk areas

The first is to list all the possible risk areas with risks from general management activities and supply chain-specific activities combined. For example, supply/procurement risk is inherent in supply chains, but legal risk and strategic risk is more related to ordinary business activities. The individual risk events are grouped under these risk areas. Table 2-1 demonstrates the risk types that are discussed by SCRM researchers who used this typology. The references here are not exhaustive because other SCRM research also explicitly and implicitly developed its discussion on supply chain risks based on this basic typology. In addition, the risks in this table are neither exhaustive nor weighted because this typology does not fully concern itself with the systematic classification. However, the risk categories often referred by SCRM researchers can be derived from this table.

Supply chain researchers tend to focus on supply chain issues despite a lengthy list of risk types when the most frequently-mentioned-risks, marked with shading in Table 2-1, are concerned. It is because supply/procurement, operations/production and logistics/delivery risks are critical activities of supply chain management. Legal, regulation/policy risks are external to supply chains, but have a great impact on supply chain operations by shaping and regulating them. Finance/money risk is related to business objectives and supply chains cannot escape from this risk factor. In the next group, such categories as strategic risk, organisational risk, receivable risks, accounting risk, health and safety risk and reputation risk are rather associated with general management than specific to supply chain management, but still have direct and/or indirect impacts on supply chain risks, which will be the reason why there have been included in SCRM studies. This typology is useful as it can embrace as many risk events as possible with various dimensions of risk in business covered. But it still lacks a comprehensive understanding on how the risks in supply chains are formed.

Table 2-1: Risk categorisation by general risk areas

	Chopra & Sodhi (2004)	Zsidisin *et al.* (2004)	Waters (2007)	Blackhurst *et al.* (2008)	Lin & Zhou (2011)	Olson & Wu (2011)	Tummala & Schoenherr (2011)	Lavastre *et al.* (2012)
Supply / Procurement Risk	O		O	O	O	O		O
Operations / Production Risk		O	O		O		O	O
Planning / Forecast Risk	O		O	O	O			
Logistics / Delivery Risk			O	O	O		O	
Capacity / Availability Risk	O	O		O			O	
Regulation / Policy Risk			O		O	O		O
Legal Risk		O		O		O		O
Financial / Cost Risk		O	O			O		O
(Information) Systems Risk	O			O			O	
Inventory Risk	O			O			O	
Disruption Risk	O			O			O	
Strategic Risk			O					O
Organisation Risk			O		O			
Information Risk			O		O			
Receivables Risk	O			O				
Accounting (Fiscal) Risk						O		O
Quality Risk		O		O				
Health & Safety Risk		O	O					
Asset Impairment Risk						O		O
Reputation Risk						O		O
Supplier Risk		O				O		
Customer Risk						O		O
Competitive Risk						O		O
Political Risk			O				O	
Environment Risk		O	O					
Product Risk			O			O		
Delay Risk	O						O	
Intellectual Property Risk	O			O				

Note: (1) Reference sources are not exhaustive but can be seen as examples
(2) The risks are neither exhaustive nor weighted, therefore their relative importance cannot be judged

(Source: Author)

2.3.2. Organisational boundary

The second type of risk classification is based on organisational boundary. In most cases, it uses terms like "internal/external risks." From an organisation's perspective, risks are either internal or external to the organisation. While risks interconnected with the organisation's own activities are regarded as internal risks, all the rest should be labelled as external risks. This categorisation is closely related to controllability of risk events: internal risks are more accessible to be controlled with risk mitigation measures set by the organisation while it may be difficult or sometimes impossible to control external risks. In that sense, this categorisation also relates to responsibility of mitigating risk events. Other researchers, however, consider the risks internal or external to the supply chain rather than to an individual organisation (Thun and Hoenig 2011). In this case, only the environment risks can be left within the external risk category.

Although providing a clear understanding on the risks with the distinction of internal and external issues, this classification may not capture the distinctive features of risks from supply chain partners. Researchers show discrepancies in dealing with risks from supply chains because supply chain risks are 'external to the focal organisation' but 'internal to uncontrollable external environments' surrounding supply chains. For instance, Cucciella and Gastaldi (2006), Blackhurst *et al.* (2008), Natarajarathinam *et al.* (2009), Trkman and McCormack (2009) and Olson and Wu (2010) view that there are internal and external scopes in the organisational boundary, hence consider internal risks and external risks only. On the other hand, such studies as Jüttner *et al.* (2003), Zsidisin (2003) and Schoenherr *et al.* (2008) assume risks in a separate boundary which does not belong to either internal or external scope.

SCRM researchers have established classifications commonly based on organisational boundary, which consist of internal risks, supply chain risks and external risks, but there are also slight discrepancies as demonstrated in Table 2-2. The risks are, in general, broadly labelled just as the organisational boundary, but more details can be added to these categories. For example, supply chain risks can be divided into supply chain partner risks, network-related risks and extended supply chain risks. Likewise, external risks can consist of environmental risks and industry (market) risks. This typology has strength in being parsimonious, thus can be applicable to any supply chain function. In international logistics circumstances from shippers' perspectives, for instance, the companies will easily consider any risks arising within their organisations (internal), within logistics activities beyond their control (supply chain) and external to their logistics operations (external).

Table 2-2: Risk categorisation by organisational boundary

	A	B	C	D	E	F	G	H	I	J	K
Internal			O	O	O		O		O		O
Organisation	O							O			
Problem-specific								O			
Decision-maker								O			
Product		O				O					
Supply Chain	O			O							
SC Partners		O				O				O	
Network-related	O										
Extended SC										O	
External			O	O	O		O		O		O
Environment	O					O		O			
Industry (Market)		O						O		O	

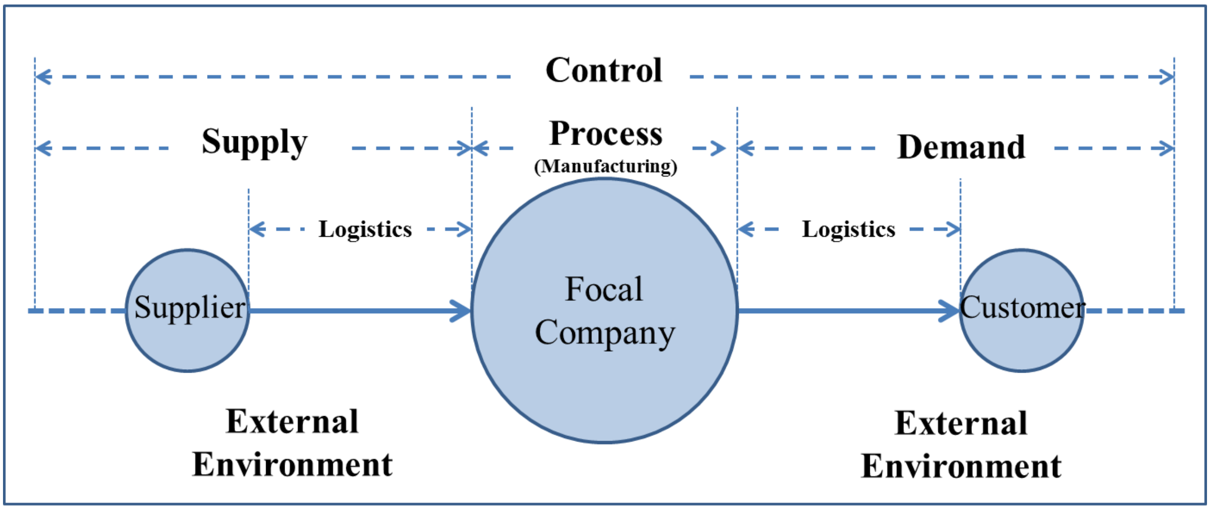
A: Jüttner *et al.* (2003); B: Zsidisin (2003); C: Cucciella & Gastaldi (2006); D: Waters (2007); E: Blackhurst *et al.* (2008); F: Schoenherr *et al.* (2008); G: Natarajarathinam *et al.* (2009); H: Rao & Goldsby (2009); I: Trkman & McCormack (2009); J: Zsidisin & Wagner (2010); K: Olson & Wu (2010)

(Source: Author)

2.3.3. Risk sources

The third categorisation is in accordance with supply chain processes and functions, which is the most common classification to SCRM researchers. These processes and functions are where risks may arise, so they are called risk sources. Risk sources have been expanded by SCRM researchers. The first author who explicitly discussed risk sources was probably Davis (1993) who pointed out that there are three distinct sources of uncertainty, namely suppliers, manufacturers and customers. Later, using product delivery process, Mason-Jones and Towill (1999) argued that causes of uncertainty are to be found in the supply side, manufacturing process, demand side and, most notably, control systems which overarch the other three processes. As disruption risks, natural disasters and security risk emerged after global warming and 9/11, Christopher and Peck (2004) added environment risk to these four risk sources. Some researchers even tried to separate logistics activities from supply and demand as an independent risk source (Hauser 2003; Serangi and Srivatsan 2009), which would eventually create six risk sources as shown in Figure 2-2. It assumes three main parties in the supply chain, namely supplier, focal company and customer, and then demonstrates the location where these six risks will arise. Except for the ‘control’ overarching all the SCM activities, each source is seen to take its distinctive activity area and generate idiosyncratic risks.

Figure 2-2: Risk sources drawn on a supply chain process map



(Source: Author)

The six risk sources were not always agreed upon among researchers; as demonstrated in Table 2-3, logistics was the least common risk source while (manufacturing) process and control were often neglected or treated as one risk source. Researchers like Wagner and Bode (2008) even insisted that these two risk sources, process and control, should be considered as risk drivers which increase the possibility of risk occurrence rather than standing as risk sources *per se*. On the contrary, supply and demand risks were unanimously discussed by most studies.

Table 2-3: Risk categorisation by risk sources

<table>
<tr><th></th><th>Mason-Jones & Towill (1998)</th><th>van der Vorst & Beulens (2002)</th><th>Hauser (2003)</th><th>Jüttner (2005)</th><th>Gaudenzi & Borghesi (2006)</th><th>Tang (2006a)</th><th>Wagner & Bode (2006)</th></tr>
<tr><td>Supply</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td></tr>
<tr><td>Demand</td><td>O</td><td>O</td><td>O</td><td>O</td><td></td><td>O</td><td>O</td></tr>
<tr><td>Process</td><td>O</td><td>O</td><td>O</td><td></td><td>O</td><td>O</td><td></td></tr>
<tr><td>Control</td><td>O</td><td>O</td><td></td><td></td><td></td><td>O</td><td></td></tr>
<tr><td>Environment</td><td></td><td></td><td></td><td>O</td><td></td><td>O</td><td>O</td></tr>
<tr><td>Logistics</td><td></td><td></td><td>O</td><td></td><td>O</td><td></td><td></td></tr>
<tr><td></td><td>Sodhi & Lee (2007)</td><td>Manuj & Mentzer (2008a)</td><td>Manuj & Mentzer (2008b)</td><td>Wagner & Bode (2008)</td><td>Oke & Gopalakri-shnan (2009)</td><td>Serangi & Srivatsan (2009)</td><td>Christopher et al. (2011)</td></tr>
<tr><td>Supply</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td></tr>
<tr><td>Demand</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td></tr>
<tr><td>Process</td><td></td><td rowspan="2">O</td><td rowspan="2">O</td><td></td><td></td><td>O</td><td rowspan="2">O</td></tr>
<tr><td>Control</td><td></td><td></td><td></td><td>O</td></tr>
<tr><td>Environment</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td><td>O</td></tr>
<tr><td>Logistics</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

(Source: Author)

2.3.4. Loss types

The fourth classification uses types of losses from supply chain risks. Supply chain management is generally defined as "the management of material, information and financial flows through a network of organisations that aims to produce and deliver products or services for the consumers" (Tang 2006a, p. 453). From this perspective, disruptions to material, information and finance flows will create risks, thereby damaging the values which can be created by supply chain management. Concentrating on important values in SCM, some researchers arranged risks according to several types of losses in consideration of these 'flows' or 'values' as shown in Table 2-4. The most common losses, proposed by SCRM researchers, were material, financial, information and time losses. Relationship among SC partners, corporate social responsibility (CSR), performance, organisation, information system security etc. were also raised but not very significant across studies. Though not explicitly discussed in extant research, reputation loss also emerges as one of the important types of losses in supply chains. Supply chain glitches, such as a horse meat scandal and massive recall of vehicles, damage the reputation of the entire supply chains, thereby leading to losses of profits and future business at the corporate and supply chain level.

Table 2-4: Risk categorisation by loss types

	van der Vorst & Beulens (2002)	Cavinato (2004)	Spekman & Davis (2004)	Gaudenzi & Borghesi (2006)	Waters (2007)	Tang & Musa (2011)	Lavastre *et al.* (2012)
Material		O	O	O	O	O	O
Financial		O	O		O	O	O
Information		O	O		O	O	
Time	O			O			O
Relationship		O	O				
Organisation					O		
Quantity	O						
Quality	O						
Order Completeness				O			
Order Correctness				O			
Performance							O
Psychological Damage							O
Social Damage							O
Information Security			O				
CSR			O				
Innovation		O					

(Source: Author)

2.4. Risk Analysis

The major role of risk analysis is to measure and assess the level of individual risks to justify the mitigation of certain risks with priorities. Implementing risk mitigating responses involve a considerable amount of finance/human investment. Only when the benefit from risk mitigation is larger than the cost, can the implementation be justified. In this regard, risk assessment aims to prioritise the usage of resources to manage risks (Zsidisin *et al.* 2004).

Fundamentally, risk assessment is related to whether risk can be measured objectively (Khan and Burnes 2007), which also raises the question as to whether risk is objective. The researchers who argue the subjective nature of risk (Kahneman and Tversky 1979; Mitchell 1999) prefer using the term risk perception to emphasise the subjective sense-making of risks

(Slovic 2000; Zsidisin 2003). In this case, risk is evaluated by individual perception even if it is numerically represented. On the contrary, some researchers stick to hard numbers measured by the heuristic probability and the amount of loss from a risk event. Apart from the objective/subjective nature, the nature of risk assessment can also be "formal to informal" or "quantitative to qualitative" (Zsidisin *et al.* 2004, p. 398).

At the methodological level, several methods were found to evaluate the level of risks. In any case, risk identification must precede risk analysis at least to provide the catalogue to be evaluated, but the unit of evaluation can be either individual risk events or risk categories. The majority of SCRM research (Yates and Stone 1992; Harland *et al.* 2003; Hallikas *et al.* 2004; Zsidisin *et al.* 2004; Blackhurst *et al.* 2008; Khan *et al.* 2008; Tummala and Schoenherr 2011) adopted the risk diagram consisting of probability (or likelihood/frequency) on one axis and impact (or consequence/magnitude) on the other, as illustrated in Figure 2-3. The scaling differs between researchers, but normally 3 to 5 point scales are used to evaluate the probability and impact. Figure 2-4, for example, uses a 5-point scale that evaluates the probability with very high probability to none and the impact with catastrophic to none. Contrary to the subjective evaluation in Figure 2-3, an objective measurement can be used by assessing the exact probability of the event occurrence and the risk magnitude converted to the monetary term. In any case, the level of risk is computed by the multiplication of the probability and the impact.

Figure 2-3: Risk evaluation using probability and impact

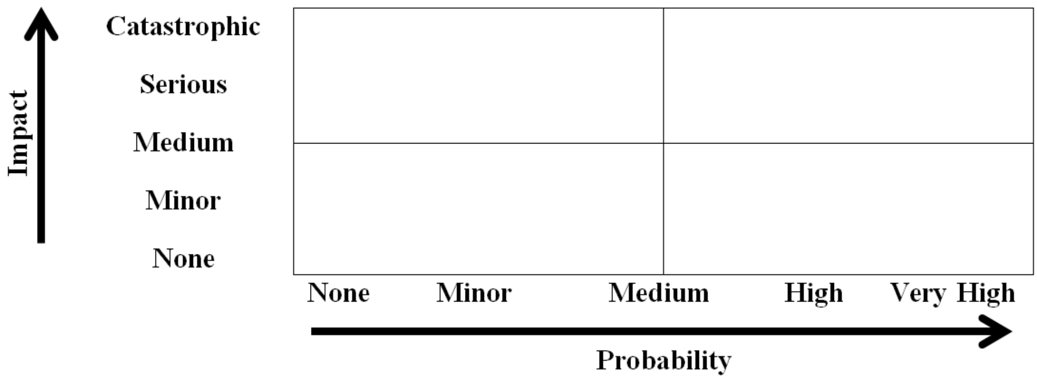
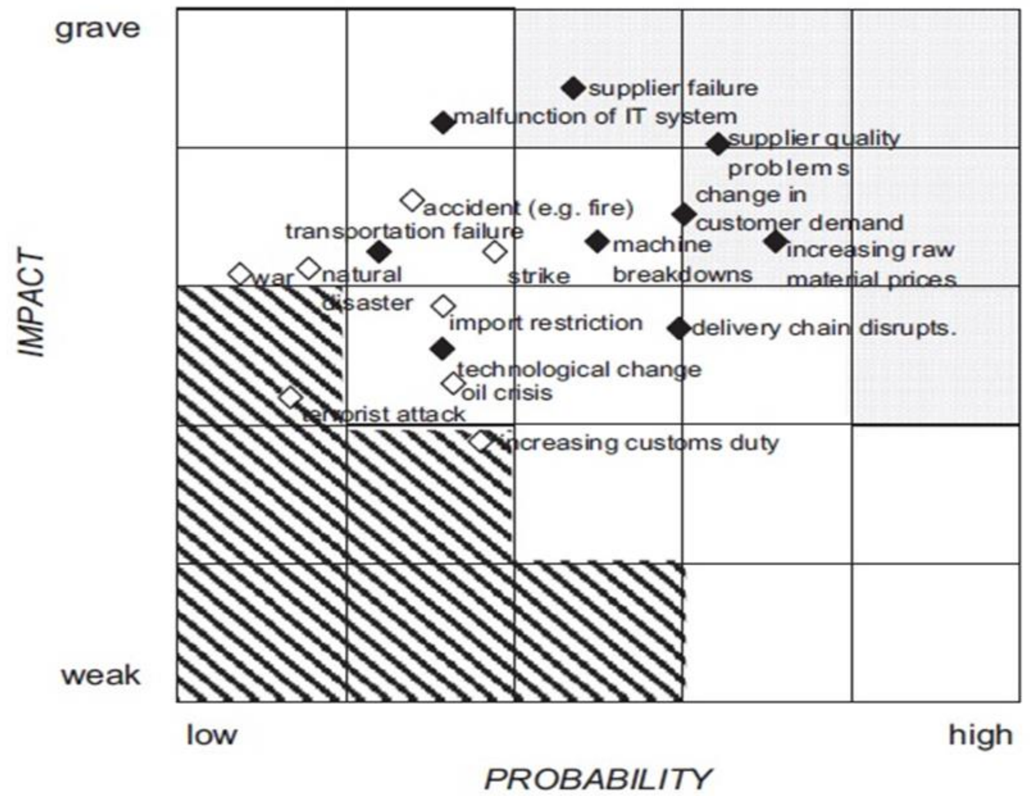


Figure 2-4: An example of risk assessment



(Source: Thun and Hoenig 2011)

More dimensions to evaluate the risk can be added to the probability/impact dimensions. For instance, Steele and Court (1996) suggested estimating the problem duration based on past experience together with probability and impact. As well as the duration, the speed of the risks is also considered by some researchers (Manuj and Mentzer 2008b; Braunscheidel and Suresh 2009). Vilko and Hallikas (2012) focus on the facets that constitute the impact of risk: therefore delay, disruption, costs and damage of a risk were evaluated separately along with the likelihood of the risk.

Analytic Hierarchy Process (AHP) is another method that has been frequently used by SCRM researchers. It is a useful technique to build up a priority hierarchy depending on the importance of the objectives (Gaudenzi and Borghesi 2006). AHP is a multi-criteria decision making (MCDM) technique when there is a complex problem involving several decision criteria as well as alternatives (Saaty 1990). It compels decision makers to systematically evaluate the relative importance of each criterion by comparing with another criterion (Levary 2007).

By comparing the weights, the relative importance of each objective can be understood to provide a strategic priority. Tsai *et al.* (2008) applied AHP to create a ranking for risk factors relating to asset risk, relationship risk and competence risk. In addition, by comparing the weights for risk factors, they conclude that there are differences in risk perception between the firms outsourcing transportation only and the firms outsourcing multiple logistics functions. Wu *et al.* (2006) also used AHP to determine the relative weights of risk factors relating to suppliers. Kull and Talluri (2008) generated risk factors of delivery failure, cost failure, quality failure, flexibility failure and confidence failure, and then found out how much one failure impacts business performance relative to other failures. The most comprehensive application of AHP was conducted by Schoenherr *et al.* (2008), which developed the hierarchy consisting of the goal (supply chain risk), main objectives (product, partner and environment), sub objectives (quality, cost, service and management capabilities) and 17 risk factors.

In practice, however, companies apply risk measurement tools and techniques that are suitable for their risk analysis. For instance, the comprehensive outsource risk evaluation (CORE) system was developed by Microsoft and Arthur Anderson to evaluate 19 risk factors arising from infrastructure, business controls, business value and relationships with weighted values to capture the comprehensive risk level (Zsidisin *et al.* 2004). This method analyses risks by both objective measures (i.e., financial data) and subject measures (i.e., the strength of inter-firm relationships). The "House of Risk" proposed by Pujawan and Geraldin (2009) can be also used by companies which strive to thoroughly evaluate the level of risks in their supply chain. This is developed by considering risk events with their severity as well as risk agents with their occurrence. By multiplying these two elements, the aggregate risk potential of each risk agent can be calculated. Nonetheless, these analyses are quite similar to the basic probability * consequence formulae except some variations in their applications.

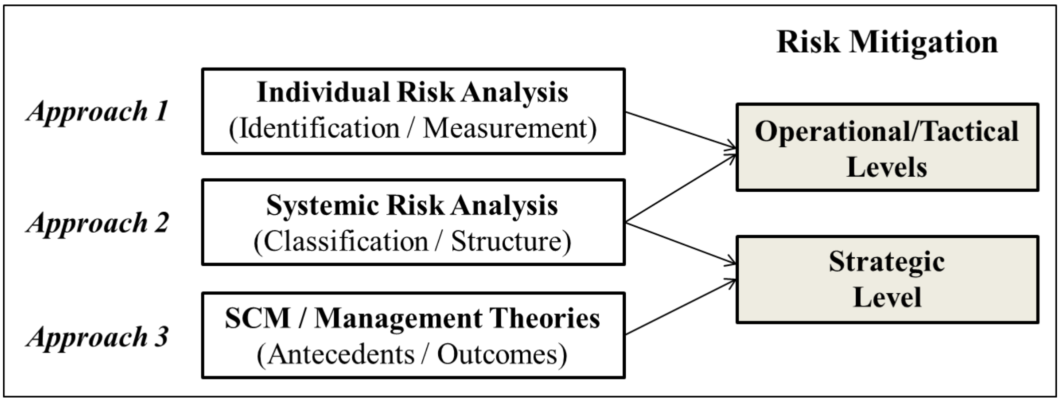
2.5. Risk Mitigation

Supply chains implement various countermeasures to supply chain risks. According to the risk spiral proposed by Christopher and Lee (2004), risks create a self-enhancing loop, generated by lack of visibility and lack of confidence. Childerhouse and Towill (2004) also identified the several feedback loops that can aggravate uncertainties in delivery performance and induce catastrophe in the supply chain. The complex control system in supply chains creates the nature of the feedback system, thereby leading to amplification effects from uncertainty in information, forecasting and inventories (Prater 2005). Firms, therefore, acknowledged the necessity to find measures to break this risk spiral and feedback loops in order to build up robust and resilient supply chains.

SCRM studies show several distinctive research approaches to investigating risk mitigating strategies. As supply chain risks can be divided into operational disturbances, tactical disruptions and strategic uncertainty (Paulsson 2004), the decisions on the measures can also be differentiated by the operational, tactical and strategic levels (Ritchie and Brindley 2007b). Among these studies, Mintzberg and Waters (1995) argued that strategic decisions are aggregate of a series of operational and tactical decisions which lead to planned or emergent pattern. Risk mitigating strategies are delineated as "those strategic moves organisations deliberately undertake to mitigate the uncertainties identified from the various risk sources (Jüttner *et al.* 2003, p. 200)."

Figure 2-5 illustrates the three approaches to risk mitigation. The first approach is completely limited to operational and tactical measures that are effective to mitigating individual risks (see Chopra and Sodhi, 2004; Pujawan and Geraldin, 2009). This focuses on identification and measurement of individual risks, thereby generating direct countermeasures rather than overarching corporate strategies. Although the second approach starts from an analysis of risks similar to the first approach, its holistic risk analysis to find out the risk sources, loss types and root causes may lead the risk mitigation to the strategic level (see Ellegaard, 2008) as well as the operational/tactical levels. Compared to the previous approaches, the third approach focuses solely on the strategic measures by applying theories and research frameworks in the SCM or other management disciplines (see Bode *et al.* 2011; Christopher *et al.* 2011). Among these three research approaches to exploring supply chain risk mitigation, the first approach still prevails in SCRM research, which often provides a lengthy list of tactics that a firm cannot implement at the same time. On the contrary, the strategic level of SCRM measures has drawn less attention from researchers.

Figure 2-5: Three research approaches to risk mitigating measures



(Source: Author)

The adoption of particular strategies may curb the causes or impact of risks even when the firm is not able to manage the sources of risk exposures. In international logistics, the risk sources, such as the external environment and logistics partners, are often uncontrollable due to lots of constraints. Nonetheless, implementation of some strategies can enable firms to reduce the occurrence of risk events and the eventual impact from the events (Ritchie and Brindley 2007b). To this end, Chopra and Sodhi (2004) recommended two things before building a SCRM strategy, which are (1) creating an organisation-wide understanding of supply chain risks and (2) determining general mitigation approaches that are adapted to the circumstances specific to a firm.

Jüttner *et al.* (2003) derived four risk mitigating strategies, valid to supply chain contexts, from Miller (1992). The first is avoidance which involves withdrawing from specific products, geographical areas, suppliers and/or customers. The occurrence of risks can be reduced or, even, eliminated by this strategy. The second is control which restrains disruptions in an active manner. Control strategy in this research encompasses both vertical integration of organisations (including exercising influences on suppliers) and redundancy of inventory or capacity. The third is co-operation, more inclined to joint efforts than to unilateral control. This strategy will improve supply chain visibility and facilitate information sharing, but can be restricted by a partner's initiatives. The last is flexibility which increases responsiveness once disruptions occur. Postponement, local sourcing and multiple sourcing can be the instances. As Sheffi (2001) asserted, trade-offs exist, when implementing risk mitigating strategies, in repeatability vs unpredictability, the lowest bidder vs known supplier, centralisation vs dispersion, collaboration vs. secrecy and redundancy vs efficiency.

When a firm faces risks, its initial response can be, in essence, either 'do nothing' or 'do something.' A firm can choose to 'do nothing' by ignoring or accepting the risk (Waters 2007). It is better to sit back and do nothing if the probability and the impact of the risk are proved to be small because the efforts to be put in to identifying, analysing and mitigating the risk will be costly. Risk acceptance, risk retention and risk internalisation are typical examples of the 'do nothing' response. If a firm decides to 'do something' to mitigate the risk, there can be several strategies. Waters (2007) proposed that firms can (1) reduce the probability of the risk, (2) reduce or limit the consequences, (3) transfer, share or deflect the risk, (4) make contingency plans, (5) adapt to it and (6) oppose a change and/or (7) move to another environment. These strategic dimensions to do something against risks, however, have been understood with a great variability by SCRM researchers.

Indeed, SCRM strategies that respond to disruptive events have been explored from diverse theoretical approaches (Bode *et al.* 2011). For instance, Hallikas *et al.* (2004) proposed strategic responses similar to Waters (2007), including risk transfer, risk taking, risk elimination, risk reduction and further analysis of individual risks. In a similar vein, Manuj and Mentzer (2008a; 2008b) categorised risk management strategies into avoidance, postponement, speculation, hedging, control, transferring and security. Christopher and Peck (2004) suggested a different perspective, arguing that the resilient supply chain can be achieved by strategies stimulating supply chain re-engineering, agility, collaboration and culture Blackhurst *et al.* (2011) rather assumed that risk management strategies enhance supply chain resilience capability from the resource-based view, and divided the resilience enablers into investment in (1) human capital resources, (2) organisational and inter-organisational capital resources and (3) physical capital resources as the resilience enhancers.

Lee (2002), on the contrary, aligned supply chain strategies to respond to the uncertainties from product characteristics.

Despite the diversity of strategic dimensions used in SCRM research, some strategic frameworks are commonly used. However, it must be noted that even the researchers who use the same terminologies often interpret the concepts in a different manner. It is mainly attributed that the majority of research was based on case studies where contingencies and business contexts played a great role to determine their framework of strategic dimensions.

Basically, researchers tend to acknowledge that strategies to create buffer or slack resources should be contrasted to the ‘modern’ risk management strategies. Zsidisin *et al.* (2000) argued that risk management activities within a supply chain can be segregated into buffer and process improvement strategies. Similarly, Giunipero and Eltantawy (2004) asserted that buffer is a risk management measure that can be distinguished from other risk management strategies, but is a traditional approach that limits performance, reduces competitive advantage and incurs extra costs. Buffer strategies, such as inventories (safety stock and a well-stocked supply pipeline) and alternative sources for instance, exist to take actions against unforeseen events even if firms can reduce a certain degree of risk occurrence by implementing other risk management strategies (Zsidisin *et al.* 2000). On the other hand, process improvement strategies are implemented to decrease the likelihood of risk events with using increased information flows and joint efforts among the entities (Zsidisin *et al.* 2000). For instance, strategic alliances (Smeltzer and Siferd 1998), supplier development (Krause 1999) and effective communication can fall into the process improvement strategies. The process improvement strategies found in their empirical case study were: (1) forming alliance relationships; (2) having the supplier responsible for developing mitigation plans; (3) maintaining common platforms; (4) direct access to "brainware" of suppliers; and (5) establishing industry standards (Zsidisin *et al.* 2000).

The distinction between proactive and reactive strategies is also common in SCRM research. They appear to be clearly distinguished, but the actual distinctions are not very clear-cut. Proactive strategies often refer to preventive strategies (Sheffi 2001), but they can also foster mitigation after a disruption. Creating a contingency plan, for example, is a proactive measure but not a preventive measure because it is effective after a disruption occurs. To this end, proactive measures are sometimes considered to be cause-related measures to lower the risk probability, whereas reactive measures are deemed to be effect-oriented measures to mitigate the negative impact. “Note that both, preventive as well as reactive instruments are induced before an incident occurs, but only preventive instruments show also their impact beforehand, whereas reactive instruments can only show an impact afterwards when an incident already occurred although they are induced ex ante” (Thun and Hoenig 2011, p. 245).

Risk management strategies often encompass singlehanded strategies within a firm and cooperative strategies between firms. Lavastre *et al.* (2012) argued that risk management is associated with attitude toward risks in supply chains. On the contrary that risk attitude, in general, refers to the risk-averse, risk-neutral and risk-loving attitude of decision-makers as individuals, this study concerns the initial behaviour of organisations once they expect or face risks in inter-organisational contexts. They may deal with the risks within the organisation by singlehandedly elaborating to eliminate/reduce risks, buying insurance or even ignoring those risks. Otherwise they can manage the risks in relation to other entities in the supply chain by collaboration, risk sharing and risk transferring. According to their survey, collaboration with partners was the most favoured attitude, followed by risk sharing with partners. Khan and Burnes (2007) distinguished the approaches to mitigating supply chain risks by two broad categories, which are relationship management and strategic/proactive purchasing. As relationship with supply chain partners is the biggest concern for some firms, they develop a high level of trust with key suppliers or try to understand the capacity restriction of suppliers in order to consider alternative suppliers (Blackhurst *et al.* 2011). It was reported that there was a progression in risk management strategies from the individual responses within a firm to the more co-operative responses (Kleindorfer and Saad 2005; Ritchie and Brindley 2007b). This is closely related to the increasing notion that an outcome for one firm can be transformed into a risk event for another firm in the supply chain (Manuj and Mentzer 2008b).

Risk mitigation strategies are often derived from risk identification and analysis. This research approach finds out the list of risks inherent to supply chains first, and then suggests mitigating strategies that can be matched to each risk. When risk clusters or risk sources are considered as the unit of analysis to be controlled, risk management is discussed at the strategic level (see Prater 2005). Tang (2006b) asserted, for example, that the basic approaches of risk management can be depicted as supply management, demand management, product management and information management, which match with the risk categorisation by risk sources. As easily expected from their titles, they intend coordinated or collaborative measures to upstream, downstream, product/process design and information within a supply chain where risks can emanate. If individual risk events are taken into account, on the contrary, the discussion is discoursed at the lower level. As this approach addresses individual risks, it often lacks strategic concerns while rather focusing on tactics to rectify specific risk phenomenon. Ellegaard (2008), on the other hand, began his conceptualisation of risk management initiatives with the components to evaluate risks: (1) the probability of a loss-making event; (2) the significance of the event; and (3) the knowledge of loss-making-events. To this end, risk mitigating strategies aim either (1) to reduce the risk probability, (2) to reduce the risk significance or (3) to increase the risk knowledge.

The review of SCRM research on risk mitigation presented here reveals that the strategic dimensions of countermeasures to supply chain risks have been conceptualised with a great variability by researchers but still share some similar aspects. To summarise the findings, there exist distinctions between:

(1) strategic dimensions and tactical/operational dimensions;

(2) buffer strategies and risk management strategies;

(3) proactive strategies and reactive strategies; and

(4) intra-firm strategies and inter-firm strategies.

The risk management strategies as well as practices to fulfil the strategies will be further discussed later in Chapter 5 supported by the empirical findings from interviews.

2.6. Contexts of SCRM

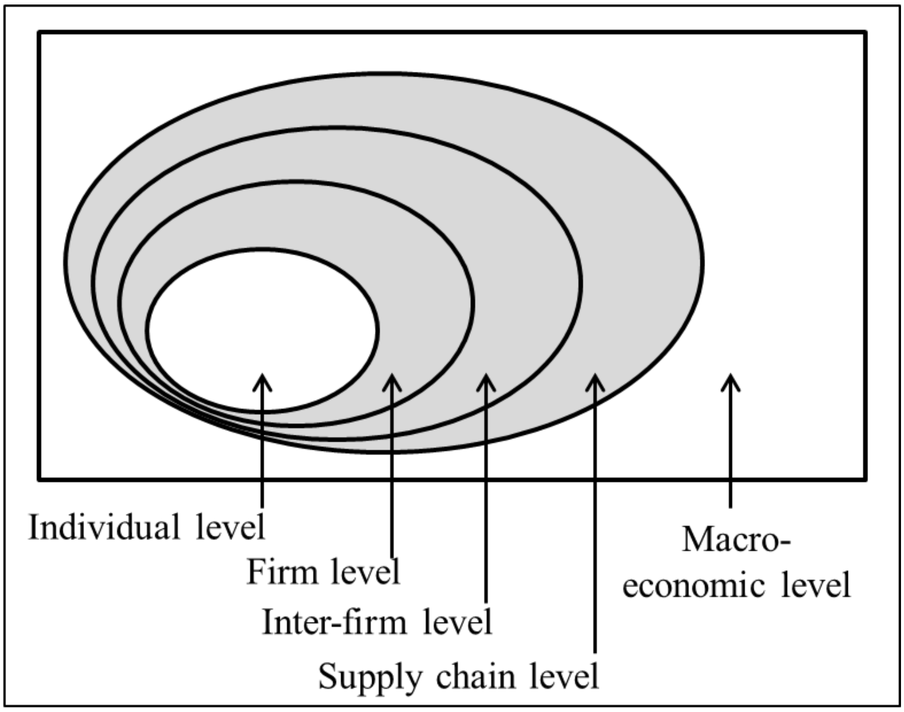
2.6.1. Risk drivers

The review of SCRM research found that there are five levels in the drivers that influence supply chain risks: they are individual level, firm level, inter-firm level, supply chain level and macro-economic level, as illustrated in Figure 2-6. Basically, the antecedents of risk perception within supply chain decisions can be attributed to two factors, the strategy maker’s psychological characteristics and the situational characteristics (Das and Teng 2001). Whereas the former is related to the individual perception of risk, the latter addresses risk drivers beyond personal characteristics. Job function, buyer’s personality, experience, knowledge and risk attitude, suggested by Mitchell (1995), can fall into the risk drivers at the individual level. The situational characteristics can be roughly divided into factors internal and external to the supply chain. The risk drivers external to supply chains are related to macro-economic situations. Monopoly/oligopoly situations, entry barriers and technological advancement (Kraljic 1983) will constitute the risk drivers at the macro-economic level. In fact, risk drivers at individual and macro-economic levels were found to have rarely drawn attentions from SCRM researchers.

2.6.1.1. Firm level risk drivers

Risk drivers at the firm level are associated with business features as well as product features. As for business features, company size and an organisation’s performance can determine the level of risks (Mitchell 1995). Compared to large counterparts, small companies have lower occurrence of psychosocial risk due to the shared nature of decisions while having higher occurrence of performance risk due to limited capability to tolerate undesirable results from the decision (Newall 1977). From the observation that risk taking takes place when the profit is falling (Shapira 1986), it can be found out that good performance leads to a conservative attitude to risk. The product features, on the other hands, are represented by customisation and technology (Ellis *et al.* 2011). If the customisation level is increasing, the coordination between supplier and buyer becomes more complex, which easily leads to opportunistic behaviour and bounded information (Hedge *et al.* 2005). The rate of technological changes also augments the risk level by making the standard price and quality assessment more ambiguous (Ellis *et al.* 2011).

Figure 2-6: Five levels of risk drivers



(Source: Author)

2.6.1.2. Inter-firm level risk drivers

Risk drivers at the inter-firm level delineate the factors attributed to the business relationships within a supply chain. Mitchell (1995, p. 121) labelled it as customer/supplier interaction stating that "the degree of communication or state of the relationship between a buyer and supplier will influence the amount of perceived risk." The deficiency of important elements in a supply chain relationship, such as trust and communication, can endanger supply chains (Svensson 2002; Trkman and McCormack 2009). Often asymmetry in power and excessive dependence can be the source of risk drivers at this level (Ojala and Hallikas 2006). Node criticality is generated when some nodes within a supply chain are more important than others, which is positively related to the severity of supply chain disruptions (Craighead *et al.* 2007; Ellis *et al.* 2011). Similarly, reduction of the supplier base (Jüttner *et al.* 2003; Jüttner 2005; Thun and Hoenig 2011) and single sourcing (Wagner and Bode 2008) engender dependence that augments the risk level.

2.6.1.3. Supply chain level risk drivers

Rao and Young (1994) have illustrated the characteristics of the global supply chain with three kinds of complexity, which are network complexity, process complexity and product complexity. Among these three elements, network complexity and process complexity can play the role of risk drivers at the supply chain level by affecting flow activities (Blackhurst *et al.* 2011). Network complexity indicates the geographic dispersion of supply chain partners and intensiveness of transactions with some partners, which encompass (1) number of supplying and distribution trading partners, (2) number of countries involved in the supply chain, (3) number of continents (or regions) involved in the supply chain and (4) stock-keeping unit (SKU) and origin-destination (OD) pair permutations (Rao and Young 1994; Hofer and Knemeyer 2009). This aspect is often described as the complexity stemming from globalisation (Jüttner 2005; Craighead *et al.* 2007; Thun and Hoenig 2011). Process complexity is related to the time and task compression in the supply chain from complicated processes which include (1) time sensitivity of transactions within the supply chain, (2) manufacturing cycle times for components and products and (3) order cycle times for customer orders (Rao and Young 1994; Hofer and Knemeyer 2009). Focus on efficiency (Jüttner *et al.* 2003; Thun and Hoenig 2011), reduction of inventory holding (Jüttner 2005) and time dependence (Svensson 2002) aggravates the process complexity within supply chains.

2.6.2. Risk mitigating contexts

Risk mitigating contexts refers to enhancers and reducers of risk mitigating strategies. The empirical model of Blackhurst *et al.* (2011) assumed that the level of firm's global supply resilience can be affected by several ‘resilience enhancers’ and several ‘resilience reducers’.

From this perspective, a firm is required to foster the resilience enhancers and to constrain the negative impact from resilience reducers. The first resilience reducer is the group of factors related to flow activities (Svensson 2003), including the number of nodes and transfer points, congestion of ports, vessel capacity restrictions and presence of regulation or security issues. The logistics networks become longer and more complex when the number of nodes increases and vice versa. The existence of congestion and restrictions in the logistics flows increases the amount of time for the material to flow or even halts the flow entirely. The second resilience reducer is the factors related to the product which constitutes the flow unit. Some products may require special storage, handling or quality standard, which aggravates the difficulties in the material flows. Product complexity arising from difficulties in producing and sourcing makes a firm vulnerable to any changes. In addition, special requirements for handling reduce the resilience of the logistics operations. The third reducer is source of flow units which indicates the vulnerability of supplier's location, facility and capacity to deal with disruptions.

It is generally agreed that the logistics complexity has a negative impact on the overall risk management outcome as discussed by Blackhurst *et al.* (2011) arising the term of ‘resilience reducers’. "Firms may be able to moderate the impact of resiliency reducers. However, resiliency reducers may fall outside a firm's control (such as customs regulation) and therefore it could be more effective for firms to focus on developing resiliency enhancers….. There may be moderating effects both within and between each enhancer or reducer” (p.385). These statements presume the interaction effects within either enhancers or reducers. It should not be overlooked, however, that firms have motives to stabilise the logistics operations when more disruptions are expected due to complexity within the logistics networks. In other words, complexity can stimulate firms to implement risk management strategies to an extent that the complexity can be controlled.

As firms pursue stability in the internal and external operations, they have motives to implement some responses once disruptions occur. Bode *et al.* (2011) referred to this motive as a 'stability motive' that is expressed as two generic responses, which are buffering and bridging. They asserted that both external resources (i.e., control, power and vulnerability) and internal processes (i.e., information and smoothing functioning) are the factors that bring about the stability motive. Bode *et al.* (2011), therefore, asserted that motivations to act, such as dependence, supply chain disruption impact and supply chain disruption orientation, trigger organisational responses to supply chain disruptions. In addition, trust and prior experience play the role of mediator to determine the relationship between these motivations and organisational responses.

The extent to which firms invest in risk management largely depends on situational factors, such as buyer's perceived experience, degree of product technology, security needs and relative importance of suppliers, in order to optimise their performance and minimise their risk simultaneously (Giunipero and Eltantawy 2004). As antecedents of risk management strategy selection, on the contrary, Manuj and Mentzer (2008b) exemplified a firm's temporal focus, supply chain flexibility and the supply chain environment represented by risk levels in supply and demand markets.

Braunscheidel and Suresh (2009) took a slightly different stance on the risk mitigating contexts by proposing and testing hypotheses where organisational orientations and organisational practices can have a positive influence on a firm's agility. In their research model, market orientation and learning orientation were tested as to whether they affect internal integration, external integration and external flexibility which will eventually have an impact on a firm's agility. Although the impact of learning orientation is limited only to internal integration, market orientation has a significant impact on the three organisational practices, thus indirectly influences a firm's agility level.

2.7. Outcomes of Risk Management

A series of studies led by Hendricks and Singhal has illustrated how supply chain disruptions affect the corporate performance measured by stock market price. By using statistical analyses and mathematical modelling of secondary data, they concluded that announcement of supply chain glitches can damage 10.2% of shareholder value (Hendricks and Singhal 2003) by decreasing the stock returns by 40% within two years (Hendricks and Singhal 2005). They also looked at the effects of several risk mitigating measures on the stock market's reaction to disruptions (Hendricks *et al.* 2009). The findings revealed that a high degree of slack resources and a high level of vertical integration led to a less negative stock market reaction, whereas geographical diversification amplified the negative stock market reaction. In their research, the stock market performance was considered to be the scales to measure the outcomes of supply chain risk management.

On the other hand, performance measurement for supply chains has also been used in SCRM studies. For instance, Manuj and Mentzer (2008b) have applied total and average unit cost, total and average unit profit, average inventory, total inbound lead time, delay to customers, stock-outs, fill rate, premium freight usage and cash-to-cash cycle time to evaluation of risk management results. In a similar vein, Chen *et al.* (2012) have utilised percentage of orders meeting design specifications, percentage of meeting quality requirements, percentage of on-time delivery, cost of purchased parts, average investment in purchased part inventory, lead time for special orders and time required in order to measure the performance in the SCRM contexts. Thun and Hoenig (2011) suggested the supply chain performance measures encompassing increasing on-time deliveries, failure reduction, reactivity improvement, decreasing stocks, less internal interruptions, cost reduction, increased flexibility, reduction bull-whip effect and external disruptions resilience, and found that both preventive and reactive risk management can create differences in these performance measures compared to no implementation of risk management.

Despite the emphasis on monitoring and feedback in the SCRM process, however, work on the effect of risk management on supply chain performance is very scarce. Just a few hypotheses relating to the relationships between risk management strategies and their desired outcomes, have been validated by statistical analyses. The examples are as follows.

(1) Flexibility and Performance (Fawcett *et al.* 1996) – SEM

(2) Resiliency practice and Disruption occurrence (Zsidisin and Wagner 2010) - Regression

(3) Preventive/Reactive SCRM and performance (Thun and Hoenig 2011) – ANOVA

(4) Guanxi (relationship development) and performance improvement (Cheng *et al.* 2012) – SEM

(5) Risk mitigation and risk performance (Kern *et al.* 2012) – SEM

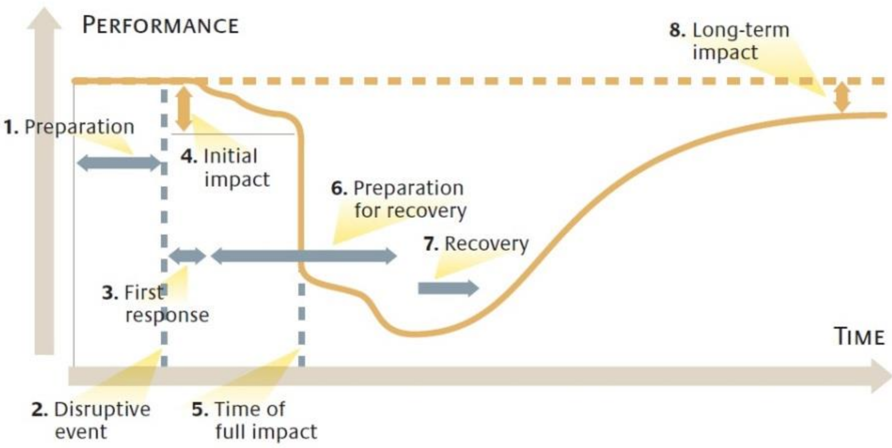
Rather, SCRM studies tend to concentrate more on the achievement of desirable supply chains that can adamantly endure or promptly react to supply chain risks. The representative features of the desired outcomes from supply chain risk management are robustness and resilience.

How firms can become robust and resilient against threats and disruptions has been a subset of SCRM research (Zsidisin and Wagner 2010). Robustness and resilience are often referred to as the capabilities to effectively deal with supply chain risks. A robust and resilient supply chain or logistics network is also the ultimate goal of supply chain risk management (Colicchia and Strozzi 2012) which enables a firm to be sustainable even in the face of severe disruptions. These two terms are often used interchangeably, but have distinctive connotations (Christopher and Peck 2004; Spiegler *et al.* 2012). According to the distinctions by Asbjørnslett (2008), robustness is the capability to resist and sustain while resilience is the capability to adapt and retain, in essence.

Resilience, on the other hand, is related to the elasticity of a material or a living creature to return to its original state after receiving external influence (Spiegler *et al.* 2012). In this regard, it is defined as "the ability of a system to return to its original state of move to a new, more desirable state after being disturbed (Christopher and Peck 2004, p. 2)", "the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function (Ponomarov and Holcomb 2009, p. 131)" or "the ability to return to normal performance levels following a supply chain disruption" (Zsidisin and Wagner 2010, p. 3). Researchers agree that resilience can be achieved by redundancy, flexibility, agility, responsiveness, visibility and collaboration (Christopher and Peck 2004; Sheffi and Rice 2005; Ponomarov and Holcomb 2009). Contrary to robustness, supply chain resilience aims to deal with unforeseeable events which can be characterised as low-probability but high-consequence (Pettit *et al.* 2010).

Figure 2-7 shows the stages of a disruption proposed by Sheffi and Rice (2005). It highlights several important features relating to disruptions. Firstly, it distinguished the initial impact of disruptions from their full impact. Even when facing the same disruptions, the level of impacts varies across companies. Some companies can easily recover from disruptions whereas others struggle to escape from the disruption having second and third waves of disruptive events. If a logistics network is preparing to minimise the occurrence and the impact of the risk events, the initial impact would be minimal. Since the risk events are all interconnected, however, one disruption can cause another serious disruption which creates the second impact. Moreover, the self-enhancing loop of risks can greatly worsen the situation by making it impossible to bounce back immediately.

Figure 2-7: A suggested model of disruption stages



(Source: Sheffi and Rice 2005)

Secondly, this model emphasised the time factor alongside with the risk impact. In general, risk is understood as the combination of the likelihood and the impact (Blackhurst *et al.* 2008; Thun and Hoenig 2011), thus, a risk is evaluated as the multiplication of risk likelihood and risk impact. However, some studies added extra dimensions to explain the magnitude of risks, such as duration and speed. The main reason is that the likelihood is meaningful when it is anticipated by a probability: when it comes to the disruptive events whose occurrence is uncertain and unpredicted, this kind of risk assessment cannot properly capture the magnitude of a risk. Instead of risk likelihood, Figure 2-10 suggests time or duration so that the risk magnitude can be represented by areas which are calculated by using the integral. For instance, the initial impact of the risk can be assessed by $\int f(t)dt$ of a particular triangular area.

These two features are closely associated with the distinctive characteristics of robustness and resilience. First of all, robustness plays a pivotal role in the initial stage of a disruption. A well-prepared logistics network with high risk awareness can minimise or even eliminate the risk occurrence. The variation from the normal performance level is also constrained because a robust supply chain can withstand and control disruptions at a tolerable level. Flexibility, anticipation with visibility, outsourcing quality control and collaborative risk preparation reduce the risk occurrence and risk impact. This in turn contributes to the robustness capability of a supply chain. In addition, robustness can buy time for a firm to find out and implement the most effective risk mitigating measure by controlling the speed of the performance deterioration.

On the other hand, resilience is critical to the second stage of a disruption because of its reactive nature to mitigate unexpected risk events. As adaptability is the key to resilience, even some researchers argue that “a resilient supply chain must be adaptable” (Ponomarov and Holcomb 2009, p.132). It enables firms to re-engineer the processes by adequately responding to the new environment (Christopher and Peck 2004). The speed of re-engineering is directly linked to the speed of recovery, thus responsiveness also constitutes an important part of resilience. As a consequence of the adaptability and responsiveness, the resilient supply chain can quickly recover from disruptions to the normal performance level or to a more desirable level. In addition, since resilience shrinks the time between the disruption and the full recovery, the magnitude of a disruption that is largely affected by the duration of the disruption, can be significantly reduced.

2.8. International Logistics Risk Management (ILRM)

Among the numerous studies on SCRM, there is little research on logistics-specific risks. This is because inbound and outbound logistics are embraced in the upstream and downstream supply chain respectively and thus it is not necessary to specify logistics risks. In this way, however, logistics risks were not illuminated properly while being treated as peripheral risks outside a focal organisation despite the growing importance of logistics in supply chain management. Especially, risks arising from inter-organisational relationships are increasing as logistics activities are generally outsourced to third party logistics service providers. According to the logistics triad proposed by Bask (2001), logistics activities are executed by flows of material, information and relationship among shipper, customer and carrier, which generate a lot of risky areas during logistics operations. When logistics intermediaries (lead logistics provider) or 4PL providers are also considered, these relationships become more complex by incorporating more entities and more transactions of those flows among entities. In this respect, some researchers concentrated only on logistics among supply chain management activities and identified various risks within logistics activities.

Sanchez-Rodrigues *et al.* (2008) created a “transport operation-focused vulnerability model” based on the logistics triad suggested by Bask (2001) and the uncertainty cycle model by Mason-Jones and Towill (1998). Their conceptual model has five key locations of logistics uncertainty: supplier, carrier, customer, control system and external uncertainty. They tried to organise a number of logistics risks found in the literature by using their model. Later, Sanchez-Rodrigues *et al.* (2011) conducted an empirical study to find out uncertainties and uncertainty clusters based on the previous model. Using the focus group method, they discovered uncertainties prevalent in logistics activities, and cause-effect diagrams provided them with clusters of those uncertainties: delays, coordination, demand/inventory issues and delivery constraints.

Svensson (2002) and Nilsson (2006) conducted empirical studies and found that there are several dimensions within logistics vulnerability and uncertainty factors. From the interviews with executives of a Swedish car manufacturer, Svensson (2002) derived service level (degree of reliability), deviation (degree of non-reliability), consequence (degree of negative impact) and trend (direction of changes) as the four dimensions of vulnerability; and these are supported by an exploratory factor analysis of risk events. Nilsson (2006) also conducted interviews with logistics practitioners in various industries to investigate their perceived uncertainties and challenges they were facing in logistics operations. From the interviews with practitioners, he argued that logistics uncertainties consist of customer demand and expectation (service level), internal process (integration of sales/marketing and logistics), human factors (experience, mistakes and power) and general trends (development of technology, ideas and concepts) dimensions.

Tsai *et al.* (2008) provided a different viewpoint on logistics risks by focusing on logistics outsourcing. As outsourcing entails inter-organisational relationships, they adopted two prominent theories in outsourcing: transaction cost economics (Williamson 1975) and resource-based view (Barney 1991). From the theories, they derived asset risks, relationship risks and competence risks as the main risk aspects in logistics outsourcing and matched them with 14 risk events referred to in the logistics practices.

There have been three notable studies on risks in international maritime logistics. Bichou (2004) investigated the security risks in port logistics and developed a framework for port security assessment and management. This conceptual study highlighted (1) channel design and process mapping, (2) risk assessment and management and (3) cost control and performance monitoring to minimise risks stemming from port security issues. Vilko and Hallikas (2011), in their research on multimodal logistics in the Gulf of Finland and the Finnish mainland, interviewed a logistics service provider involved in logistics activities in the region and identified a lengthy list of risk events in maritime transport, port operations and inland transport. They then categorised them into six groups based on the typology suggested by Manuj and Mentzer (2008a): supply risks, security risks, operation risks, macro risks, policy risks and environment risks. Another piece of research was done by Berle *et al.* (2012) and identified risk events, using failure mode in maritime logistics. It assumed that ports, terminals, intermodal connection, navigable waterways and vessels are the locations of risks and considered supply, financial flows, transportation, communication, internal operations/capacity and human resources as elements of the failure modes.

These three studies deal with risk identification, which is quite similar to the typologies used in SCRM research. However, since their research scopes are confined to specific logistics areas, identified risk categories and risk elements show discrepancies. For instance, Vilko and Hallikas (2011) transformed the risk categories of 'general risk areas' into six forms of international logistics risks, whilst Berle *et al.* (2012) adopted the typology of risk sources to reflect such risk sources in international maritime logistics as ports, terminals, vessels and etc.

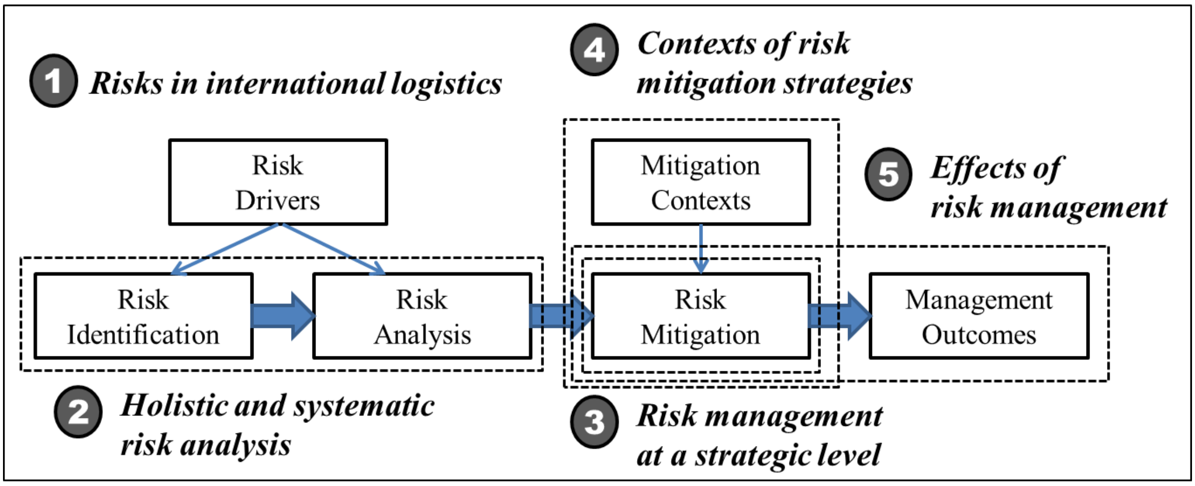
Bichou (2004), on the other hand, applied the typology of loss types by dividing port risks into tangible risks in material flows and intangible risks in finance and information flows.

Although these studies partly contributed to the identification and analysis of risks in international maritime logistics, they commonly lack the focus on the holistic international logistics operations from shippers' perspectives. Therefore, the findings from the studies are often fragmented and biased to specific logistics functions. Moreover, they did not cover risk management based on empirical grounds. This deficiency can lead to the conclusion that a study on international logistics risk management is highly required given the level of international commodity trade across the world.

2.9. Research Gaps

In consideration of the findings from the literature review, some research gaps in extant SCRM studies can be placed throughout the SCRM research framework, as illustrated in Figure 2-8. In this figure, five research gaps are demonstrated followed by circled numbers.

Figure 2-8: The research gaps in SCRM



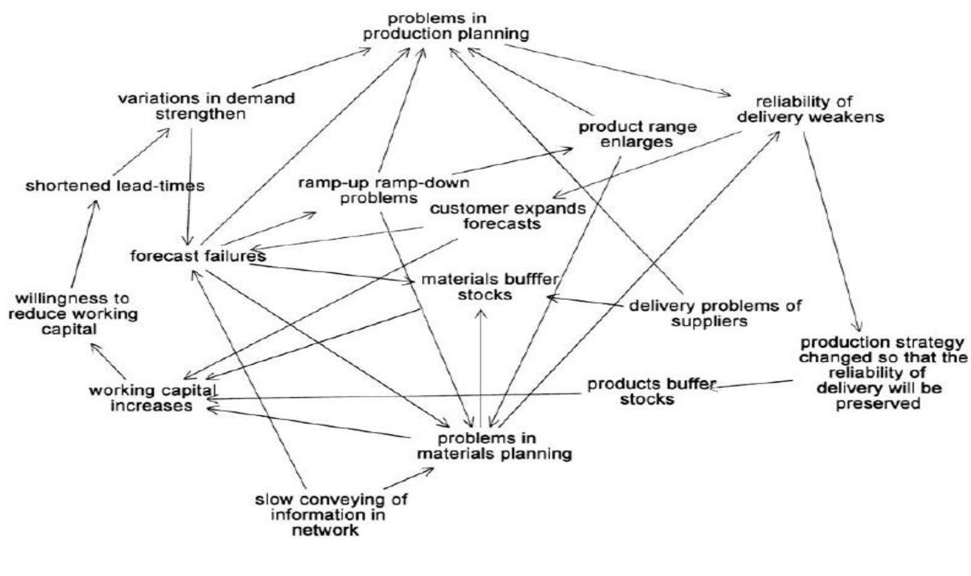
(Source: Author)

The first research gap is the deficiency in the research relating to disruption risks stemming from international logistics. The literature review showed that a significant amount of research has been conducted to identify risks in supply chains and to provide classifications of risks that can best describe the features of supply chain risks. Kouvelis *et al.* (2006) once argued that risk identification in the supply chain has not been fully explored, which may now be falsified when the number of empirical/conceptual studies on the topic is considered. However, it may be true to some degree because every empirical research has a constraint to limit its findings to the industry of supply chain scope, thus risks in the entire supply chain cannot be 'fully' investigated. As an example, researchers' focus on risks in international logistics is still limited despite numerous studies on the risks in supply chains. This may be because researchers think this area is sufficiently studied as part of general supply chain operations. Or it may be attributed to the complexity of global supply chain operations which deters researchers from exploring the risks in maritime logistics, a key element of international logistics. There are several studies that expand their interests to risk management in global supply chain (Norrman and Jansson 2004; Spekman and Davis 2004; Manuj and Mentzer 2008a, 2008b) but there have been only a few studies on maritime logistics risks. Moreover, those studies are more dedicated to risks in logistics service providers operations rather than focusing on the risks that shippers (cargo owners) face when they use maritime logistics service (Vilko and Hallikas 2011; Berle *et al.* 2012). When the volume of global cargo movement and increasing vulnerabilities from global logistics operations are taken into account, the lack of studies on international logistics risk management represents a significant research gap.

The second research gap is that the majority of extant research regarding risk identification and analysis only explored risks and provided typologies or taxonomies of those identified risks without considering interconnections between risks. Although the occurrence of a risk event may be triggered by other risks from the holistic perspective, their relationships are often overlooked by previous research. Categorisation generally offers a good framework to identify risk events, but often lacks consideration on the interdependencies between different risk clusters because it intends to separate clusters from one another. Mason-Jones and Towill (1999) have highlighted the importance of discovering risk interactions by arguing that "reducing uncertainty is achieved by understanding and tackling the root causes inherent in each of the (risk) areas, and, equally importantly, how they interact with each other." Based on interviews with supply chain practitioners, Peck (2005) also pointed out that when asked to talk about risk, practitioners rarely made distinctions between risk sources, drivers and outcomes, and rather strived to explain risk as "tales of cause and effect" like a multi-dimensional construct. In this respect, supply chain risks may constitute a holistic risk structure with hierarchies and interactions, which can eventually provide clues for strategic risk management once understood thoroughly and comprehensively.

Some studies have tried to illustrate the complex nature of supply chain risks as shown in Figure 2-9. However, it has been pointed out that the validity and usefulness of the tools for risk identification and analysis are not strongly supported by empirical evidence (Hendricks *et al.* 2009; Colicchia and Strozzi 2012). Adhitya *et al.* (2009) also asserted that a systematic way of risk identification has not been provided by the existing literature. Therefore, it is apparent that risk identification is comprised of three sequential steps: (1) producing a list of risks, (2) clustering those events and (3) devising a risk structure based on interconnections between risks. There are, however, few studies which cover the third step unless they use systematic risk identification methods, such as interpretive structural modelling, failure mode or process engineering.

Figure 2-9: The mapping of complex risk interactions



(Source: Hallikas *et al.* 2002)

The third research gap lies in the strategic dimensions of risk management. When it comes to the three research approaches to exploring supply chain risk mitigation as can be seen in Figure 2-5, the first approach prevails in SCRM research, which often provides a lengthy list of tactics that a firm cannot implement at the same time. This might be an unavoidable consequence of the SCRM process because detailed tactics rather than strategies are more suitable to mitigate a risk event identified and prioritised in the process. As analysed in Section 2.5, however, there are several common approaches to highlighting the distinctive features of risk mitigating strategies. Nevertheless, the majority of existing strategic dimensions are more conceptual than empirical, which cast a doubt on their application to a business. The lack of empirical evidence generates ambiguity and variability in defining the strategies as well as in finding out practices to serve the strategies. Case-based conceptualisations were only applicable to certain business contexts owing to lack of generalisation. Also, there were just a few attempts to incorporate well-established organisational and inter-organisational theories, which is another reason that the variability is created. This research gap augments the necessity of developing an empirically-validated SCRM strategy model that can incorporate scattered operational/tactical measures into the strategies supported by theories.

The fourth research gap is that business contexts affecting implementation of risk management strategies have not yet been fully explored. In specific terms, it is difficult to find out empirical studies using a large-scale survey of the relationships between the mitigating contexts and risk mitigation strategies. Although risk management strategies have been suggested, the knowledge about the attributes leading to the adoption of the strategies is scarce. To this end, the literature falls short in exploring under what conditions the strategies are implemented (Manuj and Mentzer 2008b). Reviews on SCRM research commonly identified that SCRM research is lacking a holistic approach (Tang and Musa 2011; Ghadge *et al.* 2012), which is partly due to the deficiency of considerations on contingencies of a firm or a supply chain which can affect the selection of risk management strategies. In addition, organisational orientations and culture which facilitate risk management initiatives need to be taken into consideration.

The fifth research gap is associated with the effect of risk management strategies. Risk management has a trade-off of cost and benefit: once the investment into risk management is executed, it brings about costs and benefits at the same time. To this end, some studies have attempted to evaluate the effect of risk management on the corporate/supply chain performance (Fawcett *et al.* 1966; Thun and Hoenig 2011; Cheng *et al.* 2012) or on the risk-related performance (Zsidisin and Wagner 2010; Kern *et al.* 2012). However, risk management strategies do not just affect the performance but also influence the capability of a supply chain network, such as robustness and resilience. When it is considered that creating a robust or resilient supply network is the desired outcome for every supply chain, the influence of risk management strategies on these risk management capabilities needs to be clarified. Despite a number of SCRM studies mentioning robustness or resilience, this relationship has not been empirically tested.

Although these research gaps were found in the SCRM literature, they are still effective to the research on international logistics risk management. As discussed in the previous section, ILRM research is scarce and their research scope is limited: in particular, their focus was mainly on risk identification because that is the pre-requisite process to understand ILRM. Similar to SCRM research, therefore, it lacks holistic understanding of risks, strategic dimensions in risk mitigation, concerns about business contexts and the relationship between risk management and its effect.

In order to address the research gaps aforementioned and to bridge the existing literature with international logistics risk management, this thesis proposes research questions outlined as below. More specifically, RQ1 is associated with the first and second research gaps (identification and analysis of international logistics risks) while RQ2 relates to the third, fourth and fifth research gaps which highlight risk management strategies as well as their contexts and effectiveness.

RQ1: What are the risk areas to be managed in international logistics?

RQ1a: What are the risks in international logistics operations?

RQ1b: How are these risks understood by using clustering?

RQ1c: How are these risk clusters interacting with each other?

RQ2. How can a firm effectively manage risks in international logistics?

RQ2a. What are the main risk management strategies to be considered?

RQ2b. Which factors can facilitate implementation of these risk management strategies?

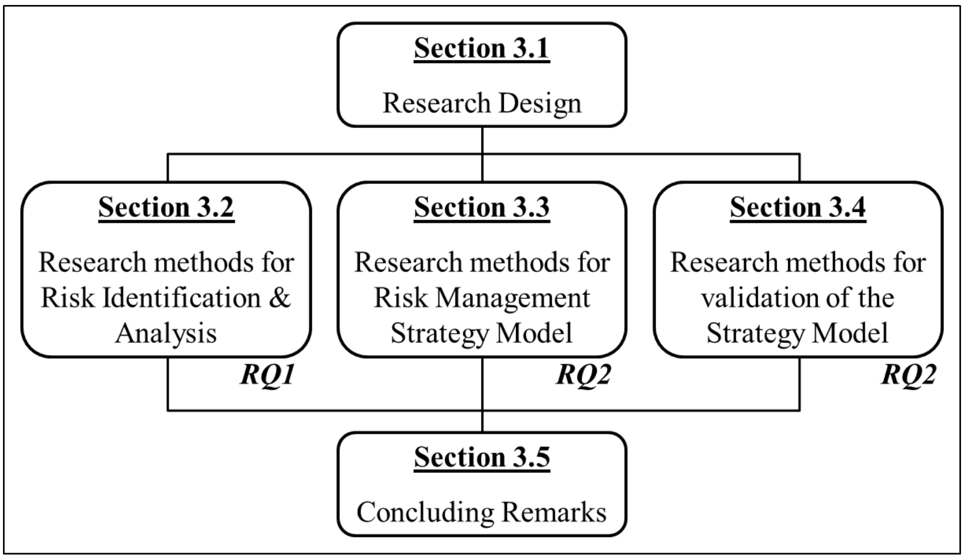
RQ2c. Can these strategies generate positive outcomes for the logistics network?

Chapter 3

Research Methodology

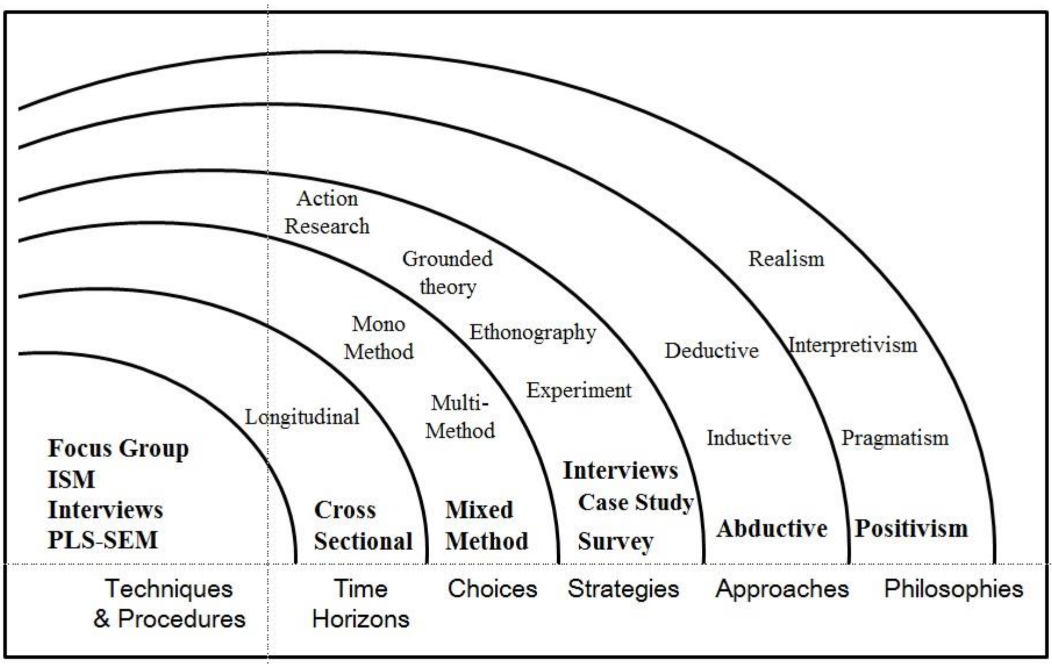
This chapter aims to explain research methods that can adequately address the research questions in the previous chapter based on the research gaps found in the literature review. As the interests of this thesis encompass all three phases of the risk management process, namely risk identification, risk analysis and risk mitigation, one research method is not able to sufficiently cover the entire topic of risk management. Rather, selection of appropriate research methods for each phase will be more desirable, which eventually leads to a multi-phase research approach. This multi-phase approach will bridge the findings from each risk management stage, which will eventually suggest holistic risk management for international logistics.

Figure 3-1: The outline of Chapter 3



This chapter consists of five main sections. The first section will discuss the general research design, such as research philosophy, approach and strategies. The next three sections focus more on the data collection methods and analysis techniques that will be applied in Chapter 4, 5 and 6 respectively. More specifically, the third section will present the research method for identifying and analysing risks. The method to develop a risk management strategy model will be explained in the fourth section, while the approach to validating the measurement and structural model will be outlined in the fourth section. The final section will summarise the chapter and suggests a brief guidance of the following chapters.

Figure 3-2: The overview of research design



(Adapted from Saunders *et al.* 2012)

3.1. Research Design

Research design is an overarching framework which guides the implementation of the research (Bryman and Bell 2011) and presents a plan to achieve research objectives by addressing research hypotheses (McDaniel and Gates 1999). This is a series of choices to best answer research questions under the given constraints (Ghauri and Gronhaug 2002). It can be compared with a research method, which in general refers to the technique for collecting and analysing data (Bryman and Bell 2011). Saunders *et al.* (2012) presented a framework for research to describe these important decisions in research design at a glance, which can be adapted to this thesis as shown in Figure 3-2.

3.1.1. Research philosophy

The philosophical stance of the thesis is the objectivism as ontology and positivism as epistemology. Ontological questions are related to the nature of social entities. More specifically, they are about the assumptions that we make about the way in which the world works (Saunders *et al.* 2012). The social entities, in this context, can be considered to be independent from the external reality, or alternatively they may build up the social constructions through their perceptions and actions (Bryman and Bell 2011). In social science, the former is labelled as objectivism and the latter as subjectivism or constructivism. When it comes to the nature of knowledge, objectivism assumes an objective reality and absolute truths, which leads to an identification of general knowledge and understandings which underpins social phenomena (Sarantakos 2005).

Positivism assumes that the objective reality lies outside individuals, which leads researchers to study social phenomena in the same manner as natural scientists do (May 2001). This means that positivism extends scientific methods to social science by accepting an empiricist account of natural sciences (Benton and Craib 2001). This paradigm pursues generalisations by the causality of variables (Thomas 2004), which entails hypotheses testing and deductive reasoning by adopting mainly quantitative methods dealing with statistical analyses of large datasets (Easterby-Smith *et al.* 2002). Benton and Craib (2001, p. 23) summarised the features of positivism as follows:

1. *The empiricist account of the natural sciences is accepted.*
2. *Science is valued as the highest or even the only genuine form of knowledge.*
3. *Scientific method, as presented by the empiricists, can and should be extended to the study of human mental and social life, to establish these disciplines as social sciences.*

4. Once reliable social scientific knowledge has been established, it will be possible to apply it to control, or regulate the behaviour of individuals or groups in society.

When it is considered that the thesis also seeks some contexts and mechanisms which affect the risk management process with mixed methods, it might have been based upon critical realism (Bhaskar 1975) or pragmatism (Tashakkori and Teddlie 2003). However, positivism is the main epistemology of this research because (1) explanations demonstrate causality, (2) concepts are operationalized, (3) generalisation is pursued through statistical probability and (4) sampling requires a large number (Easterby-Smith *et al.* 2002). Accordingly, this research is designed drawing on positivism in that it is undertaken based on observable phenomena in an objective value-free way (Saunders *et al.* 2012).

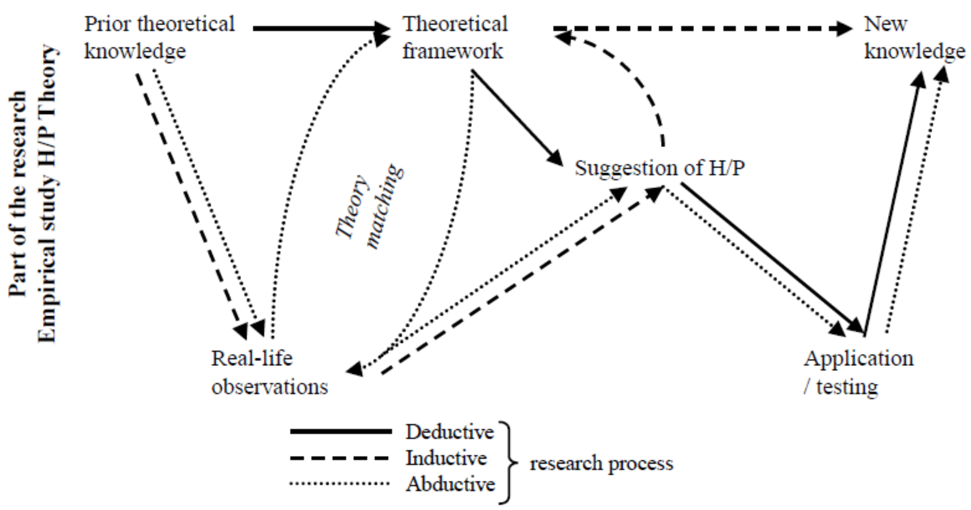
It is well-known that logistics research was historically heavily biased towards the positivist paradigm (Mentzer and Kahn 1995; Naslund 2002; Spens and Kovacs 2006). A recent systematic literature review on port research also showed that 830 out of 840 articles adopted a positivist paradigm (Woo *et al.* 2011). For multi-disciplinary supply chain and logistics research, positivism is regarded as the basic consensus across disciplines. Specifically, SCRM includes a significant quantity of operations research which is often based on the engineering discipline and the positivist paradigm. Also, adoptions of theories from relevant disciplines require deductive testing. The practice-oriented and solution-based research tradition of SCRM seeks applicability and generalisations, which definitely needs an objective paradigm. The studies on tangible resources such as manufacturing process and logistics networks assimilate SCRM to natural science.

3.1.2. Research approach

This study adopts the abductive research approach which combines both inductive and deductive reasoning. Research approach is a matter of use of theory (Saunders e*t al.* 2012), which concerns the nature of the relationship between theory and research (Bryman and Bell 2011). According to Kovacs and Spens (2005), there are three types of research approaches, which are deductive, inductive and abductive. Deduction is a theory-driven reasoning to explain or predict empirical observations whereas induction refers to a law or theory generating reasoning from empirical observations (Ghauri and Gronhaug 2002). In other words, the deductive approach is a theory testing process which validates hypotheses generated from theories, but the inductive approach is a theory development process which proceeds by generalising the specific observations (Bryman and Bell 2011). To this end, the main difference between the approaches lies in which comes first between data or theory.

Kovacs and Spens (2005) argued that the reason why the logistics discipline doesn’t have a rich heritage of theory development is largely due to its established deductive approach. They also suggested that the concept of abduction can generate the development of new theories in this discipline. An abductive approach differs from a deductive approach in that it aims to understand a phenomenon from a new conceptual framework (Dubios and Gadde 2002). It also differs from an inductive approach because it aims to form a new theory through a theory testing process (Kovacs and Spens 2005). An abductive approach is an iterative theory matching process which moves back and forth between theory and empirical study (Dubios and Gadde 2002). Figure 3-3 demonstrates the comparison of the three research approaches.

Figure 3-3: Three different research approaches



(Source: Spens and Kovacs 2006)

What is important in the abductive strategy is how to integrate those two different approaches into one unified approach (Spens and Kovacs 2006): in this thesis, “the risk management model" will play the role of bridging those approaches by using both theory-building and theory-testing analysis. To generate the most critical risk factors in international logistics, this thesis will employ inductive reasoning mainly using qualitative research methods. In developing the risk management model to mitigate these critical risks, an abductive approach will use both the theoretical knowledge and real-life observations to find out the new framework (Kovacs and Spens 2005). The risk management model based on theories and empirical findings will be tested by a deductive approach to explain the effective risk management strategies and their antecedents.

3.1.3. Research strategies

This study employs interviews, case study and survey strategies. Here the research strategies are delineated as the strategies to meet the research objective and to answer the research questions (Saunders *et al.* 2012). The categorisation of research strategies varies considerably according to researchers: Robson (2002) suggested experiment, survey and case study whereas Saunders *et al.* (2012) included action research, grounded theory, ethnography and archival research in addition to those three strategies. Bryman and Bell (2011), in contrast, used only two strategies, quantitative and qualitative, while providing distinguished specifications in the research design and data collection methods. Kumar (2011) also followed the same specifications as Bryman and Bell (2011) used. In any types of specifications, this thesis adopts the multi-strategy which combines qualitative case study and quantitative survey strategies. From the perspective of the abductive approach, it is very reasonable to mix both qualitative and quantitative strategies.

Interview is considered as the most appropriate method for exploratory studies which can seek what, how and why a social phenomenon happens (Robson 2002; Saunders *et al.* 2012). Interview is, in general, categorised into structured, semi-structured and unstructured interviews (Bryman and Bell 2011). This thesis, however, uses different types of interviews, such as a focus group interview and panel discussion. A focus group interview is an interactive group discussion, which can generate abundant but refined ideas. It is applied in this thesis to identify various risks in international logistics and to find risk clusters (RQ1 – exploratory study). The panel discussion, on the other hand, is adopted to decide the contextual relationships between risk clusters by a series of panel discussions to reach a consensus (RQ1 – analytic study).

Case study is the research strategy to investigate a particular instance or a few carefully selected cases intensively (Gilbert 2008). The case study strategy has strength in generating answers to ‘why’ questions as well as ‘what’ and ‘how’ questions (Saunders *et al.* 2012). Therefore, it is the most appropriate method to comprehensively understand the phenomenon by contextualising the cases specified (Yin 2009), especially when the research area is new or existing theories look inadequate (Ghauri and Gronhaug 2002). A variety of data can be employed for case studies, such as observation, interviews, documents, questionnaire and archival data (Bryman and Bell 2011) regardless of qualitative and quantitative formats (Yin 2009). Triangulation of multiple data sources is critical in the case study strategy (Saunders *et al.* 2012). According to Easterby-Smith *et al.* (2002), there are four types of triangulation which are data, investigator, methodological and theoretical triangulations. This thesis strives to ensure these triangulations by adopting multiple case studies, multiple data collection methods and multiple data analysis methods. In this thesis, case study was mainly used for the development of the risk management strategy model (RQ2 – exploratory study).

Survey, on the other hand, is the research strategy to collect a large amount of quantitative data which can be analysed in a deductive manner. Research showed that survey is a dominant research method in the SCM studies (Mentzer and Kahn 1995; Sachan and Datta 2005; Giunipero *et al.* 2008) together with case study because it is an economical and non-invasive strategy to measure various concepts in SCM and logistics (Mentzer and Kahn 1995). The primary objective of using a large-scale survey is to validate existing theories with empirical data (Forza 2002). Thus, a conceptual or empirical model derived from theories and exploratory research can be validated using survey methods. The role of surveys in this thesis was to find out the degree of implementing risk management strategies and to validate the risk management strategy model (RQ2 – predictive/confirmatory).

3.1.4. Time horizons

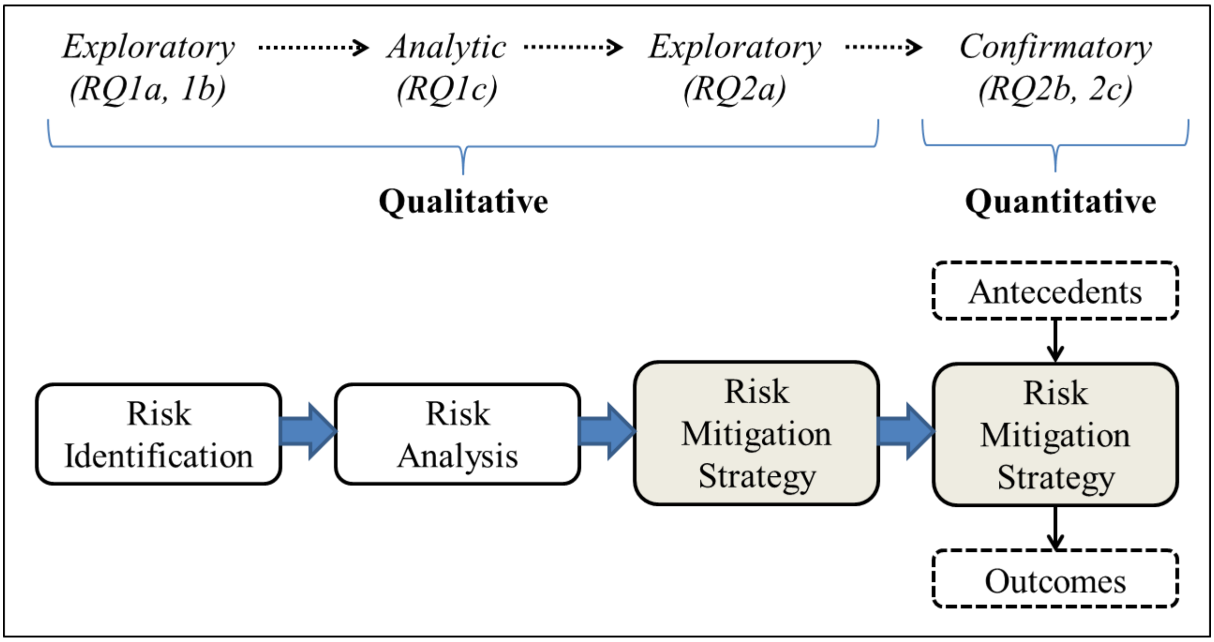
The thesis adopts cross-sectional design in terms of time horizon. The cross-sectional design involves the data collection on more than one case at a single point of time (Bryman and Bell 2011). It normally entails a questionnaire survey and structured interview, but also encompasses other data collection methods such as structured observation, content analysis and official statistics. The important element of this research design is that more than one case of quantitative/quantifiable data should be collected at a single point of time in order to show the patterns of association. An alternative to be considered for the research would be the longitudinal design to enhance the external validity of the results. In particular, the level of risk management implementation given certain types of business contexts can be tracked down in a longitudinal study. Also, long-term impacts of risk management strategies can be also illuminated by comparing two sets of logistics performance measured at two different time periods. However, there are practical constraints in conducting one more questionnaire survey with a considerable time gap during the PhD course. Therefore, this thesis focuses on the cross-sectional studies at a particular time.

3.1.5. Research choices

The thesis mixes several qualitative and quantitative methods to address research objectives. According to the categorisation of Saunders *et al.* (2012) who divided multiple methods into four distinctive choices, mixed-method research is adopted in the thesis because it uses both qualitative and quantitative data collection method and analysis techniques in a sequential manner. This is an inevitable choice not just because the thesis follows a SCRM framework which comprises of sequential steps but because the research objective for each step can be best addressed by using different research methods. Mixed method research has strengths to offset the weakness of adopting one method and to provide more evidence in resolving research questions (Creswell and Clark 2011). The thesis also pursues the advantages of each research method to overcome methodological limitations of previous research.

The overview of the research design for this thesis is demonstrated in Figure 3-4. It consists of four phases which aim to address different aspects of the research objective using different research methods. The first phase is an exploratory study which seeks the risks in international logistics and risk clusters (RQ1a and RQ1b) by applying focus group interviews. The second phase is an analytic study to investigate the interactive risk structure (RQ1c) by analysing panel interview results on the contextual relationships between risk clusters using Interpretive Structural Modelling (ISM). The third phase is another exploratory study which mainly finds out risk mitigation strategies in international logistics operations (RQ2a) although it will also explore their antecedents and outcomes. The last phase is a predictive/confirmatory study to test the relationships among risk mitigation strategies, their antecedents and outcomes using Partial Least Squares Structural Equation Modelling (PLS-SEM) analysis of survey data (RQ2b and RQ2c).

Figure 3-4: The overview of the research stages



3.2. Research Methods for Risk Identification and Analysis

The first phase of this thesis aims to identify and analyse risks in international logistics, more specifically, risks within the logistics operations from an exporter's warehouse to an importer's warehouse by multiple modes of transport with sea transportation as the main leg of transport. As highlighted in the research gap of the extant literature, researchers have paid little attention to risks in international logistics, thereby requiring risk management strategies starting with appropriate risk analysis.

The foremost and core process of SCRM is risk identification aiming at the recognition of possible risks, which motivates the necessity for risk evaluation and mitigation. It entails the definition of supply chain process and its operational divisions so that they are checked in detail to seek all the risks in them (Waters 2007). Risk identification initially produces a list of risks regardless of the various facets of 'risk': they can be risk events, risk sources or risk consequences. Therefore, risk identification often leads to risk categorisation to annotate hierarchy or clusters to the identified risks and to group them into a taxonomy in order to devise risk mitigation strategies rather than one-off tactical measures.

However, this classification never provides the insight into the structure of risks, the interconnectedness of various risks in particular. Producing a risk structure given interrelationships among the identified risks or risk clusters will be the last stage of risk analysis because it offers a comprehensive understanding of risks in a supply chain for effective risk management.

According to the three stages of risk analysis shown in Figure 3-5, this research phase established three research questions for the research objective as follows:

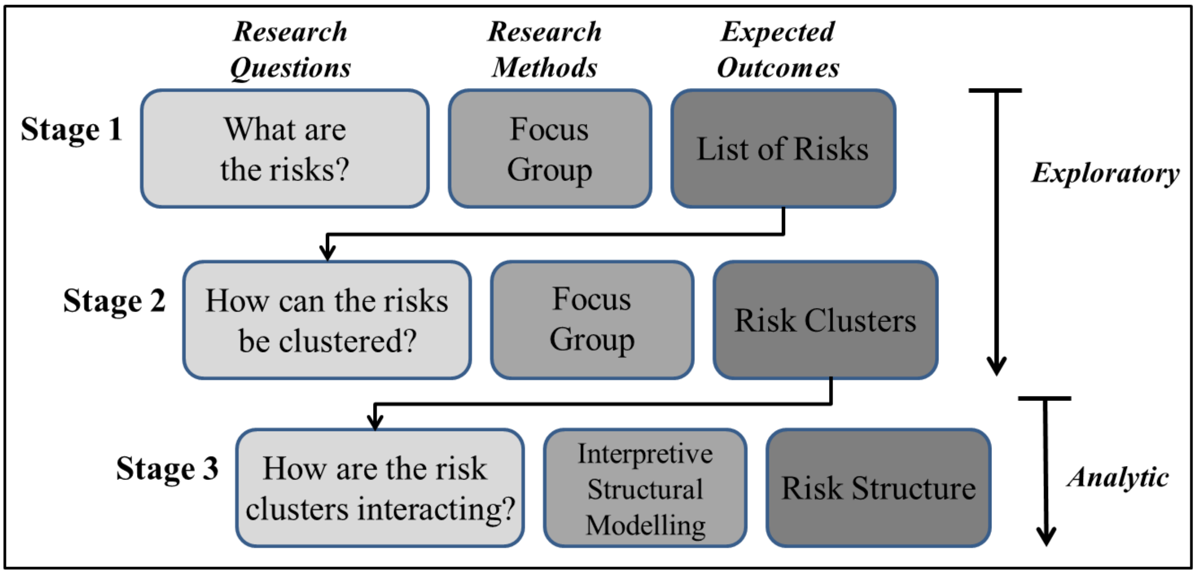
RQ1a: What are the risks in international logistics operations?

RQ1b: How are these risks understood by using clustering?

RQ1c: How are these risk clusters interacting with each other?

To address these research questions, the triangulation of multiple methods was applied. The research design is "multiphase design" among the four distinctive mixed methods research suggested by Creswell and Clark (2011) because the design was selected to address sequential research questions aiming at one objective: the risks discovered in the first research question become the objects of clustering in the second research question, and the clusters are to be used as elements for risk structure in the third research question, which results in a holistic risk analysis. As risk analysis requires in-depth investigation into operations and processes, qualitative research methods would be suitable for the research objective. In this study, two different qualitative research methods, focus group and interpretive structural modelling (hereinafter, "ISM") were adopted for exploratory and analytic purposes respectively.

Figure 3-5: Three steps for risk identification and analysis



3.2.1. Focus group

The focus group method is defined as an interactive group interview on a specific topic (Robson 2002). It is a series of focused group discussions among selected experts in the subject area (Krueger 1998). The advantages of focus groups are interactions among participants (Patton 2002), high data quality compared to normal interviews (Bryman and Bell 2011) and the representation of a population by small groups (Krueger 1998). In this research, a series of focus group discussions were carried out to collect more comprehensive and systematic ideas about risk events and risk clusters. Compared to the case study method that most extant research adopted, focus groups can lead to conclusions reflecting more extensive but refined opinions from group discussions of various entities. According to

Sanchez-Rodrigues *et al.* (2010) the focus group method can be descriptive, exploratory or explanatory given the research objective: in this study, focus group method was adopted for exploring the risks in international logistics and to provide the appropriate taxonomy for further analysis since there is little empirical research on the topic. In SCRM research, Pettit *et al.* (2010) and Sanchez-Rodrigues *et al.* (2010) primarily used this method to identify risks in supply chains and in transport respectively. Focus group method was also applied to SCRM research as the secondary method to enhance or support the findings from interviews or survey (Blackhurst *et al.* 2005; Jüttner 2005; Craighead *et al.* 2007; Manuj and Mentzer 2008b). Despite the extensive findings from a series of group discussions, however, focus group method is not often used in SCRM research.

According to McNarama (2010), focus group method takes several steps.

(1) Developing questions
(2) Constructing participant groups
(3) Planning the discussion: schedule, venue and agenda
(4) Facilitating the discussion
(5) Implementing more rounds of discussions until theoretical saturation is reached
(6) Analysing discussion outcomes

Among the three aforementioned research questions, the focus group method was applied to address the first two questions (RQ1a and RQ1b). The following sub-sections will explain the detailed process of focus group method applied in this research, encompassing participant groups, planning and facilitation of the discussions and theoretical saturation.

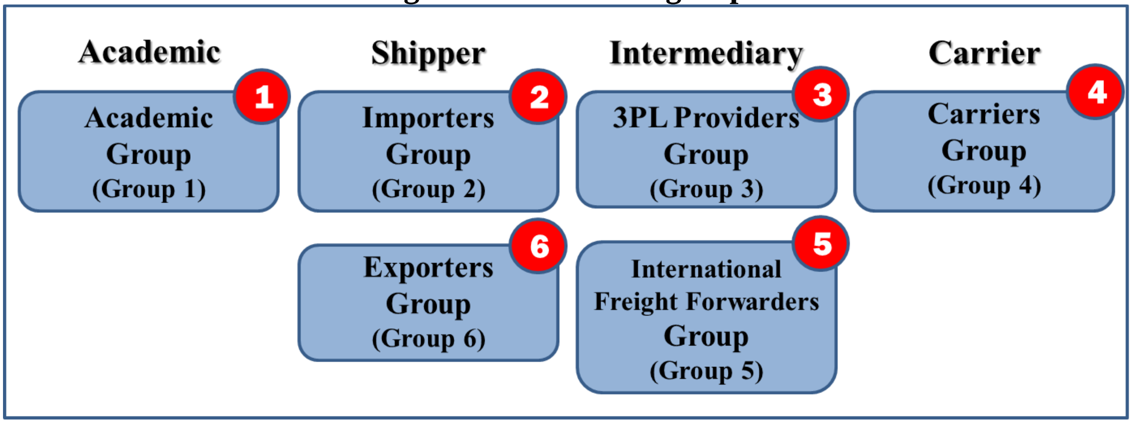
3.2.1.1. Construction of participant groups

Focus group method is executed by a series of discussions among expert groups whose participants were sampled from logistics experts in South Korea. There are several methodological issues to be clarified in constructing groups of these logistics experts. Participant sampling, group characteristics and the number of participants in a group are all critical in achieving the research objective by using focus group methods, so this research carefully dealt with these issues in order to maximise the effectiveness of the research method.

The first was related to participant sampling. As the scope of this research covered international logistics, the cargo movement from an exporter's warehouse to an importer's warehouse via sea transport, it was desirable to seek the opinions from all the entities involved in international logistics. The participants with different interests in international logistics would consider the issue from diverse dimensions, illuminating the very details of risks that might have been neglected by other entities. Therefore, six groups of participants were selected: academics, exporters, importers, 3PL providers, international freight forwarders and carriers. This research separated cargo owners into exporters and importers because they control different stages of international logistics. The intermediaries were also divided into 3PL providers and international freight forwarders because their ranges of control over cargo differ in the degree of logistics outsourcing involved. As for the carrier group, this research involved container shipping lines because they provide shippers with a door-to-door service, which includes sea transport, rail transport and road haulage. In addition, a group of academic researchers was invited to participate because they were expected to offer more general views which could be amalgamated with the more discrete perspectives provided by the practitioners. Terminal operators and road transporters were also considered to create one more group, but were dropped at a later stage. This is because logistics carrier group and intermediary groups (international freight forwarder group and 3PL provider group), who have the direct contractual relationships with terminal operators and road transporters in maritime logistics, were expected to sufficiently identify risks occurring in those risk areas.

The participants for focus group discussions were selected by purposive sampling, one of the non-probability sampling methods, to meet the group criteria and to ensure sufficient industry experience (Saunders *et al.* 2012; Bryman and Bell 2011). Participants from industries were all at the managerial or higher level in their firms with experience of at least five years in their field, suggesting that they are experts in managing and executing the entire process in international logistics. The academic group consisted of researchers and postgraduate students in the logistics discipline who thoroughly understood the process of international logistics. The recruitment process was conducted until a total 36 participants were filled in 6 participant groups.

Figure 3-6: Six focus groups



The second is related to group characteristics developed depending on grouping participants. This research did not mix the participants up when forming each of the six groups, but rather deliberately planned for each group to contain members from similar industry roles to facilitate easier and deeper group discussions. Also, this group setting can directly compare the findings between groups. In fact, there is a debate on this kind of ‘naturally occurring group’ because participants tend to consider some assumptions as taken for granted (Morgan 1998). However, some researchers have deliberately used pre-existing groups in order to achieve the most natural interactions among participants (Bryman 2012). This study was also concerned about the possibility that group discussions may become diffused and unproductive if the participants in each group came from contrasting backgrounds because their interests in international logistics differ. In addition to this, some cultural aspects of South Korea were also taken into account to select natural groups. In this culture, open discussions with total strangers with different backgrounds are regarded as barely workable. It was also considered that the social hierarchy between outsourcing firms and outsourced firms may deter the latter to openly advocate their opinions without concerning the former.

Table 3-1: The profile of focus group participants (N=36)

Industry	Position (Industry Experience)	
Exporters (Shippers)	President/CEO (18 years) Senior Manager (18 years) Manager B (9 years)	Director (19 years) Manager A (13 years) Manager C (8 years)
Importers (Shippers)	Director (17 years) Senior Manager B (14 years) Manager A (9 years)	Senior Manager A (14 years) Senior Manager C (12 years) Manager B (7 years)
3PL Providers (Intermediaries)	Director A (22 years) Senior Manager A (17 years) Manager A (8 years)	Director B (17 years) Senior Manager B (14 years) Manager B (7 years)
Freight Forwarders (Intermediaries)	President/CEO (28 years) Senior Manager A (18 years) Manager A (11 years)	Director (22 years) Senior Manager B (13 years) Manager B (7 years)
Liner Companies (Carriers)	Senior Manager A (16 years) Manager A (10 years) Manager C (7 years)	Senior Manager B (13 years) Manager B (7 years) Manager D (7 years)
Academic	Researcher A (12 years) Researcher C (6 years) Postgraduate student B (3 years)	Researcher B (6 years) Postgraduate student A (4 years) Postgraduate student C (3 years)

The third is the number of participants per group. In the focus group research, the size of a group matters. Krueger (1998) argued that bigger groups would have less controllability but better quality of information. Therefore, Blackburn and Stokes (2000) suggested a group should consist of less than eight people, while Morgan (1998) thought six to ten participants to be appropriate. A large group can definitely obtain more ideas from discussions, but the number of participants should be manageable by the facilitator and 'focused' discussions should be generated among participants (Bryman and Bell 2011). To maximise all of them, six people per group were selected in this research as the optimum group size with six groups being used.

3.2.1.2. Administration of the discussion

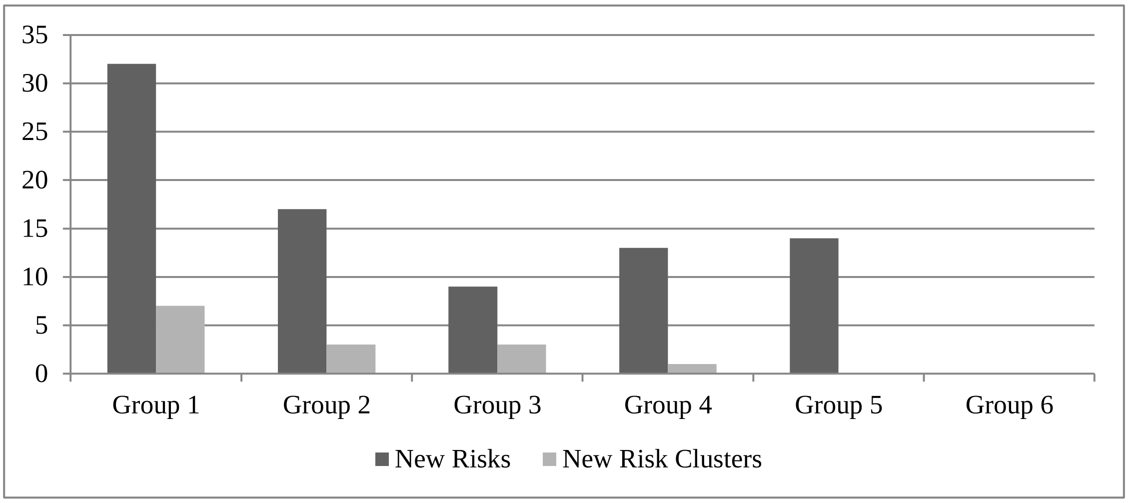
The venue and time for focus group discussions was selected in order not to disturb their working hours. Two seminar rooms, one in the city centre and another in the Kangnam district in Seoul, South Korea, were chosen for the venue in consideration of the proximity to the working places of the participants. The seminar rooms were purpose-built for group discussions, thus ideal for this research's purpose. As participants of academic, 3PL provider and international freight forwarder groups were relatively flexible in their working hours, the discussions were held on three separate afternoons. On the contrary, the discussions of other groups were held on three separate evenings after working hours.

The agenda for discussions to address research questions was devised and disseminated to the participants before the discussions. The discussion agenda consisted of three stages. The first stage would provide the participants with the opportunity to share their experiences of any disturbances and disruptions in international logistics and to express their concerns about their daily logistics operations. This brain-storming session was aimed to remind the participants of various risks which had happened in the past or were still happening at present so that they can think of critical risks in international logistics. After finishing the initial open-ended discussions, the second stage would ask each participant to write down approximately ten critical risks to their international logistics operations, each on a separate sticky note. Specifically, participants were asked to consider international logistics risks from the shippers' (cargo owners') perspective because they take the ultimate responsibility for the entire international logistics operations. This stage was designed to identify risks and to create a list of risks in international logistics to answer RQ1a. The number of risks a participant can present was restricted to deter one participant from writing down too many risks, some of which may be trivial to others. In the third stage, the participants would be asked to find out risk clusters that can effectively categorise the identified risks by using a cause and effect diagram. The clustering patterns generated in the clustering process were thought to be equally important as the risk clusters that participants would create because the patterns could lead the research to more comprehensive conclusions which encompass six separate group discussions. Thus, the facilitator took notes of the main patterns in the clustering process while tape-recording the entire discussions. In this way, RQ1b could be fully addressed by the risk clusters and risk clustering patterns.

3.2.1.3. Theoretical saturation

After a series of focus group discussions, data collection can be ceased when it reaches the theoretical saturation where no more new information can be obtained from additional participants (Krueger 1998). To confirm the theoretical saturation, this research followed the process conducted by Sanchez-Rodrigues *et al.* (2010) analysing the risks and risk clusters provided by the groups. Theoretical saturation was reached in the fifth and sixth discussions as no more new risks or clusters appeared although each group has used various names to describe the same risks and risk clusters that had been already identified by previous groups. As Figure 3-7 illustrates, the sixth group could add no more new risks and risk clusters, thus the process of data gathering from focus group discussion was finished (see Table 4-2 for the list of risk clusters identified in this process). Indeed, the risks and risk clusters identified in the focus group discussions exceeded the number and the range of risks suggested in previous SCRM studies. In this regard, further group discussions were not necessary.

Figure 3-7: Theoretical saturation



3.2.2. Interpretive Structural Modelling

Interpretive structural modelling (hereinafter, “ISM”) is a qualitative method to identify the structure of complex relations of elements by analysing two elements pair-wisely (Pfohl *et al.* 2011). The structural mapping of ISM provides researchers with the solutions for complex issues (Malone 1975; Watson 1978) by highlighting the causal connections of elements in a graphical manner (Watfield 1994). Although cause and effect diagrams used in focus group research showed a mapping of risk clusters, they had a limitation to describing the relations between risk clusters. Contrarily, ISM offers an insightful development of collective understandings of those relations so that complex interconnections of risk events can be portrayed within a model (Faisal *et al.* 2006). In this respect, ISM is seen as the most appropriate method that can address RQ1c in the research by creating a risk structure. In SCRM research, Faisal *et al.* (2006), Pfohl *et al.* (2011) and Diabat *et al.* (2012) have used this method to construct structural models of risk mitigation enablers and supply chain risk events respectively.

ISM generates an understanding of a complex system by considering the hierarchy and relationships among elements of the system (Sage 1977). The reason for ISM being considered interpretive is that the decision from an expert group discussion on how and whether the elements are related is the core in the ISM process (Pfohl *et al.* 2011). It is also described as structured because it can eventually demonstrate the comprehensive structure of a complex system (Faisal *et al.* 2007). Therefore, this method requires researchers to use the decisions of experts for modelling and to follow the logical steps of the method to create a structure.

3.2.2.1. ISM process

According to Faisal *et al.* (2007) and Pfohl *et al.* (2011), ISM is comprised of seven steps. Although Diabat *et al.* (2012) and Govindan *et al.* (2012) added one more step at the end to check as to whether the ISM model has any conceptual inconsistency which requires modification, this research will stick to the seven steps checking the validity and implications in the discussion part.

(1) The elements affecting the complex system are to be selected and listed. Identification of elements can be practiced by both conceptual and empirical works but expert opinion is recommended. Node numbers may be allocated to the elements. In this research, the risk clusters found in the focus group discussions will be used for the risk elements.

(2) The contextual relationships between two elements are to be examined.

(3) A Structural Self-Interaction Matrix (SSIM) is to be created by the pairwise relationships between elements. The participants are asked to compare two elements (*i* and *j*) and to determine their relationships with following four symbols.

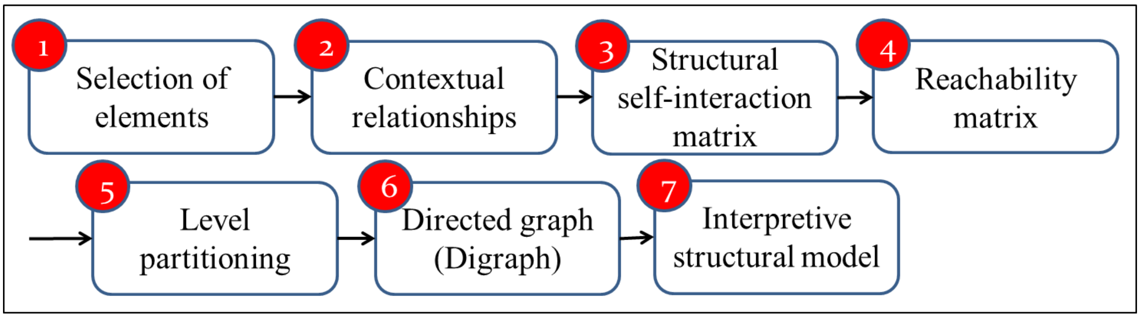
V: element *i* will cause element *j*;

A: element *j* will cause element *i*;

X: element *i* and *j* will cause each other;

O: element *i* and *j* are not related at all.

Figure 3-8: The process of ISM



(Source: Adapted from Pfohl *et al.* 2011)

(4) A reachability matrix is to be developed from the SSIM by taking transitivity into account. Transitivity denotes a contextual relation that element A is related to element C when element A and B are related and element B and C are also related at the same time. The (*i*, *j*) entry in a reachability matrix should be filled by 0, 1 or 1* based on the SSIM and transitivity according to the following rules.

0: element *i* will not cause element *j* and there is no transitivity between them;

1: element *i* will directly cause element *j*;

1*: there is transitivity between *i* and *j* by the mediation of another element.

(5) The reachability matrix is to be partitioned into several levels. For this purpose, a reachability set (Rs*i*) and an antecedent set (As*i*) for each element i should be created first. While Rs*i* consists of the elements that are directly or indirectly affected by *i*, As*i* is made up of the elements that cause *i* both directly and indirectly. If Rs*i* = Rs*i* ∩ As*i*, element i is the top level of the ISM structure and will be eliminated from the Rs and As. With the remaining

elements, the same tests are to be conducted to annotate the level of each element. This step helps to generate a digraph by highlighting the hierarchy of elements.

(6) A directed graph (or digraph) is to be drawn given the reachability matrix and level partitioning. The initial graph may include the transitivity links but the final graph should have those links removed.

(7) The final digraph is converted into an ISM by replacing node numbers with original names of the elements. The ISM will demonstrate the hierarchical structure of risks in maritime logistics and illuminate their interrelationships with the dependence and driving power of those risks to be found in focus group research shown.

3.2.2.2. Administration of ISM

The participants who would decide pairwise relationships of risks (stage 2) were selected from the focus groups because they were experts in international logistics and familiar with the research topic and risk clusters used in this research. However, the sampling of participants was largely constrained by several drawbacks of the method. Firstly, different opinions of the participants hindered generation of a unified ISM. Therefore, this study adopted Delphi method: as Delphi method is used to refine ideas and to draw a consensus among participants (Saunders *et al.* 2012), it can bridge discrepant ideas and help reach a consensus. Secondly, the number of pairwise comparisons surges exponentially as the number of elements increases. As focus group discussions have identified 20 risk clusters, a total of 190 comparisons had to be completed. Due to time consumption of completing all the comparisons, two groups made of one researcher and one practitioner were asked to directly execute pairwise comparisons, and then four additional practitioners were invited to review any discrepant opinions from the two groups and reach a consensus through a series of written discussions. The process to obtain the final experts' decisions on the set of pairwise interconnections of risk clusters is described in Figure 3-9 and Table 3-2.

Figure 3-9: The process to obtain decisions on pairwise relationships

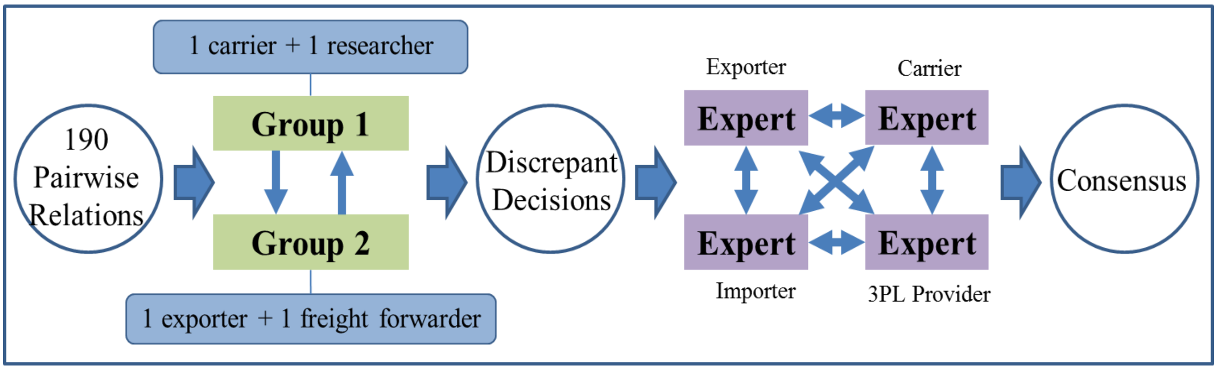


Table 3-2: The participants of ISM and the process for contextual relationships

Process	Description
Participants	(1) Group A : Carrier (Manager, 7-year experience) Researcher (Doctor, 8-year experience) (2) Group B: Exporter (Manager, 11-year experience) Freight Forwarder (Director, 14-year experience) (3) Delphi Panel: Exporter, Importer, 3PL Provider, Carrier (Managerial level with more than 7-year experience)
Round 1	(1) Group A decides the contextual relationships between two elements. (2) Group B decides the contextual relationships between two elements.
Round 2	(1) If there are discrepancies in the decisions, Group A and B produce a written statement regarding the reasons for their decisions on the discrepant topics. (2) After exchanging the written statements, Group A and B make their final decision on the pairwise relationships.
Round 3	(1) If there still exist any discrepancies, the members of Delphi panel review the relationships until they reach a consensus. (2) The decisions on the contextual relationships among the risk elements are finalised.

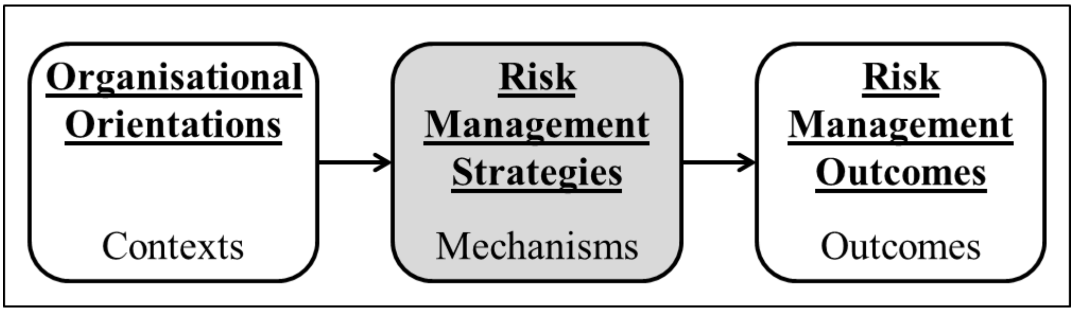
3.3. Research Methods for Model Development

The second research question (RQ2) of this thesis is regarding how to manage risks in international logistics, specific to the management of critical risks found in the risk analysis phase. This research phase aims to highlight the risk management strategies and the practices for these strategies. In addition, it aims at revealing the factors affecting the implementation of those strategies as well as the effectiveness of implementing those strategies.

After creating a theoretical model from an organisational theory, a series of case study interviews with practitioners of international logistics were used to supplement the conceptualisation of this research frame, hypothesis development and measurement development. The research model then emerged from the interactions between literature and industry practices with empirical evidence. To this end, this section mainly explains how the case study interviews were conducted to justify the research process.

The anticipated structural model, as described in Figure 3-10, consists of organisational orientations, risk management strategies and desired risk management outcomes based on the context-mechanism-outcome logic. This section is devoted to explaining the research methods applied to model development, thereby creating constructs and hypotheses that constitute the model. It will eventually result in the development of measurement scales for designing a questionnaire to test the model in the next research phase.

Figure 3-10: The initial research model



(Source: Author)

3.3.1. Case study interviews

Case study can be specified into three distinctive modes of research conduct, which are (1) theory generation, (2) theory testing and (3) theory elaboration (Ketokivi and Choi 2014). These three modes have a different degree of emphasis on general theory and empirical context. Case study as theory generation is known as inductive case study (Eisenhardt 1989) while case study as theory testing is associated with a deductive formulation. The third approach, case study as theory elaboration, contextualises logic of a general theory by elaboration to reconcile the general with the particular (Ketokivi and Choi 2014). To this end, existing theory and literature can provide a sufficient basis for the framework, but empirical data from case studies will enhance the theoretical insights. This research follows the third approach because it conceptualises and populates the strategic framework identified by an organisational theory by combining the existing literature and interviews with practitioners.

3.3.1.1. Sampling for case study interviews

The appropriate selection of representative samples for qualitative research is a critical issue from the methodological perspective. With this in mind, this research used purposive sampling which enables researchers to select, based on their knowledge and experience, the best cases that can properly address research questions (Saunders *et al.* 2012). The main purpose for the sampling was to target overarching companies which may have diverse approaches to risk management. Firstly, both cargo owners (exporters and importers) and international logistics intermediaries were considered. As the latter deal with international logistics operations in lieu of the former, these two groups appeared to experience almost the same types of disruptions, thereby striving to reduce international logistics risks. However, due to the different business focuses between these two groups, their strategies may differ. To this end, five cargo owner companies and three international freight forwarding companies were invited to this research. Secondly, companies of various sizes in terms of annual sales and number of employees were also considered. The size of a company is associated with the extent to which a firm invests financial and human resources in risk management, which may lead to different approaches to risk management. In consideration of these factors, eight companies comprised of three large-sized companies, three medium-sized companies and two small-sized companies were selected for interview. For the case study interviews, international logistics experts at manager position or above in each company were contacted via email with an invitation letter enclosing the interview agenda and the interview consent form. Eventually, 11 interviewees from 8 companies agreed to participate in the interviews. All of them had at least 7-years' experience in international logistics operations. The profiles of the case companies and interviewees are shown in Table 3-3.

Table 3-3: The profiles of case companies and interviewees

Company	Industry	Interviewees (experience)	Annual Sales	Employees
Company A	Auto-part Manufacturer	SCM manager (13 years)	$ 500 million+	< 1,000
Company B	International Freight Forwarder	1. Branch head (11 years) 2. Visibility Team manager (7 years)	$ 500 million+	< 1,000
Company C	Electronics Manufacturer	1. SCM innovation senior manager (15 years) 2. Global logistics manager (9 years)	$ 10 billion+	< 10,000
Company D	International Freight Forwarder	Global account manager (10 years)	$ 10 billion+	< 10,000
Company E	Consumer Goods Manufacturer	Procurement manager (7 years)	$ 10 billion+	< 10,000
Company F	Electronic Parts Manufacturer	International logistics manager (12 years)	$ 500 million+	< 1,000
Company G	Office Furniture Manufacturer	Vice president (15 years)	$ 10 million+	< 100
Company H	International Freight Forwarder	1. Sales manager (22 years) 2. Operation manager (8 years)	$ 50 million+	< 100

3.3.1.2. Administration of case study interviews

The case study interviews were conducted via conference calls in February 2014. Each interview lasted for 1.5-2 hours respectively. The case study interviews followed the semi-structured interviews providing the interview agenda to the interviewees in advance so that they could prepare their answers. After finishing the interviews, interviewees were asked to send archival documents and data that can present the risk management of their companies.

Figure 3-11: Interview agenda for model development

Interview Agenda

1. General Information

- How many years have you been involved in managing or operating international logistics?
- How many years have you worked for the current company?
- What is your job description in this company?
- How would you describe international logistics operations of your company?

2. Risk Profiles

- What are the main uncertainties and risks in your international logistics operations?
- What will be the future challenges in planning and operating international logistics?

3. Risk Management Strategies

- What are the responses of your company to the uncertainties and risks that you have mentioned?
- On what kinds of risks do the responses have an impact?
- What does your company prefer between independent strategies and co-operative strategies?
- What does your company prefer between strategies to reduce information processing needs and strategies to enhance information processing capability?

4. Determinants of the Strategies

- What factors affect the choice of your risk management strategies?
- Who is primarily involved in the process of selecting risk management strategies?
- To what extent are risks and risk management considered important in your company?
- How would you describe the relationship with your suppliers / customers?
- How would you describe the relationship with your logistics service providers?

5. Outcome of the Strategies

- What do you think is the important quality/capability for robust and resilient management of international logistics risks?
- Do you think that the current risk management strategies are sufficient to foster the capability? If not, what strategies will be further considered for implementation?

The interview began with asking general information of the case companies and interviewees, and then transferred to questions about risk profiles of the case company to stimulate the interviewees to think about risks within their operations as well as their reactions. In the third phase of the interview, they were requested to explain the risk management strategies and practices. At this stage, the conceptual model of risk management strategies was completed based on the information processing theory, which played a role of guidelines for the interviewees. The conceptual model was, in general, agreed by the interviewees and populated by industry practices. (This conceptual model will be elucidated in detail in Chapter 5.) Later, the interviewees discoursed about the factors affecting the selection and implementation of risk management strategies and practices, which was followed by questions about the effects of risk management. The interview agenda can be found in Figure 3-11.

3.3.1.3. Analysis of case study interviews

The interviews were all tape-recorded and transcribed. The coding process using keywords helped the sorting of lengthy transcripts into a logical order. A spreadsheet was used to accommodate essential transcripts that can adequately address the research questions. The archival data provided by interviewees also helped to understand the backgrounds and progress of risk management initiatives of case companies. As the interviews were originally in Korean, an external bilingual translator was employed to translate essential transcripts into English.

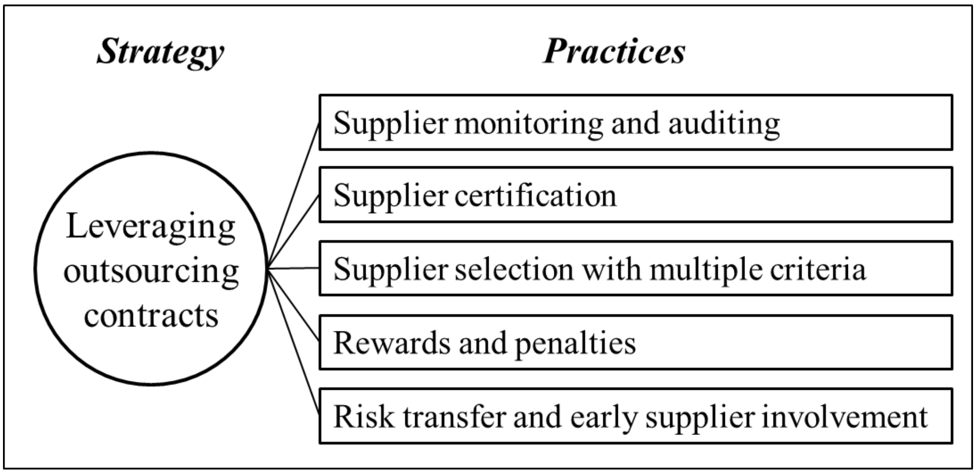
3.3.2. Model development

The objective of developing a research model, as briefed in Figure 3-10, is to understand the antecedents and outcomes of risk management strategies in more detail. Also, it can be tested in the later stage using large-scale survey data. The research model consists of constructs and hypotheses that can create measurement models and a structural model respectively. The findings from case study interviews were intertwined by existing literature to provide insights as to how a firm can effectively manage risks in international logistics.

3.3.2.1. Measurement models

As illustrated in Figure 3-10, the measurement models had to be developed in risk management strategies as well as organisational orientations and risk management outcomes. Firstly, risk management strategies were conceptualised with empirical evidence and populated by the industry practices. Contrary that the initial conceptual model had the labels from Type 1 to Type 4 strategies, the findings from the interviews can provide proper titles that can best illustrate each type of strategy. With having the clear definition of each strategy, industry practices at the operational and tactical level, which were independently studied in the literature, were organised under the overarching strategies. As a result, each strategy was populated by practices found in the interviews and the literature.

Figure 3-12: An example of measurement models



Secondly, organisational orientations and risk management outcomes that have close associations with risk management strategies were selected in reflection of the interviews. Although the constructs were effectively extracted from the interview findings, the details of the constructs were not fully discussed in the interviews because the discourse about strategies occupied the majority of interview time. To this end, further literature review on these constructs was conducted to create measurement models, particularly developing the observed variables to be used as measurement scales. In total, three organisational orientations and two desired outcomes emerged as the measurement models, together with four constructs relating to risk management strategies.

3.3.2.2. Structural model

Given the basic model in Figure 3-10, research hypotheses were developed by the interviews and literature review. As the basic model assumes the positive relationships between organisational orientations, risk management strategies and risk management outcomes, the hypotheses were also set up to state the positive relationships between constructs. However, both accepted and rejected hypotheses will be equally focused on because the comparisons of the two groups will illuminate the relationships of antecedents and outcomes with a specific strategy which a firm can selectively adopt. The hypotheses generated a structural model that will be validated in the following phase of the thesis.

3.4. Research Methods for Model Validation

This phase of research aims to validate the measurement and construct models developed in the previous phase in order to provide generalised and empirically-backed answers to the second research question. For the validation, a large-scale survey was adopted as a data collection technique. The data collected from a questionnaire survey were analysed by descriptive statistics, ANOVA and Partial Least Square Structural Equation Modelling (PLS-SEM).

3.4.1. Questionnaire survey

3.4.1.1. Questionnaire development

The initial survey design begins with item generation whose main aim is to satisfy content validity in order to verify whether scale items accurately reflect constructs that the items intend to measure (Saunders *et al.* 2012). Thus, the generated items must have clear linkages to theoretical framework as well as appropriate wordings to represent the construct.

Spector (1992) recommended an inductive approach which defines the construct in reflection of theory and generates items to support this definition. Theoretical basis and rigorous literature search, thus, is often supplemented by expert opinions in order to develop items and ensure content validity, which is particularly important when the theory is underdeveloped or when knowledge in practice has not been sufficiently studied. As shown in Section 3.3, this study adopted eleven case study interviews to seek expert opinions to build up the theoretical and practical basis of questionnaire items.

This research will generate several strategic approaches to risk management in international logistics operations which are built upon organisational and inter-organisational theories. Extensive literature review on risk management practices that are effective to international logistics contexts were sought by comparing and contrasting a number of SCRM studies. The identified practices will be initially sorted into one of the strategies taking the definitions of the strategies into account. In this process, practices with different titles but same meaning will be merged into one representative practice so as to clarify the practice. Eight case study companies will review the preliminary constructs (strategies) and items (practices). The interview questions relating to scale development are:

(1) The general risk management strategies and practices of the firm;

(2) Specific example practices for each strategy;

(3) Sorting of practices into specific strategies; and

(4) Any missing practices in the preliminary constructs and items.

Item generation is completed with the use of a sorting process that specifies items into theoretical definitions of constructs (Hinkin 1995). Content validity can be ensured by this sorting process of third party with or without experience in the studied area. This questionnaire adopted seven-point Likert scales from 1 to 7 to measure the perceptions of respondents from ‘strongly disagree’ to ‘strongly agree’ with the middle value labelled as ‘neither agree nor disagree.’

When the initial questionnaire is generated by the aforementioned processes, Q-sorting method was applied. Q-sorting is a process to check whether a latent variable is well represented by observed variables. It is conducted by providing research participants with a full set of observed variables without informing latent variables and asking them to group the variables. If the accuracy rate exceeds 80%, the questionnaire deemed to appropriately represent latent variables with a set of observed variables.

The participants of Q-sorting can be either experts or non-experts in the topic. This research invited five experts in international logistics and five non-experts to evaluate the observed variables. Moreover, feedbacks from the participants regarding the model were also sought to improve the questionnaire. Each participant’s responses were collated in a spread sheet to calculate the accuracy rate as well as to find out any common mismatching which needs to be rectified in the later stage. The overall accuracy rate of Q-sorting was 83.8%, which is satisfactory enough to use the initial questionnaire but some minor amendments were made to the statement of several observed variables given the advice from participants to improve clear understandings. For example, three observed variables found to be commonly misleading for some of the Q-sorting participants have been amended to explain their corresponding latent variables.

After finishing Q-sorting, the questionnaire in English was translated into Korean because this survey was to be conducted in South Korea. Two bi-lingual translators were recruited for the translation process: one translated the English version into Korean, and the other tried back translation from Korean to English to check whether the translation was acceptable. This translated version was provisionally distributed to 16 logistics experts in Korea for the purpose of pilot study. Their feedback was also reflected in the final version of questionnaire.

Appendix E (in English) and appendix F (in Korean) are the original questionnaires designed to measure the variables in this research. In addition, they included other variables for future studies relating to international logistics risk management. Basically, the measurement items for three organisational orientations (part 2), four risk mitigation strategies (part 3) and two outcomes (robustness and resilience in part 4) were used for this research according to the research model to be outlined in Chapter 5. As for the contingencies, available resources in part 1 as well as industry and company size in part 5 were selected. Although other contingencies will have an impact on risk management, the number of contingencies in this research was minimised to mainly focus on the most relevant issues.

To this end, corporate culture, risk characteristics, relationships, influence, innovation initiatives (part 1), logistics complexity, innovation (part 2) and competitive advantage (part 4) were set apart for future studies. For instance, relationships between innovation, robustness, resilience and competitive advantage will be validated in a separate research project. Another future research can be about the influential power of various contingencies on each risk mitigation strategy.

In the questionnaire, the contingencies in part 1 were measured by 6-point Likert scale whilst other parts were measured by 7-point scale. This is because part 1 was intended to create different groups which can show the differences in risk management. Having 6-point scale, two groups or three groups can be easily formulated according to the scale. As the variables tested in the research model were all measured by 7-point Likert scale, however, this difference in measurement scale posed no significant issues in model validation.

3.4.1.2. Sampling for questionnaire survey

The sampling process was carefully designed to incorporate diverse industries which will be keen to acquire risk management in international logistics in order to create robust and resilient logistics networks. The sample includes shippers (exporters and importers) and logistics intermediaries who operate international logistics integrating various logistics service provided by asset-based logistics service providers. The sample of logistics intermediaries was obtained from the industry directory published by KIFFA (Korea International Freight Forwarder Association) which was cross-checked with the most recent Korea Shipping Gazette. Since 612 logistics intermediaries eventually emerged, the same number of shippers was selected with random sampling from the lists provided by KILA (Korea Integrated Logistics Association) and KOIMA (Korea Importers Association) and

Korea Chamber of Commerce. A single response was collected from one company to minimise respondent variance.

3.4.1.3. Administration of questionnaire survey

The questionnaire survey was conducted with over 5 weeks in March and April 2014. The questionnaire was converted into an online version at Google Docs to make it easier for respondents to answer the questions. In addition, it had advantages in easy distribution and automatic coding of the answers on a spreadsheet. The invitation letter to the questionnaire survey was sent to the 1,224 companies via an e-mail containing a link to the online survey. Two reminders, the one at the end of week 2 and the other at the end of week 4, followed to encourage the companies to participate in the survey. As a consequence, 174 usable responses were collected showing the response rate of 14.2%.

3.4.2. Descriptive statistics and ANOVA

Three statistical analyses were applied to this research. The first was descriptive statistics of mean and standard deviation, which can show the degree to which companies implement specific risk management strategies and practices. Likewise, the levels of organisational orientations and of risk management outcomes can be easily understood and compared by numerical figures. The second was Analysis of Variance (ANOVA) which tested the difference between two groups given some business contexts. ANOVA is a statistical test of a null hypothesis which states that all the group means are equal (Hair *et al.* 2010), thus best suited for this purpose. In this research, ANOVA tested any mean differences in risk management and its outcomes that can be brought about by business contexts, such as industry, company size and available resources. As ANOVA assumes the normal distribution of data, normality of the data set was tested by skewness and kurtosis. Although most measurement items were negatively skewed with negative kurtosis, the level of skewness and kurtosis was within critical ratios.

3.4.3. PLS-SEM

Structural Equation Modelling (SEM), encompassing both Covariance-based SEM (CB-SEM) and Partial Least Squares SEM (PLS-SEM), is referred to as second generation data analysis techniques (Bagozzi and Fornell 1982) which can test interrelated hypotheses in a single, systematic and comprehensive analysis (Gefen *et al.* 2000) by modelling the multiple relationships among independent and dependent variables (Gerbing and Anderson 1988). Contrary to the first generation techniques, such as linear regression, ANOVA and MANOVA, have a limitation in that they can examine only one layer of relationship at a time, SEM enables researchers to test a series of dependent relationships at the same time (Gefen *et al.* 2000; Hair *et al.* 2010). Given the real world with intricate casual networks, SEM is rated as an effective analysis technique that can embrace the complex processes to serve both theory and practice (Gefen *et al.* 2000). When the model is so intricate that a dependent variable in the first hypothesis becomes an independent variable in the later hypothesis, SEM is a useful technique to examine the underlying relationships of all the latent variables simultaneously (Hair *et al.* 2010).

In addition, SEM has an advantage to evaluate both the measurement and structural models in one technique (Hair *et al.* 2010). This does not just enable the factor analysis to be embedded in the hypothesis testing, but also integrates the measurement errors of observed variables into the hypothesised model (Gefen *et al.* 2000). Without using SEM, it is required to conduct two unrelated tests (1) to examine the loading of observed variables on the latent variables via factor analysis and (2) to examine the hypothesised relationships (Gefen *et al.* 2000).

Despite the methodological merits of SEM, just a few SCRM studies have used SEM as an analysis technique. As far as the author acknowledged, the application of SEM to SCRM research can be found in Braunsheidel and Suresh (2009), Cheng *et al.* (2012) and Kern *et al.* (2012). Interestingly, these three studies do not have any common constructs. Also, they didn’t directly measure the risk management strategies. On the contrary, there are several studies which used regression analysis of multi-scale variables. Zsidisin and Ellram (2003), Wagner and Bode (2006), Wagner and Bode (2008), Zsidisin and Wagner (2010), Bode *et al.*

(2011) will be the examples of these studies. Nonetheless, the number of researchers utilising regression analysis is still limited.

3.4.3.1. PLS-SEM vs. CB-SEM

SEM can be divided into PLS-SEM and CB-SEM. They have a similarity in testing the measurement model and structural model simultaneously, but distinctions in the analysis objectives, the statistical assumptions and the nature of the fit statistics among others (Gefen *et al.* 2000). In fact, terminologies, analysis process and result presentation used in PLS-SEM are heavily influenced by CB-SEM (Chin 2010) because CB-SEM is a dominant analysis technique over PLS-SEM. Therefore, it is required to identify the differences between these two techniques in order to illuminate why PLS-SEM is an appropriate method for this research.

(1) Analysis objectives

When it comes to analysis objectives, CB-SEM focuses on the theoretical fit of the model whereas the latter produces parameter estimates that can be used for prediction (Hair *et al.* 2010). The objective of PLS-SEM, in this regard, is to show high R2 and significant t-values, which is very similar to linear regression that test the null hypothesis of no-effect (Gefen *et al.* 2000). On the other hand, as CB-SEM sets up the null hypothesis of the entire model, it aims to examine the complete set of all the paths that are generated by the operationalization of theories (Gefen *et al.* 2000).

(2) Statistical assumptions

The assumptions about data characteristics are minimal in PLS-SEM, particularly in terms of normality of data and types of data (Hair *et al.* 2010). Multivariate normality is strictly assumed in CB-SEM which uses Maximum Likelihood (ML) functions as default estimation. Though there are several ways to deal with the non-normality, such as weighted least squares and bootstrapping (Byrne 2001), they cannot perfectly banish the assumption of normality.

On the other hand, the parametric assumption is not the pre-requisite for the estimation techniques in PLS-SEM. To this end, PLS-SEM can analyse the data without multivariate normality.

(3) Analytical technique

As an analysis technique, PLS-SEM is based on regressions which focus on explanation of variance rather than covariance (Hair *et al.* 2010). PLS-SEM estimates its coefficient using the variance of the indicator from the mean like regression, but partials out variance from the structural model through iterative analysis, which is common with CB-SEM (Gefen *et al.* 2000). However, PLS-SEM cannot provide any model fit statistics as CB-SEM normally produces. Therefore, the significance testing for parameter estimates can only be possible by using either a jackknife or bootstrapping technique (Gefen *et al.* 2000; Hair *et al.* 2010).

(4) Formative construct

Being impossible to be measured directly, latent variables always require measurement models of indicators or observed variables. As CB-SEM assumes that the observed variables reflect the latent variables, the arrows between observed and latent variables point away from the latent variables (Gefen *et al.* 2000). For these reflective constructs, therefore, the indicators are caused by latent variables. If the indicators cause the latent variables, in contrast, it is called formative measurement which can be examined only by PLS-SEM (Gefen *et al.* 2000; Hair *et al.* 2010).

In sum, Hair *et al.* (2011) recommended that the research with the following characteristics is better to select PLS-SEM rather than CB-SEM.

(1) Research goals: exploratory research, extension of existing theory, prediction of key target constructs and identification of key “driver” constructs

(2) Measurement model: formative and/or reflective constructs

(3) Structural model: complex model with many constructs and indicators

(4) Sample size: relatively low sample size

(5) Data characteristic: non-normal distribution of the data

(6) Model evaluation: latent variable scores for subsequent analysis

Table 3-4: Comparisons between PLS-SEM and CB-SEM

Criteria	CB-SEM	PLS-SEM
Statistics		
Analysis of overall model fit	Provided	Provided
Analysis of individual causation paths	Provided	Provided
Analysis of individual item loading paths	Provided	Provided
Analysis of residual non-common error	Provided	Not Provided
Types of variance examined	1. Common 2. Specific 3. Error	Common combined specific and error
Analysis of statistical power	Not available	Available through the R^2 statistics
Capabilities		
Examines interaction effect on cause-effect paths	Supported	Supported
Examines interaction effect on item loadings	Supported	Not readily supported
Examines interaction effect on non-common variance	Supported	Not readily supported
Examines interaction effect on the entire model	Supported	
Can cope with relatively small sample size	Problematic	Supported
Readily examines interaction effect with numerous variable levels	Problematic	Supported
Can constrain a path to a given value	Supported	Not supported
Examines nested model	Supported	Supported

(Source: Adapted from Gefen *et al.* 2000)

In SCRM research, Kern *et al.* (2012) highlighted that the distribution-free method, small sample size, predictive applications and theory building are the main reasons for their selection of PLS-SEM as the appropriate analytical technique. When it comes to this research, the application of PLS-SEM has merits in research goals and complexity of the structural model. Firstly, the hypotheses generated in this research have both exploratory and confirmatory aspects in nature, which are against the assumptions of CB-SEM. In this thesis, confirming a research model as a whole is not an objective: rather, it seeks to find whether a certain organisational orientation has an impact on a certain risk management strategy, or as to whether a certain risk management strategy has an impact on a certain outcome. In this sense, this research is more or less similar to multiple regressions which try to find out the statistically significant independent variables among a set of variables. Secondly, there are a total of 22 hypotheses in this structural model, which is too complicated to apply CB-SEM. At a glance, this thesis will present seven representative hypotheses combining the risk management strategies as one concept. However, if four strategies are expanded, the total number of hypotheses becomes 22. As PLS-SEM showed more methodological fit to this research than CB-SEM did in these aspects, PLS-SEM was adopted in this research for the model validation technique.

3.4.3.2. PLS-SEM procedure

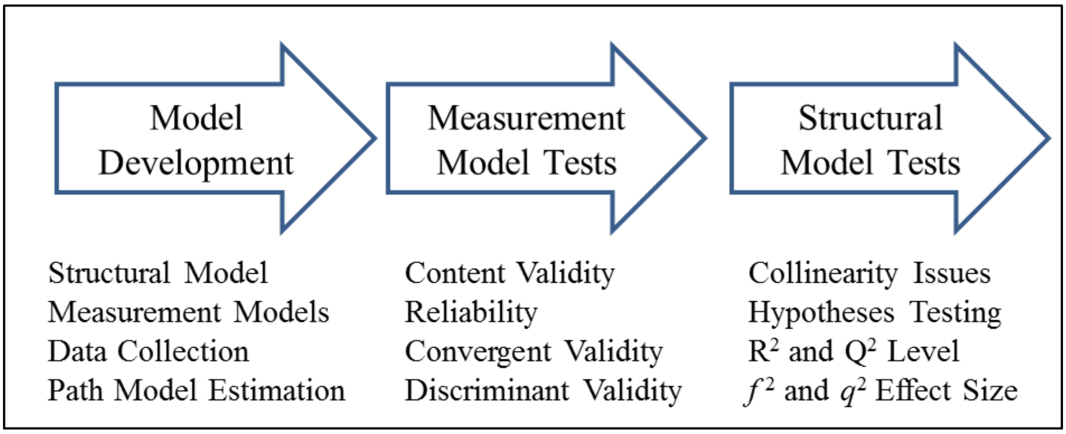
Hair *et al.* (2014) suggested that the procedure of applying PLS-SEM comprises of seven stages as follows:

(1) Specifying the structural model
(2) Specifying the measurement models
(3) Data collection and examination
(4) PLS path model estimation
(5) Assessing PLS-SEM results of the measurement models
(6) Assessing PLS-SEM results of the structural model
(7) Interpretation of results and drawing conclusions

The very initial step of PLS-SEM technique is to draw a path model that can reflect the research hypotheses and relationships between variables. Path models consist of the structural model and the measurement models, which are also referred to, in PLS-SEM, as the inner model and the outer model respectively. To this end, this procedure separates the development and analysis of the structural model and the measurement models. The measurement model makes it possible to produce a questionnaire to collect data to be examined. Also, the structural model leads to the estimation of the PLS path model. The initial four stages of the PLS-SEM procedure will be dealt in the model development chapter

(Chapter 5). On the other hand, the statistical analysis starts from stage 5, which will be described in Chapter 6.

Figure 3-13: The process of PLS-SEM analysis



(Source: Adapted from Hair *et al.* 2014)

3.4.3.3. Model tests

The measurement and structural models were analysed by SmartPLS 2.0 (beta) software package (Ringle *et al.* 2005). The tests for measurement models are similar to those for CB-SEM, except that PLS-SEM does not produce model fit indices. The measurement model is expected to meet reliability and validity in order to avoid any measurement errors, which is assessed by content validity, reliability, convergent validity and discriminant validity.

Content validity is the degree to which a construct is represented by scale items to embrace the meaning of the construct (Garver and Mentzer 1999). There is no statistical analysis to prove the existence of content validity; rather it is evaluated by checking whether the construct is adequately reflected by scale items (Churchill 1979). Reliability is commonly measured by Cronbach’s alpha. However, Cronbach’s alpha is criticised as it is inflated when the number of scale items is increasing and it assumes the equal reliability of every item (Fornell and Larker 1981; Gerbing and Anderson 1988). Therefore, composite reliability and average variance extracted (AVE) were introduced in consideration of the measurement errors and the amount of variance within a construct (Hair *et al.* 2010).

Convergent validity is the extent to which a construct correlates to its scale items (Garver and Mentzer 1999). To this end, factor loadings of each item on a construct are used to assess convergent validity. Discriminant validity, on the other hand, is the extent to which scale items reflecting a construct discriminate the construct from other constructs (Garver and Mentzer 1999). There are several ways to evaluate the discriminant validity, but the most common method is to compare AVE of each variable with a construct's highest squared correlation with any other latent variables.

On the contrary that CB-SEM's structural model is tested by the overall model fit, PLS-SEM emphasises the significance of the relationships between variables (Gefen *et al.* 2000). Though PLS-SEM doesn't provide any information about the overall model fit, the structural model can be evaluated by the R^2, Q^2, the significance tests and the effect size tests using a bootstrapping and a blindfolding technique.

After passing the collinearity test, the degree of R^2 and Q^2 can be examined. Due to the prediction-oriented purpose of PLS-SEM, high R^2 level is required to explain the endogenous latent variables' variance (Hair *et al.* 2011). Stone-Geisser's Q^2 is also used to understand the model's predictive capability by using blindfolding procedure.

The statistical significance of the parameter estimates for dependent relationships can be verified by using bootstrapping methods. Bootstrapping is a technique of repeated sampling (Hair *et al.* 2010). With the minimum number of 5000 samples, the significance test can be conducted (Hair *et al.* 2011). If the t-values are larger than the critical t-values determined by the significance level, then the parameter estimate can be assessed to be significant.

The effect size test can be conducted by identifying the substantial effect of independent variable on the dependent variable (Chin 1998). The f^2 value, which represents the effect size, can be computed as follows:

$$f^2 = \frac{R^2_{included} - R^2_{excluded}}{1 - R^2_{included}}$$

where $R^2_{included}$: R^2 when the independent variable is included; and
$R^2_{excluded}$: R^2 when the independent variable is excluded.

Table 3-5: Criteria for model tests

Model	Criteria	Thresholds
Measurement Model	Content Validity	No statistical tests
	Reliability	Composite reliability > 0.7 Cronbach's α > 0.7 Average variance extracted > 0.5
	Convergent Validity	Indicator loadings > 0.7
	Discriminant Validity	1. AVE of each latent variable > the construct's highest squared correlation with any other latent variables 2. Indicator's loadings > all of its cross loadings
Structural Model	Collinearity assessment	VIF of predictor constructs < 5
	R^2 for endogenous latent variables	Substantial (0.75^+), Moderate (0.50^+), Weak (0.25^+)
	Predictive relevance	Q^2 value > 0 (with using blindfolding)
	Path coefficients' significance (Hypotheses testing)	T-value > critical value (with using bootstrapping)
	f^2 and q^2 effect sizes	Large effects(0.35^+), Medium effects (0.15^+), Small effects(0.02^+)

(Source: Adapted from Hair *et al.* 2011)

3.5. Concluding Remarks

This chapter proposed the overall research design of this thesis and explained in detail the methods to be applied to each research phase. Firstly, it discussed research philosophy, research approach, research strategy, time horizon and research choice as an overarching idea of research methodology. Subsequently it presented and justified the mixed data collection and data analysis methods in the three research phases: risk identification and analysis, model development and model validation. The sampling process, administration and data analysis method of focus group, interpretive structural modelling, case study interviews and statistical analyses including PLS-SEM were discussed in detail to define the methodology. The following chapters from Chapter 4 to Chapter 6 will apply this methodology to empirical settings to investigate the interconnected features of international logistics risks, risk management strategies to break the self-enhancing risk spiral as well as the antecedents and outcomes of those strategies.

Chapter 4

Analysis of International Logistics Risks

This chapter is dedicated to addressing the first research question as to how to understand the risks in international logistics. It aims to identify and analyse the risks, specifically focusing on the interconnectedness of risk factors. With this purpose in mind, a mixed method approach of focus group discussions and interpretive structural modelling (hereafter, ISM) was adopted not just to produce a list of risks and risk taxonomies but also to comprehensively understand the structure of those risks for effective risk management. Given the research objective and research gaps, this study established three research questions to be addressed in this chapter as follows:

RQ1: What are the risk areas to be managed in international logistics?

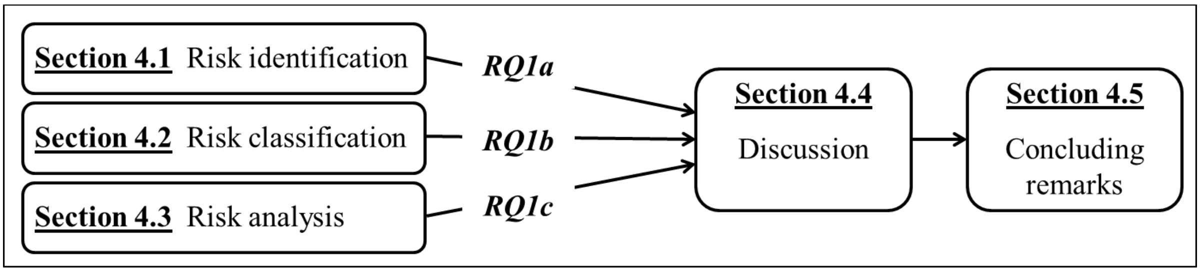
RQ1a: What are the risks in international logistics operations?

RQ1b: How are these risks understood by using clustering?

RQ1c: How are these risk clusters interacting with each other?

This chapter comprises five sections. The first section will identify individual risk events in international operations by presenting the findings from focus group discussions. The risk events will be categorised in the second section by the classification patterns found in the discussions. The third section will analyse these risk clusters using ISM in order to provide a comprehensive outline of international logistics risks in consideration of their interconnectedness. These findings will be further discussed in the fourth section to highlight the structure of international logistics risks, which will be followed by concluding remarks.

Figure 4-1: The outline of Chapter 4



4.1. Risk Identification

Identification of risks in international logistics is the foremost phase of risk management which provides the profiles of risks that should be mitigated. To identify as many risks as possible, the use of focus groups was adopted as a research method because the group discussion can stimulate participants to exchange their experience of logistics disruptions and to generate the list of critical risk events.

Six focus group discussions were held in January 2012. The six groups comprised of (1) the academician group, (2) the importer group, (3) the 3PL provider group, (4) the carrier group, (5) the international freight forwarder group and (6) the exporter group. Participants were invited to a quiet seminar venue where six participants could discuss the topic for two hours without disturbance. The facilitator took notes of the discussions and also tape-recorded them for transcription on the consent of participants. Every focus group discussion took approximately two hours to complete the three stages of discussion as outlined below:

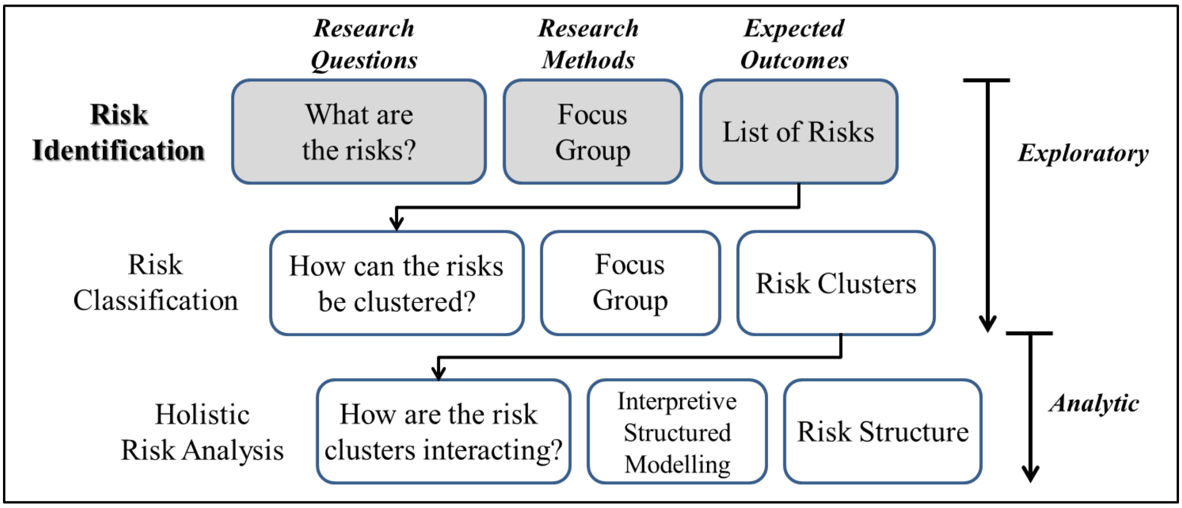
(1) A free discussion on disturbances and disruptions in operating international logistics;

(2) Presenting and clarifying approximately 10 critical risks in international logistics; and

(3) Clustering those risks by using a cause and effect diagram.

Among these discussion topics, the first two are related to risk identification. To this end, this section will be dedicated to present the findings from these two discussions.

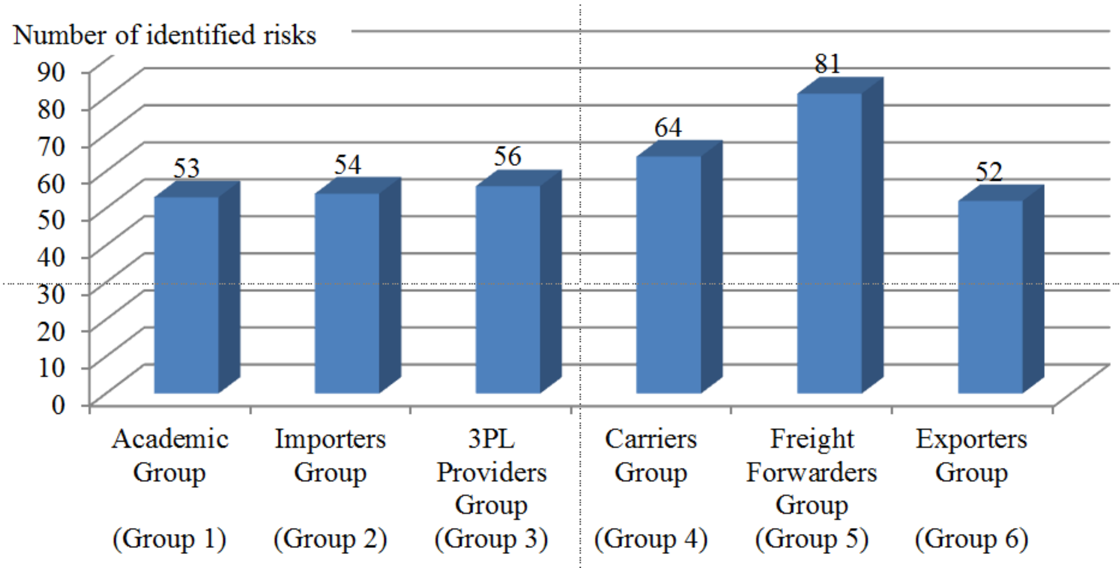
Figure 4-2: Risk identification and other research phases



In the first brain-storming stage, groups of logistics service providers (hereafter LSPs), i.e., freight forwarders, 3PL companies and carriers, were more vigorous in the discussion than shipper groups (exporter and importer groups) to talk about their experience. This was partly because one of their routine tasks is dealing with shippers' complaints relating to logistics disruptions. Also, it may depend on the priority of logistics activities because the value of LSPs' activities mainly lies in the logistics excellence, whereas logistics is just a small part of the business activities of shipper groups. The majority of experiences exchanged were largely sympathised by other participants although there were some risks that could happen only in certain logistics circumstances. As Peck (2005) pointed out, participants shared an idea of risk with a story of causes and effects, which is enhanced by the experiences of other participants. Thus, a series of logistics disruptions and their subsequent losses was often presented by participants, which highlighted that risk events should not be evaluated independently but analysed in a comprehensive manner.

After sparing sufficient time for open discussions, participants were asked to write down approximately ten international logistics risks they thought most critical. They were provided with a dozen separate notes so that only one risk could be written on one note. Even at this stage, the groups of LSPs continued to be more active, presenting more risks than those of shippers. After completing the writing down of the risks, the participants shared their answers to clarify the exact nature and context of each risk. Each participant explained every risk that he/she wrote to other participants and corrected some risks into appropriate wordings if necessary. Eventually, a total of 360 risks were collected from 36 participants in 6 groups, which meant that each participant proposed 10 risks on average. The number of risks counted by each group is shown in Figure 4-3. The most productive group, which is the international freight forwarders group, presented 50% more risk factors than the exporters group did.

Figure 4-3: The number of risks suggested by each group

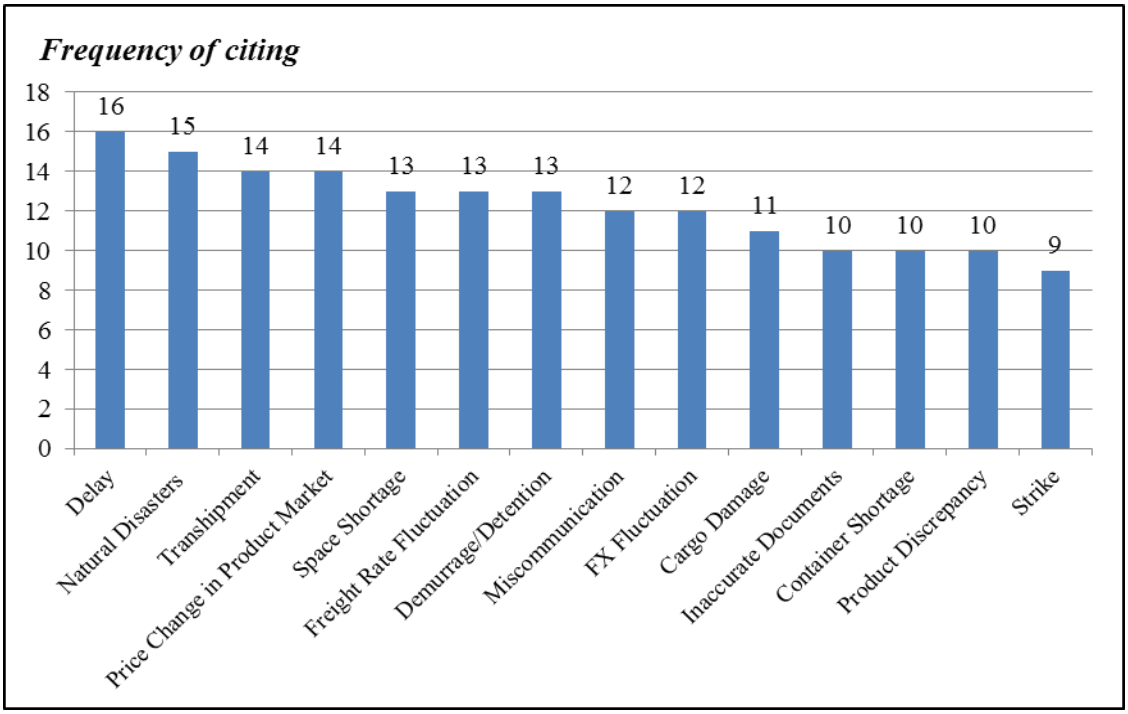


(Source: Author)

When the participants were asked to write down critical risks in their daily operations of international logistics on separate notes, a total of 360 notes were collected. Initially, there were over 100 different risks according to the words and phrases they wrote down. In the later discussions, however, different words describing the same concept were incorporated into one kind of risk, which reduced the number of different risks to 88. There were several risks about which more than one third of the participants agreed, whereas certain risks were identified by only one participant. Figure 4-4 shows the risks that participants mentioned most frequently. If it is presumed that the most frequent relates directly and closely to the criticality of the risk factors, the risks referred to most frequently can be interpreted as the critical disruptions in international logistics operations.

According to the list of identified risks, international logistics has unique risks compared to the risks suggested by SCRM literature. When confined only to the most-frequently-mentioned risks shown in Figure 4-4, international logistics risks comprise the risks that are common in general supply chain management and the risks that are unique to international logistics. The examples of the former will be delay, availability issues (container/space shortage), miscommunication, product discrepancy (order completeness) and strikes, which can happen in general supply chain operations regardless of whether they are domestic or global. As these risks have been well explained in the SCRM literature, it is not necessary to explain all of them again in this research.

Figure 4-4: The most frequently mentioned risks



(Source: Author)

On the other hand, transhipment, freight rate fluctuation, document inaccuracy and demurrage/detention have rarely appeared in the SCRM research while they are considered to be critical in international logistics risk management. The participants who raised these risks tried to explain the seriousness of these issues in the international logistics contexts.

Transhipment is an operation at terminals or inland container depots to transit a loaded container from one mode to another so that the container can complete the subsequent legs of the transport. Due to the hub and spoke transport system, the networks of sea transport consist of main routes and feeder routes. This means that only large ports can be included on the main routes but small- or medium-sized ports are only served by feeder vessels which inevitably require cargo transhipment. Unless both the port of loading (POL) and the port of discharging (POD) are large ports on the trunk routes, feeder transhipment cannot be avoided in this network. For instance, if the POL is Shanghai in China and the POD is Hamburg in Germany, no feeder transhipment is needed because they are large ports at which main vessels connecting East Asia and Europe call. However, if the POD is Helsinki in Finland, there should be at least one feeder transhipment at Hamburg in Germany or at Rotterdam in Netherlands. Participants in this study warned that various consequences arise from transhipment, such as delay, cargo damage, cargo loss and failure to track cargo. The delay is, in particular, a serious problem because slight delay in the first leg of transport can be lead to a one-week delay given the weekly schedule of the second leg of transport. Although the likelihood is not very high, cargo damage and loss can also occur when cargo is unloaded, stored and loaded again at the transit port.

Freight rate fluctuation is a rare event in domestic transport where freight rate is normally fixed by an annual contract and will not change very frequently. In the sea transport, however, freight rate may be changed on a monthly- or even weekly-basis, which is why participants considered it as a critical risk. The recent figures make it apparent how freight rate fluctuation is prevalent in the liner shipping market. During only three weeks in September 2013, the all-in rate from Shanghai to Rotterdam was reported to have dropped from $966/teu to $765/teu. To recover the rate at financially viable levels, Maersk, the world’s largest liner shipping company, announced a $950/teu of general rate increase (GRI) in November 2013 (Damian 2013). Nonetheless, it is not very certain that the GRI can bring about the full recovery of rates because it solely depends on the negotiation between shippers and liners. The enormous ups and downs themselves have significant influences on shippers, but the issue becomes more complicated with the fact that the extent of rate fluctuation will vary across liner companies and individual shippers in this stagnated market situation.

The ocean freight rate is determined by the supply and demand of vessel spaces. As for shipping companies, the load factor is an imperative issue because the unused vessel spaces cannot be stored and the low load factor results in the high average cost per container given the high fixed costs compared to variable costs. In this respect, shipping companies strive to allure cargoes by offering discounted freight rates if the demand is being diminished. The reduction of freight rates looks at a glance beneficial to exporters and importers, but it can create conflicts between the parties because the profit from the low freight rate goes only to one party according to trade terms. When the freight rate goes up because of increasing demand for vessel space, the problem becomes worse. Although there are annual contracts such as service contract (S/C) between shippers and liner companies, the freight rate can be easily altered by a unilateral announcement of general rate increase when it is notified one month in advance. If the market is growing, GRI may be declared almost every month, and shippers have no option but to accept it to book vessel spaces for the timely transport. In this case, the profit expected from international trade is seriously undermined, and moreover, the quality of shipping service is also eluded. Although the time when the focus group discussions were conducted it was the shipper's market with low freight rates, many participants were concerned about this issue and spared much time to discuss about it.

Document inaccuracy is quite prevalent in international trade and logistics, but has not been properly covered in supply chain risk management. Errors in documents such as commercial invoices, packing lists and bills of lading can be just clerical, but their impact in international logistics can be serious. For instance, if the consignee's name on the B/L is slightly different from the original consignee, shipping lines may refuse to deliver the goods to the consignee, which can lead to at least one or two days' wait while errors between the shipper, the shipping line and the consignee are being rectified. In addition, if a document is related to quality and regulation issues, import of the products to a country or launching of the products in a new market can be entirely prohibited. In particular, if supply chains require seamless flows of goods within a specific timeframe, the delay caused by amending and sending the document can disrupt the overall production or supply plans of a product.

Demurrage and Detention is another problem unique in maritime transport. Demurrage is imposed when loaded containers are not removed from port yards of both POL and POD beyond a certain period of time, and often comes with storage charges imposed by terminal operators. At the POL, exporter's failure in logistics planning or forecasting may leave loaded containers in the port yard longer than expected. There are more reasons for the demurrage occurring at the POD which deter importers from taking delivery of the cargo in time. Since cargo cannot be taken without an accurate original bill of lading in normal practices, delay in shipping documents and inaccurate documents results in importers with no right to claim the cargo, thereby incurring demurrage. Sometimes, there may be conflicts in the cargo entitlement, product price or other issues between trade partners, which delay the cargo delivery. Even when demurrage is being accumulated due to continuous conflicts between partners, demurrage itself becomes a source of a new conflict which aggravates the situation. Detention occurs when containers are not returned to shipping company's premises in time due to a delay in the loading and unloading schedule at shipper's warehouses. Demurrage and detention, therefore, cause unexpected increases of logistics costs as well as other risks emanated from them.

When the entire range of risks identified in the focus group discussions is considered, as demonstrated in Table 4-1, there are more risks that are exclusive to international logistics, such as customs clearance issues, shipping surcharges, port congestion and etc. It may be concluded that the characteristics of risks in international logistics are similar to supply chain management and domestic logistics, but have significant distinctions particularly when it comes to liner shipping operations and cross-border cargo movement. Although participants have taken only a cargo owner's perspective to international risks into account, the detailed risk events showed discrepancies from the risks in SCRM. They paid more attention to relatively low reliability and high vulnerability in sea transport which may undermine the values expected to be achieved by global trade, rather than other logistics activities that have been topics in SCRM research. More specifically, these findings address low-frequency but high impact risks, which is often overlooked by most companies and less studied by the SCRM research (Chopra and Sodhi 2004; Faisal *et al.* 2006). Another notable point is that commercial issues, such as the financial credit of trade partners and product price in the market were also frequently mentioned by participants as international logistics risks. This may be because vulnerabilities in international logistics, such as long lead time, uncertainty from trading with an unknown party and few methods to resolve misunderstandings, may bring about commercial instability which can badly disrupt logistics operations.

As Jüttner *et al.* (2003) argued, however, the list of risks identified by participants encompasses various hierarchies of risk concepts, which means one risk can embrace some of the other individual risks. For instance, the most common risk, delay, was broad enough to cover other risks such as shortage of equipment, shortage of space and transhipment. The same issue also matters in the cargo damage risk because there were so many reasons for cargo damage detected by participants. Some of the participant groups identified this problem when they reviewed the risks on their notes, thus admitted that their list consists of different dimensions of risks because some of them are risk events and others are consequences. This rationalisation helped participants understand that there are certain types of risks which can more effectively explain the characteristics of risks in international logistics.

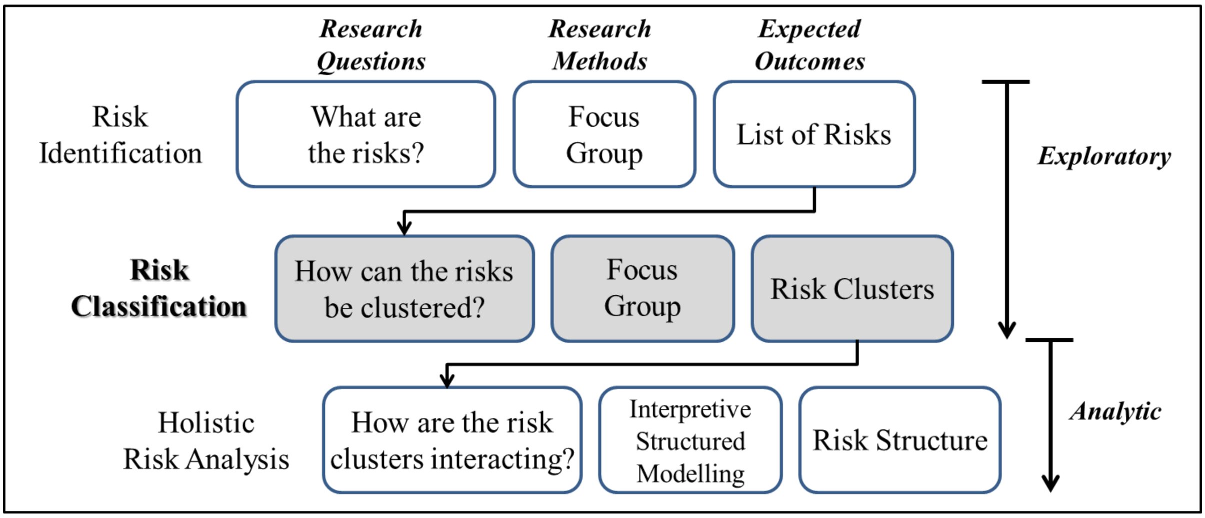
Table 4-1: The full list of identified risks within international logistics

High Frequency		Medium Frequency		Low Frequency		Low Frequency	
Risks	**Freq**	**Risks**	**Freq**	**Risks**	**Freq**	**Risks**	**Freq**
Delay	16	Cargo Tracing & Tracking	8	L/G Acceptance	2	Local Feeder Quality	1
Natural Disasters	15	Unclear Liable Party	8	Cultural Gaps	2	Filthy Containers	1
Transshipment	14	Reliability of Trade Partners	7	Nomination of LSPs	2	Power Imbalance	1
Price Change in Product Market	14	Transit Time Reliability	7	Meeting CY Closing Time	2	Pirates	1
Space Shortage	13	Customs Clearance	7	Freight Rate Differences	2	Regulation Changes	1
Freight Rate Fluctuation	13	Regulation Differences	7	Lack of Responsiveness	2	Import Rules/Quota	1
Demurrage/Detention	13	Oil Price Fluctuation (BAF)	7	Service/Route Change	2	Operational Differences	1
Miscommunication	12	Accidents	6	Currency Adjustment Factor	2	Open Inspection	1
FX Fluctuation	12	L/C Negotiation Period	6	Pilferage	2	Immunisation	1
Cargo Damage	11	Unexpected Surcharges	6	Mishandling	2	Order Change/Cancel	1
Inaccurate Documents	10	Additional Costs at Destination	6	Lashing & Shoring	2	L/C Delay	1
Container Shortage	10	Port Skip	5	Information Sharing	2	Freight Settlement	1
Product Discrepancy	10	Bankruptcy (Credit)	5	Customer Demand Change	2	Dangerous Cargo Handling	1
Strike	9	Faulty Containers	5	IT System Breakdown	2	Cartel by LSPs	1
		Cargo Overweight	4	Demand Forecasting	2	Financial Status of LSPs	1
		Loss of Cargo	4	Long Lead Time	2	Inflation Rate	1
		Relationship Issues	4	Lack of Flexibility	2	Smells in Containers	1
		Insufficient Inventory	3	Security	2	LSP Selection	1
		Rail/Trucking Service Quality	3	Shipping Volume Fluctuation	1	Dependency	1
		Own Delivery Issue	3	OB/L Loss	1	Cash Flow	1
		Port Congestion	3	Special L/C Clauses	1	Warehouse Management	1
		International Politics	3	Disputes between Trade Partners	1	KPI Failure	1
		Misdelivery	3	Inappropriate Operations	1		
		Reefer Temperature Setting	3	Lack of Quality of LSPs	1		
				Liner Joint Service	1		

4.2. Risk Classification

With the proposed risks within a group, the participants started a group discussion to classify the risks into clusters according to their characteristics, by drawing a cause and effect diagram. The facilitators took notes of main patterns generated in the clustering process so that the patterns could lead the research to more comprehensive conclusions which encompass the six group discussions. Seven to nine risk clusters per group emerged covering the business environment and entities relating to risk sources and risk types. In the discussion, there were discrepancies in opinions because participants had different experiences. Still they agreed to label a cluster as manageable if at least one participant suggested a feasible strategy to overcome most risks in the cluster. While some clusters appeared to be out of control, others were regarded more likely to be managed and effectively mitigated by entities in international logistics. In this manner, the concepts of risk clusters became more systematic and analytic.

Figure 4-5: Risk classification and other research phases



The focus groups suggested six to nine clusters of risks which were named upon their discussions, as shown in Table 4-2. The most common cluster was related to delay although the carriers group divided it into delay by trade partner and delay by LSPs and, with similar reasons, the freight forwarder group incorporated delay risk into trade partner risk and LSP risk. Other common clusters were related to cargo loss & damage, LSP risk, logistics cost and trade partner risk although the details varied across groups. In particular, the carrier group intertwined LSP risk and trade partner risk with delay and cost by creating four risk clusters out of them. Also, the IFF group argued that logistics cost is made up of two distinctive cost types: freight rate type and additional cost type. Other risk clusters, regardless of slightly different naming by groups, are summed in Table 4-2.

Table 4-2: Risk clusters by focus groups

Groups	Risk Clusters
Academic Group	*Delay*, Service Availability, Information Sharing, Logistics Cost Relationship Management, Loss & Damage, Lack of Flexibility*
Importers Group	Delay, Logistics Cost, Loss & Damage, *Culture & Regulations*, *Product Price Change*, *Trade Partner Risk*, LSP Risk
3PL Providers Group	Delay, Information Exchange, Logistics Cost, Loss & Damage, Product Price Change, *Product Quality*, *Credit*, *Planning & Control*
Carriers Group	Delay**, Loss & Damage, Policy & Regulation, Trade Partner Risk**, LSP Risk**, *Force Majeure*
Freight Forwarders Group	Information Exchange, Relationship Management, Logistics Cost***, Loss & Damage, Trade Partner Risk, LSP Risk, Credit, External Environment
Exporters Group	Delay, Relationship Issues, Regulation Differences, Product Price Change, Trade Partner Risk, LSP Risk

Note:
*: Risk clusters in italics denote totally new clusters that appeared in the specific group.
**: The carriers group used the interactions of loss types and risk sources for these clusters. In this respect, their genuine risk clusters were delay by trade partners, cost by trade partners, delay by LSPs and cost by LSPs.
***: The freight forwarders group used two types of logistics costs: one was freight rate fluctuation and the other was unexpected costs incurred at destination.

(Source: Author)

Due to the discrepancies in the classification between groups, however, it was necessary to examine the risk clusters further in a comprehensive manner. For this purpose, the clusters of international logistics risks were analysed by looking at the clustering patterns of participants so that the final risk clusters can emerge.

4.2.1. Clustering pattern 1 – Risk Sources

The advantage of focus group methods over individual interviews is that it provides a chance to observe interactions among participants sharing ideas and opinions (Duggleby 2005). In the discussions, several interesting grouping patterns were identified regardless of the participants' acknowledgement. The first pattern was the sources of risks. The participants connected individual risks with responsible parties, which effectively distinguished the sources of risks. However, the ways of classification varied depending on groups. The exporter and importer groups mainly used only two sources, namely trade partner risks (internal) and LSP risks (external). The former was largely related to the product price and performance of the trade contracts, which is inclined to the commercial side but still affects international logistics. Factors involved in the physical distribution of material fell into the latter source. This was, to some extent, because they regarded these risks as LSPs' responsibilities irrespective of the real causes once the cargo is under the control of LSPs.

However, a different perspective emerged from the carrier and IFF groups. They clearly distinguished between the disruptions caused by force majeure, trade policies at the national level or the market situation (all "macro" factors) from the disruptions caused by LSPs which could be considered as "micro" factors. Therefore, they tended to use three sources of risks: trade partner, LSP and external environment risks. The 3PL provider group added one more source to this list. As 3PL providers focus on the design of logistics to cover the entire processes of supply chains effectively, they had a long list of risks originated from the failure in the planning and information sharing system covering the processes. They thought that this system control issue was their responsibility, distinctive from the risks caused by other sources. Although the academic group did not use all the four sources of risks that the 3PL provider group suggested, they explicitly set aside the control risks from other kinds of risks because they thought that risks in the information flow (control risks) should be distinguished from those in the material flow (other risks). In consequence, the participants, explicitly or implicitly, acknowledged some or all of the risk sources: trade partner, LSP, external environment and control risks.

This study shows that the risk sources in previous SCRM research such as Mason-Jones and Towill (1998) and Sanchez-Rodrigues *et al.* (2008) are still effective in analysing the risks from the international logistics operations. In particular, shipper, customer, carrier, control systems and external uncertainty, the five uncertainty sources in transport operations argued by Sanchez-Rodrigues *et al.* (2008), were presented in this research as well. The sole discrepancy is that the participants in the present study considered both exporters and importers as one risk source. It may be partly due to the long-lasting perception on the two distinctive entities in international logistics, shippers and carriers. In addition, the participant may have thought that, as most risks happen beyond the control of shippers, there was no need to separate the shipper risks from the consignee risks.

4.2.2. Clustering patterns 2 – Loss types

The second pattern observed in the discussions was related to types of losses. When categorising the risks into clusters, participants felt that there were certain paramount concepts which could embrace other risk factors. Specifically, the carrier group and freight forwarder group explicitly suggested that there were three types of losses in international logistics. SCM researchers, in general, agree that there are material, information and financial values in SCM (Chopra and Sodhi 2004; Tang 2006; Stefansson and Russell 2008). The participants in this study also acknowledged cost (financial value) and product (material value), but they selected time rather than information as the core value of international logistics.

The first loss type was ***time*** which is closely associated with delay caused by disruptions. Delay was an extensive concept which some of the groups even regarded as *"the core of the risks in international logistics"* and *"the factor that every logistics risk will result in."* A number of risks explained various causes of delay, which means that delay should be a superordinate concept to other risk factors. This led most participants to indicate delay as an independent cluster but to facing difficulties to make a boundary for risks in the delay cluster.

The second loss type was ***cost***. While delay is the critical issue in operations, cost addresses the business profitability in performing international logistics. Tensions among the entities created by risks relating to cost can lead to disputes or even to closure of the business. The cost issue in the study encompassed not just logistics costs but also product costs and the credit of trade partners. The cost fluctuation and uncertainties in international logistics are greater than those in domestic logistics because they are amplified by the uncertainties of supply and demand in the freight and product market at the international level that cannot be easily anticipated.

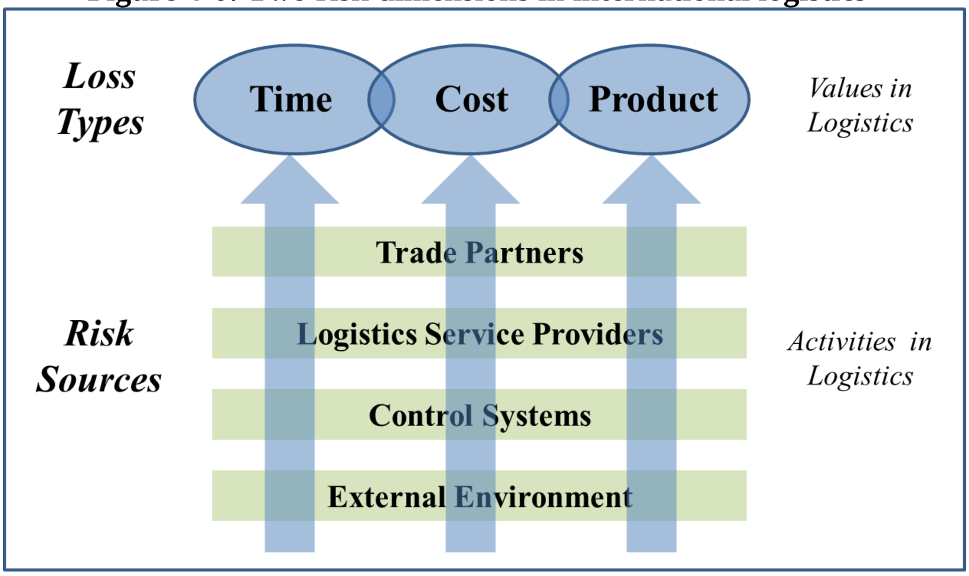
The last loss type was ***product***. In logistics, 'right product' is as important as 'right time.' Moreover, the long lead time in international logistics makes the business vulnerable when a wrong product is received as the re-procurement takes a long time and the return of the goods also costs a great deal. The participants pointed out that the product could be defective either from the beginning because of quantity or quality issues or during the logistics operations due to cargo loss and damage. In either case, any rectification of the wrong product requires time and cost.

It should be noted that these loss types are not entirely independent but rather interact with each other. Therefore, focus groups insisted that one type of risk can be the cause of another or the result of the other. For instance, delay risk may incur not just additional logistics costs for emergency delivery, but also product loss if the cargo is perishable. An abrupt increase in the logistics costs may cause delay by making exporters select indirect but inexpensive routes, which can also result in cargo damage during the long journey or transhipment. This interaction can be also explained by cost of non-conformance which delineates that the failure of achieving a satisfactory quality can increase total cost by rework cost, loss of business and legal cost, etc.

When these two clustering patterns are considered, international logistics risks identified by practitioners are interwoven with clusters relating to risk sources and to loss types respectively. Similarly, some studies reflected that the features of risks consist of multi-layers. For instance, Tang and Musa (2011) combined supply chain flows (material, finance and information flows) with supply chain activities (make, source, deliver and supply chain scope) to unpack the risk characteristics and their solutions. Van der Vorst and Beulens (2002) also highlighted two dimensions in features of supply chain risks: the first is risk aspects, such as quality, quantity and time aspects, and the other is risk sources (supply, demand & distribution, process and planning & control). With these two dimensions, they created 12 (3 by 4) risk clusters that represent various risk events. Similarly, Gaudenzi and Borghesi (2006) suggested customer value (on time delivery, order complete, order correctness and damage/defect free) and supply chain areas (transport/distribution, manufacturing, order cycle, warehousing and procurement) in order to evaluate the critical area requiring risk management by using analytic hierarchy process.

When those studies are considered, the two patterns found in this research are also deeply related to customer value and supply chain risk areas. Time, cost and product are the ultimate objective of logistics which augment three of 4Ps (product, price and place) in marketing or the emphasis on QCD (Quality-Cost-Delay) in logistics operations practice. As risk events influence these values directly or indirectly, value-related risks, such as delay, become over-arching risk concepts that embrace many risk events. Trade partners, logistics service providers, system controls and external environment are, in contrast, the areas where risk events can occur to disrupt logistics activities. Those risk events eventually create losses in the supply chain by undermining the values from international logistics. The participants explicitly and/or implicitly utilised these two dimensions in classification of diversified risks, which provides insights to understand and prepare the characteristics of risks in international logistics.

Figure 4-6: Two risk dimensions in international logistics



(Source: Author)

4.2.3. Risk clusters

Although Table 4-2 provided risk clusters suggested by focus group discussants, it has limitations in terms of representing the findings across all six groups. The utilisation of two risk dimensions found in the discussions, however, will help to provide a complete list of risk clusters by unfolding how participants strived to make distinctions between clusters. In addition to that, cause-and-effect diagrams created by discussion groups may be used to clarify each cluster.

First of all, the 14 risk clusters found in focus group discussions were rearranged by risk sources and loss types as demonstrated in Table 4-3. Risk clusters were labelled by their sources with the exception of ‘delay’ and ‘loss & damage’ which constituted time loss and product loss respectively. There are several risk clusters that are related both to risk sources as well as losses. For instance, logistics cost and product discrepancy were resorted to certain risk sources despite that they have features of cost loss and product loss at the same time.

Table 4-3: Identified risk clusters sorted by loss types and risk sources

Loss Types / Risk Sources	Identified Risk Clusters
Time	Delay
Cost	(Trade Settlement Issues), (Logistics Cost)
Product	Loss & Damage, Product Discrepancy
Trade Partners	Trade Partner Risk, Trade Settlement Issues, (Failure in Relationship Management)
Logistics Service Providers	Shortage of Space & Containers, Logistics Service Provider Risk, Logistics Cost, (Failure in Relationship Management)
Control Systems	Failure in Information Exchange, Failure in Logistics Control
External Environment	Policies & Regulations, Product Price Change, Force Majeure

Note: Clusters in brackets means that they are also mentioned in other categories

(Source: Author)

Next, individual risks and risk clusters in each risk source were reviewed again based on the cause-and-effect diagrams drawn by groups in order to clarify each risk cluster by revealing hidden clusters. As a result, it is concluded that 9 clusters represent all the individual risks belonging to the clusters, which are:

(1) Delay;

(2) Cargo Loss & Damage;

(3) Product Discrepancy (in Quantity and Quality);

(4) Failure in Information Exchange;

(5) Failure in Logistics Control;

(6) Shortage of Space & Containers;

(7) Trade Settlement Issues;

(8) Policies & Regulations; and

(9) Product Price Change.

However, the remaining 5 clusters need to be further clarified because they contain too many risks that cannot be understood under a sole category. An interesting observation on focus group discussions was that these clusters were all discoursed in depth in the free discussions and grouped very broadly without notable disagreements. In the cause-and-effect diagrams that participant groups created, however, these clusters appeared with complicated second- or third-order classifications behind the explicitly-mentioned clusters.

The first cluster considered was ‘logistics service provider risks’, the largest risk cluster in terms of the number of risks identified. This cluster is actually mixed with temporal disturbances to operations and chronic low service quality as well as with liner company risks and inland transporter risks. In this respect, it is reasonable to divide this cluster into three distinctive clusters: vessel operation disruptions, inland operation disruptions and low service quality. *Vessel operational disturbances* cluster indicates the risks or risk events that may happen while the cargo is moved on a vessel, such as unreliable vessel schedule, transhipment and accidents. On the contrary, *inland operational disturbances* cluster denote any risks before and after the sea transport, mainly involving with the inland transport by rail or truck. The last *poor service quality* cluster includes risks from the deficiency of general service level of LSPs.

The second cluster was the logistics cost, another big risk cluster. The freight forwarder group insisted that *"the main issue here is the place where the cost is materialised: either at the port of loading (POL) or at the port of discharging (POD)."* Freight rate, bunker adjustment factor and surcharges are all incurred before loading on board of vessel, but demurrage, detention and other additional costs are added at the destination without expectation. Accordingly, the former can be known and fully discussed between trade partners beforehand, whereas the latter is too unexpected for trade partners to jeopardise further logistics operations unless the cost is settled. As the features of these two risk types are fundamentally different, they need to be separated into two clusters.

The third cluster was the trade partner risks. It is apparent that this cluster comprises of commercial issues and cargo operation issues. For instance, trade partners may cause significant delay or unexpected costs by producing inaccurate shipping or customs documents, setting a short negotiation period for L/C (letter of credit) and even losing original B/L (bill of lading), which will fall into the former. In contrast, logistics disruptions may be caused by exporter's operational errors at the stage of cargo loading into a container, such as overweight cargo, inappropriate lashing & shoring and inaccurate temperature setting for reefer containers.

The fourth cluster was the failure in relationship management because shippers have at least two distinctive relationships: one with their trade partners and the other with logistics service providers as argued by the logistics triad (Bask 2001). The essence of the relationship with trade partners hinges on whether the exporter and importers trust each other despite the fact that they are remotely located and exposed to a high chance of fraud at all times. A conflict led by mistrust therefore is a head-aching and lingering issue because there are few methods to dissolve these conflicts. The relationship with LSPs is rather determined by the extent of dependency upon the LSPs. High dependency upon LSPs restricts shippers in both proactive and reactive management of logistics risks. If there is no alternative supplier, a shipper has no option to choose a proper LSP that is capable of risk management. Also, if the shipper lacks bargaining power over LSPs, any proactive risk management measures cannot be requested to LSPs because LSPs will refuse the ideas in consideration of the cost increases and work burdens. In addition, even when risks are materialised, the shipper may not mitigate or share losses in co-operation with LSPs. In particular, participants were very concerned with the market where the freight rate hikes, which makes shippers vulnerable to the market power exercised by liner companies regardless of increasing risks at the shippers' side.

The last cluster identified was force majeure that leads to uncertain but large-scale disruptions during international logistics operations. The term, force majeure, was discoursed by the carrier group and the freight forwarder group to emphasise the exemption of their responsibility that is stated in their bills of lading and also approved by international conventions regulating the B/L. It can be effectively divided into natural disasters, such as heavy weather and storms, and man-made disasters like port congestion and strike.

In summary, Table 4-4 demonstrates a complete list of risk clusters found in the focus group discussions and refined by clustering patterns and cause-and-effect diagrams raised during the discussions. There are two risk dimensions, which are risk sources and loss types, in this risk taxonomy: there are four risk sources (trade partners, logistics service providers, control systems and external environment) and three loss types (time, cost and product) in the international logistics contexts. Each risk source has 3-5 idiosyncratic risk clusters that can happen in its risk area and have direct and indirect impacts on various loss types. It can be concluded, therefore, that the focus group discussions have identified a total of 20 risk clusters that should be managed when operating international logistics. The descriptions and all the risks for each risk cluster are also mentioned in the Table 4-4. Clusters such as trade settlement issues, freight rate and surcharge fluctuations and additional costs at destination can be included both in the cost loss and in trade partner/LSP risk sources. They were placed on the risk sources in Table 4-4 but will be further examined by the holistic risk analysis in the next section.

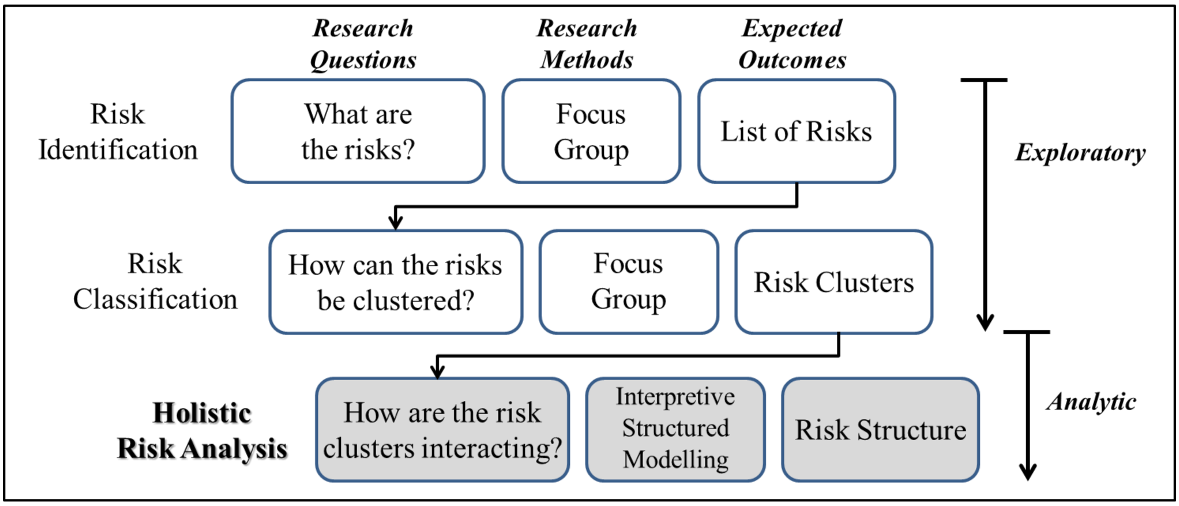
Table 4-4: Description of 20 risk clusters

Risk Sources	Risk Clusters	Description
External Environment	Product Price Change	Risks relating to product market (price) fluctuation that affects logistics flows by influencing trade partner's behaviour (e.g. price change, FX fluctuation, customer demand change)
	Policies & Regulations	Risks from national and international policy and regulation which create trade barriers or incur additional costs (e.g. regulation differences, customs clearance, international politics, regulation changes, import quota, immunisation, open inspection)
	Natural Disasters	Risks arising from act of God (e.g. natural disasters, such as earthquake, heavy rain, hurricane, bad weather)
	Human-derived Disruptions	Risks arising from disasters caused by human (e.g. port congestion, strikes, accidents, pirates, theft)
Trade Partners	Document Issues	Risks relating to shipping and trade documents but heavily influencing international logistics flows (e.g. inaccurate documents, loss of OB/L, special L/C clauses, L/C delay)
	Trade Settlement	Risks arising from importer's refusal or inability to settle the trade amount as agreed
	Cargo Loading Issues	Risks arising at the time of cargo stuffing by intentions and errors (e.g. overweight, reefer temperature settings, lashing & shoring problems, operational differences, dangerous cargo)
	Conflicts with Trade Partners	Risks arising from the conflicts between trade partners that affects international logistics flows (e.g. conflicts, pricing issues, debates on L/C terms, freight rate differences, cultural gaps)
Logistics Service Providers	Vessel Operational Disturbances	Risks arising from abnormal disturbances of LSP's vessel operations (e.g. transhipment, accidents, port skip, mis-delivery, service or route change)
	Shortage of Space & Containers	Risks arising from shortage of vessel space or containers (e.g. vessel space shortage, container shortage)
	Freight Rate & Surcharge Fluctuations	Risks arising from fluctuation of freight rate and surcharges such as BAF, CAF, PSC and others (e.g. freight rate fluctuation, BAF increase, CAF increase, unexpected surcharges)
	Additional Costs at Destination	Risks arising from any unexpected additional costs when cargo is taken (e.g. demurrage, detention, other unexpected costs)
	Poor Service Quality	Risks relating to chronically low level of operational quality of LSPs (e.g. faulty/filthy containers, inappropriate operations, lack of responsiveness/flexibility, local feeder quality, mishandling)
	Inland Operational Disturbances	Risks arising from abnormal disturbances of LSP's inland operations (e.g. trucking/rail, own delivery issues)
	Dependency upon LSPs	Risks relating to asset- , network- or process-dependency on specific LSPs (e.g. relationship issues, L/G acceptance, freight settlement, power imbalance, cartel by LSPs)
Control Systems	Failure in Information Exchange	Risks arising from failing to access and gather information for operations and disturbances (e.g. miscommunication, unclear responsible party, cargo tracing & tracking, information sharing)
	Failure in Logistics Control	Risks arising from failing to create and maintain a robust logistics network that enables logistics flows (e.g. long lead time, demand forecasting, CY closing time, LSP nomination, IT systems breakdown, security, partner selection, cash flow, warehousing)
Loss Types	**Risk Clusters**	**Description**
Time	Delay	Time loss caused by delay and transit time instability (e.g. delay, transit time reliability)
Cost	(Trade Settlement) (Freight Rate Fluctuation) (Additional Costs)	Any unexpected increases of cost from international logistics operations
Product	Cargo Loss & Damage	Loss of product or damage to product by accidents
	Product Discrepancy	Discrepancy in quality or quantity of product by malicious or negligent acts by the exporter

4.3. Risk Analysis

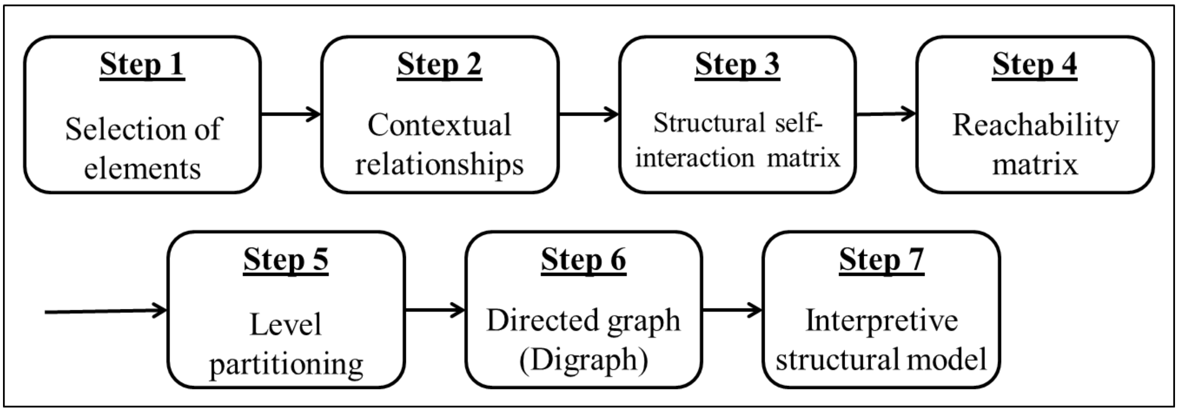
The findings from focus group discussions have addressed two research questions in this research: "*What are the risks in international logistics operations?*" and "*How are these risks understood by using clustering?*" The list of 86 different risks and 20 risk clusters based on risk sources and loss types provide the overview of various risks in operating international maritime logistics where diversified entities are involved. This kind of typology or taxonomy, however, has an intrinsic limitation because it only focuses on dividing and grouping elements in a logical manner without considering interconnections of the clusters that it creates. Most studies on risk identification and analysis also stop at the risk classifications without investigating the relations among risk clusters.

Figure 4-7: Risk analysis and other research phases



The third research question in this research is devised to highlight the interconnectedness of risks in international logistics by providing an interpretive structural model. The final model is expected to illuminate a comprehensive structure of risks with levels and hierarchies among risk clusters, which will give a clue to effective management of risks in international logistics. The analysis follows the ISM steps explained in the methodology section, as shown in Figure 4-8, based on Faisal *et al.* (2007) and Pfohl *et al.* (2012).

Figure 4-8: The procedure of ISM



(Source: Adapted from Pfohl *et al.* 2011)

4.3.1. Elements of analysis

The initial stage of ISM process is to determine the elements constituting the system to be investigated. From the empirical investigation by using focus group discussions, this research identified 20 different risk clusters based on risk sources and loss types. As these clusters encompass diversified risks identified by practitioners in international maritime logistics, they can be, without a doubt, effectively translated as risk elements to explain the system of international logistics. Numbers from 1 to 20 were allocated to these risk clusters for a handy but unbiased analysis. Also, titles of five risk clusters were altered so that they can be more clearly understood by participants without requiring further clarifications or operational definitions. In this case, a representative risk in the risk cluster was used for the new title. For this purpose, policies & regulations cluster was renamed as ‘export/import regulations’ and human-derived disruptions cluster was altered to ‘strikes & port congestion.’ Also, the title of poor service quality cluster, regardless of many aspects of quality, was substituted with ‘faulty containers’ because it was the representative risk in this cluster. Document issues cluster and freight rate & surcharge fluctuations cluster have been slightly modified to illuminate the key meaning of this cluster. Table 4-5 shows the 20 risk elements for the ISM analysis and their allocated numbers.

Table 4-5. The development of 20 elements for ISM

No	Risk Clusters	Element Titles	No	Risk Clusters	Element Titles
1	Product Price Change	**Same**	11	Shortage of Space & Containers	**Same**
2	Policies & Regulations	**Ex/Import Regulations**	12	Freight Rate & Surcharge Fluctuations	**Freight Rate Fluctuations**
3	Natural Disasters	**Same**	13	Additional Costs at Destination	**Same**
4	Human-derived Disruptions	**Strikes & Port Congestion**	14	Poor Service Quality	**Faulty Containers**
5	Document Issues	**Inaccurate Document**	15	Inland Operational Disturbances	**Same**
6	Trade Settlement Issues	**Same**	16	Dependency upon LSPs	**Same**
7	Cargo Loading Issues	**Same**	17	Failure in Logistics Control	**Same**
8	Conflicts with Trade Partners	**Same**	18	Failure in Information Exchange	**Same**
9	Product Discrepancy	**Same**	19	Cargo Loss & Damage	**Same**
10	Vessel Operational Disturbances	**Same**	20	Delay	**Same**

(Source: Author)

4.3.2. Contextual relationships

The 20 risk clusters generated 190 (= ${}_{20}C_2$) questions on pair-wise interrelationships between two elements. The contextual type of "leads to" was selected for the purpose of this research to constraint the relationship to direct effects. To assess the contextual relationships, this research organised two groups of logistics experts for the initial discussions, and also invited four logistics exports for the panel discussion. The participants in Group A and Group B discussed the relationships between two elements and allocated arrows to denote the directions of cause and effect between them. In the first round of discussions, 96 relationships showed discrepancies between the opinions of Group A and Group B. The two groups were later asked to provide written statements with respect to the reasons for their decisions on these discrepant relationships. After exchanging written statements between the groups, the two groups amended their initial opinions, thus the discrepancies were dramatically reduced to 23 relationships. These 23 different opinions were consulted to four industry experts in the Delphi panel. After several rounds of written discussions, they have reached a consensus of the pairwise interrelationships of 20 representative risks elements.

Table 4-6: Structural Self-Interaction Matrix of 20 risk elements

	j	Product Price Change	Ex/Import Regulations	Natural Disasters	Strikes & Port Congestion	Inaccurate Document	Trade Settlement issues	Cargo Loading Issues	Conflicts with Trade Partners	Product Discrepancy	Vessel Operational Disturbances	Shortage of Space & Containers	Freight Rate Fluctuations	Additional Cost at Destination	Faulty Containers	Inland Operational Disturbances	Dependency upon LSPs	Failure in Logistics Control	Failure in Information Exchange	Cargo Loss & Damage	Delay
i		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	1		A	O	O	V	V	V	V	V	O	V	V	V	O	O	V	V	O	O	O
	2			O	O	V	V	O	V	V	O	O	O	V	O	V	V	V	V	O	V
	3				O	O	O	O	O	O	V	O	O	V	V	V	O	V	V	V	V
	4					O	V	O	V	O	V	V	V	V	V	V	V	V	V	V	V
	5						V	V	X	V	O	O	O	V	O	V	O	O	X	O	V
	6							O	X	O	A	O	O	V	O	O	O	O	A	O	X
	7								X	V	O	O	O	V	O	V	O	V	A	V	V
	8									X	A	A	A	X	A	A	A	A	X	A	X
	9										O	O	O	O	O	O	O	V	A	O	V
	10											O	O	V	O	V	O	V	V	V	V
	11												V	O	V	O	X	V	X	O	V
	12													O	O	O	X	V	V	O	V
	13														A	A	O	A	A	A	X
	14															O	O	V	O	V	V
	15																A	V	X	V	V
	16																	X	X	O	X
	17																		X	A	X
	18																			A	X
	19																				X
	20																				

(Note - V: *i* → *j*, **A:** *j* → *i*, **X:** *i* ↔ *j*, **O:** no relationship**)**

(Source: Author)

4.3.3. Structural Self-Interaction Matrix

The list of contextual relationships between elements agreed by 8 experts was transformed to the structural self-interaction matrix (SSIM). The arrows used by participants to characterise interconnections were converted to V, A, X, O according to the following rules (Kannan *et al.* 2010):

V: element *i* will cause element *j*;

A: element *j* will cause element *i*;

X: element *i* will cause element *j* while element *j* will case element *i* at the same time; and

O: element *i* and *j* are not related at all.

Table 4-6 illustrates the pairwise relationships between two risks as a form of the SSIM. As the 190 relationships presented to participants are associated with the top-right side of the matrix, this part was filled with four symbols. Since the bottom-left side is just the transverse of the top-right side, the interactions are not necessary to appear in the area. However, the reachability matrix in the next step will reflect these transverse relationships.

4.3.4. Reachability Matrix

The initial reachability matrix converted the four symbols into either 0 or 1. Number 0 was allocated when the contextual relationship was denoted as either symbol O or symbol A because it means *i* does not cause element *j*. However, when the symbol is A, the grid in transverse position should be 1 because *j* does cause *i*. In contrast, if the symbol is O, the transverse grid will be also 0. Number 1 was given to every grid which has either symbol V or symbol X as a contextual relationship. One difference between V and X was that the transverse grid of V is 0 whereas that of X is 1 because X denotes mutual causal relationships between two elements. Number 1 was given to every grid where the same element intersects (grids in grey in Table 4-7). The initial reachability matrix after completing this process is as shown in Table 4-7.

The final reachability matrix considered transitivity among the elements. Transitivity was checked by looking at any indirect relationships among elements: if element *i* causes element *j* and also element *j* results in element *k*, the transitivity was confirmed between element *i* and element *k* due to their indirect relationship mediated by element *j*. In this case, the transitivity was incorporated into the final reachability matrix with assigning 1*, with removing 0, to the grid. Between element 3 and element 7, there is no direct relationship; thus 0 is shown in the (3,7) grid of the initial reachability matrix. When element 18 is considered, however, transitivity appears between element 3 and element 7 because element 3 causes element 18 while the latter causes element 7. In this regard, the final reachability matrix should represent 1* in the (3,7) grid rather than 0.

Table 4-7: The initial Reachability Matrix of 20 risk elements

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1	0	0	0	1	1	1	1	1	0	1	1	1	0	0	1	1	0	0	0
2	1	1	0	0	1	1	0	1	1	0	0	0	1	0	1	1	1	1	0	1
3	0	0	1	0	0	0	0	0	0	1	0	0	1	1	1	0	1	1	1	1
4	0	0	0	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1
5	0	0	0	0	1	1	1	1	1	0	0	0	1	0	1	0	0	1	0	1
6	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	1
7	0	0	0	0	0	0	1	1	1	0	0	0	1	0	1	0	1	0	1	1
8	0	0	0	0	1	1	1	1	1	0	0	0	1	0	0	0	0	1	0	1
9	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	1
10	0	0	0	0	0	1	0	1	0	1	0	0	1	0	1	0	1	1	1	1
11	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	1	1	1	0	1
12	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	1	1	0	1
13	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1
14	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	0	1	0	1	1
15	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	1	1	1
16	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	1	1	1	0	1
17	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	1	1	0	1
18	0	0	0	0	1	1	1	1	1	0	1	0	1	0	1	1	1	1	0	1
19	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	1	1	1
20	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	1	1	1	1	1

(**Note – 0**: *i* does not cause *j*, **1**: *i* causes *j*)

(Source: Author)

However, a significant problem arose while checking transitivity in the matrix because several risk elements created excessive transitivity, which made the matrix full of indirect relationships and, in turn, led driving power and dependence of most elements to the maximum level. They were *conflicts with trade partners*, *dependency upon LSPs*, *failure in information exchange* and *failure in logistics control*, which are associated with the inter-organisational relationships as well as system controls risks. Contrary to other risk elements which have a definite time frame for their occurrence and realisation, these four elements retained the unique characteristics to happen all the time during the entire logistics operations and to make risky situations worse. When they were considered, the time sequence of risk events sometimes reversed without sense-making and numerous feedback loops were generated making the majority of elements being interconnected. Therefore, it was decided to eliminate these four elements from the analysis so that interconnections of remaining 16 elements can be clarified. Instead, they will be incorporated into the final structural model by discussing their roles and characteristics in international maritime logistics.

After removing the four risk elements, the number of transitivity was significantly decreased and the remaining 16 risk elements produced a final reachability matrix, as shown in Table 4-8. The matrix includes driving power and dependence of each element as expressed by numbers as well as the numbers 0, 1 and 1* to represent the pairwise relationships. The final reachability matrix can also produce the driving power and dependence of each element. An element with high driving power is able to cause a number of other elements. On the contrary, an element with high dependence will be caused by a number of other elements. Driving power and dependence will be used to conduct MICMAC analysis in the following sub-section which will group the risk elements.

Table 4-8: The final Reachability Matrix of 16 risk elements

	1	2	3	4	5	6	7	9	10	11	12	13	14	15	19	20	Driving Power
1	1	0	0	0	1	1	1	1	0	1	1	1	1*	1*	1*	1*	12
2	1	1	0	0	1	1	1*	1	0	1*	1*	1	1*	1	1*	1	13
3	0	0	1	0	0	1*	0	0	1	0	0	1	1	1	1	1	8
4	0	0	0	1	0	1	0	0	1	1	1	1	1	1	1	1	10
5	0	0	0	0	1	1	1	1	0	0	0	1	1*	1	1*	1	9
6	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1*	1	4
7	0	0	0	0	0	1*	1	1	0	0	0	1	1*	1	1	1	8
9	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2
10	0	0	0	0	0	1	0	0	1	0	0	1	1*	1	1	1	7
11	0	0	0	0	0	1*	0	0	0	1	1	1*	1	0	1*	1	7
12	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2
13	0	0	0	0	0	1*	0	0	0	0	0	1	0	0	1*	1	4
14	0	0	0	0	0	1*	0	0	0	0	0	1	1	0	1	1	5
15	0	0	0	0	0	1*	0	0	0	0	0	1	1	1	1	1	6
19	0	0	0	0	0	1*	0	0	0	0	0	1	0	0	1	1	4
20	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	1	4
Dependence	2	1	1	1	3	14	4	5	3	4	5	14	10	8	14	16	

(Source: Author)

4.3.5. Level partitioning

Level partitioning was then conducted given the final reachability matrix. Firstly, the reachability set (RS*i*), antecedent set (AS*i*) and intersection set (RS*i* ∩ AS*i*) of each element were found as demonstrated in Table 4-9. Secondly, the elements of the top level were sought by checking an element whose reachability set is the same as its intersection set. As a result, four risk elements were chosen as the top level: Trade Settlement Issues (6), Additional Costs at Destination (13), Cargo Loss & Damage (19) and Delay (20). After removing these four elements out of Table 4-9, new reachability, antecedent and intersection sets were generated: this time, Product Discrepancy (9) and Freight Rate Fluctuations (12) were selected as the second level. It is interesting that these six elements are all directly linked to three types of loss found in focus group research although some of them, such as trade settlement issues, freight rate fluctuations and additional costs at destination, are also thought to be associated with trade partner risks and logistics service provider risks.

Time Loss: Delay (20)

Cost Loss: Trade Settlement Issues (6), Freight Rate Fluctuations (12),
Additional Costs at Destination (13)

Product Loss: Product Discrepancy (9), Cargo Loss & Damage (19)

The next rounds started with taking the remaining 10 elements into account. Faulty Containers (14) was recognised as the sole element of the third level whereas removal of (14) let Shortage of Space & Containers (11) and Inland Operational Disturbances (15) become the next level. Until Level 5 and 6, the risk elements associated with trade partner risks and logistics service provider risks were completed to be partitioned though there were hierarchies among them. The elements that were left behind at the last phase were element (1), (2), (3) and (4) which constitute external environment risks.

The level partitioning may be supplemented by MICMAC analysis which aims to evaluate driving power and dependence of each element (Mandal and Deshmukh 1994). The MICMAC analysis provides four groups of risks according to the extent of driving power and dependence. Elements in a group with low driving power and low dependence (Group 1) are called autonomous elements because they are stand-alone factors in the system. Those in a group with low driving power but high dependence (Group 2) are labelled as dependent elements. On the contrary, the elements whose driving power is high but dependence is low are independent elements (Group 4). If both driving power and dependence are high enough for an element (Group 3), it is a linkage element that connects Group 2 and Group 4.

Table 4-9: Reachability set, antecedent set, intersection set and their level

Element	Reachability Set	Antecedent Set	Intersection Set	Level
1	1, 5, 6, 7, 9, 11, 12, 13, 14, 15, 19, 20	1, 2	1,	**7**
2	1, 2, 5, 6, 7, 9, 11, 12, 13, 14, 15, 19, 20	2,	2,	**8**
3	3, 6, 10, 13, 14, 15, 19, 20	3,	3,	**7**
4	4, 6, 10, 11, 12, 13, 14, 15, 19, 20	4,	4,	**7**
5	5, 6, 7, 9, 13, 14, 15, 19, 20	1, 2, 5	5,	**6**
6	6, 13, 19, 20	1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 14, 15, 19, 20	6, 13, 19, 20	**1**
7	6, 7, 9, 13, 14, 15, 19, 20	1, 2, 5, 7	7,	**5**
9	9, 20	1, 2, 5, 7, 9	9,	**2**
10	6, 10, 13, 14, 15, 19, 20	3, 4, 10	10,	**5**
11	6, 11, 12, 13, 14, 19, 20	1, 2, 4, 11	11,	**4**
12	12, 20	1, 2, 4, 11, 12	12,	**2**
13	6, 13, 19, 20	1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 14, 15, 19, 20	6, 13, 19, 20	**1**
14	6, 13, 14, 19, 20	1, 2, 3, 4, 5, 7, 10, 11, 14, 15	14,	**3**
15	6, 13, 14, 15, 19, 20	1, 2, 3, 4, 5, 7, 10, 15	15,	**4**
19	6, 13, 19, 20	1, 2, 3, 4, 5, 6, 7, 10, 11, 13, 14, 15, 19, 20	6, 13, 19, 20	**1**
20	6, 13, 19, 20	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 19, 20	6, 13, 19, 20	**1**

(Source: Author)

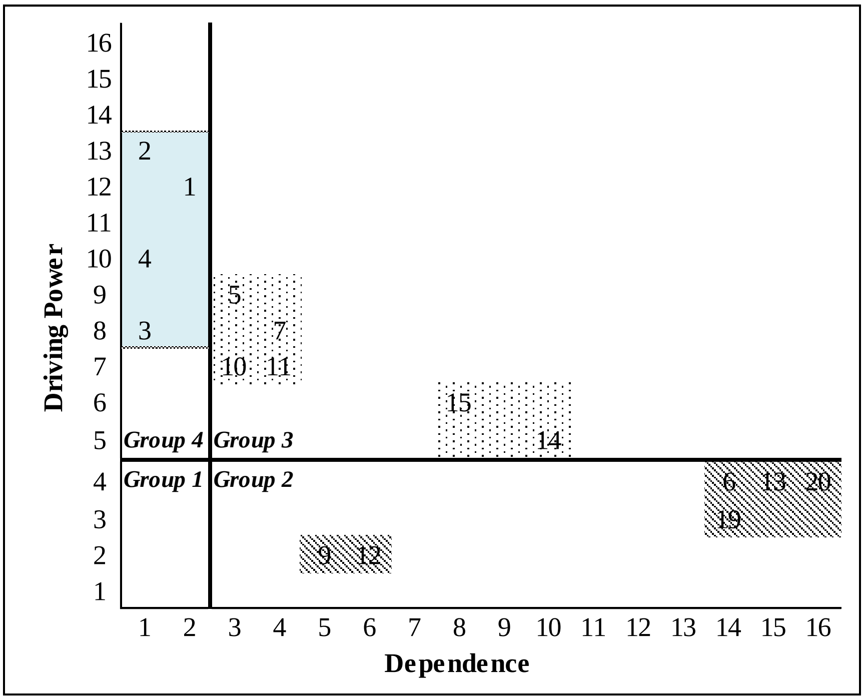
MICMAC analysis was conducted on the 16 risk elements in this research by using driving power and dependence calculated in the final reachability matrix (Table 4-8). There was no element belonging to Group 1, but elements were distributed across Group 2, 3 and 4.

Group 2 (Dependent Elements): (6), (9), (12), (13), (19), (20)

Group 3 (Linkage Elements): (5), (7), (10), (11), (14), (15)

Group 4 (Independent Elements): (1), (2), (3), (4) The result of MICMAC analysis is very similar to that of level partitioning in ISM because Group 2 is comprised of risk elements relating to risk consequences while group 3 and 4 consist of trade partner/LSP risks and external environment risks respectively. The only difference is MICMAC provides a rough categorisation compared to the level partitioning which requires strict criteria and allocates specific levels.

Figure 4-9: Grouping with driving power and dependence



(Source: Author)

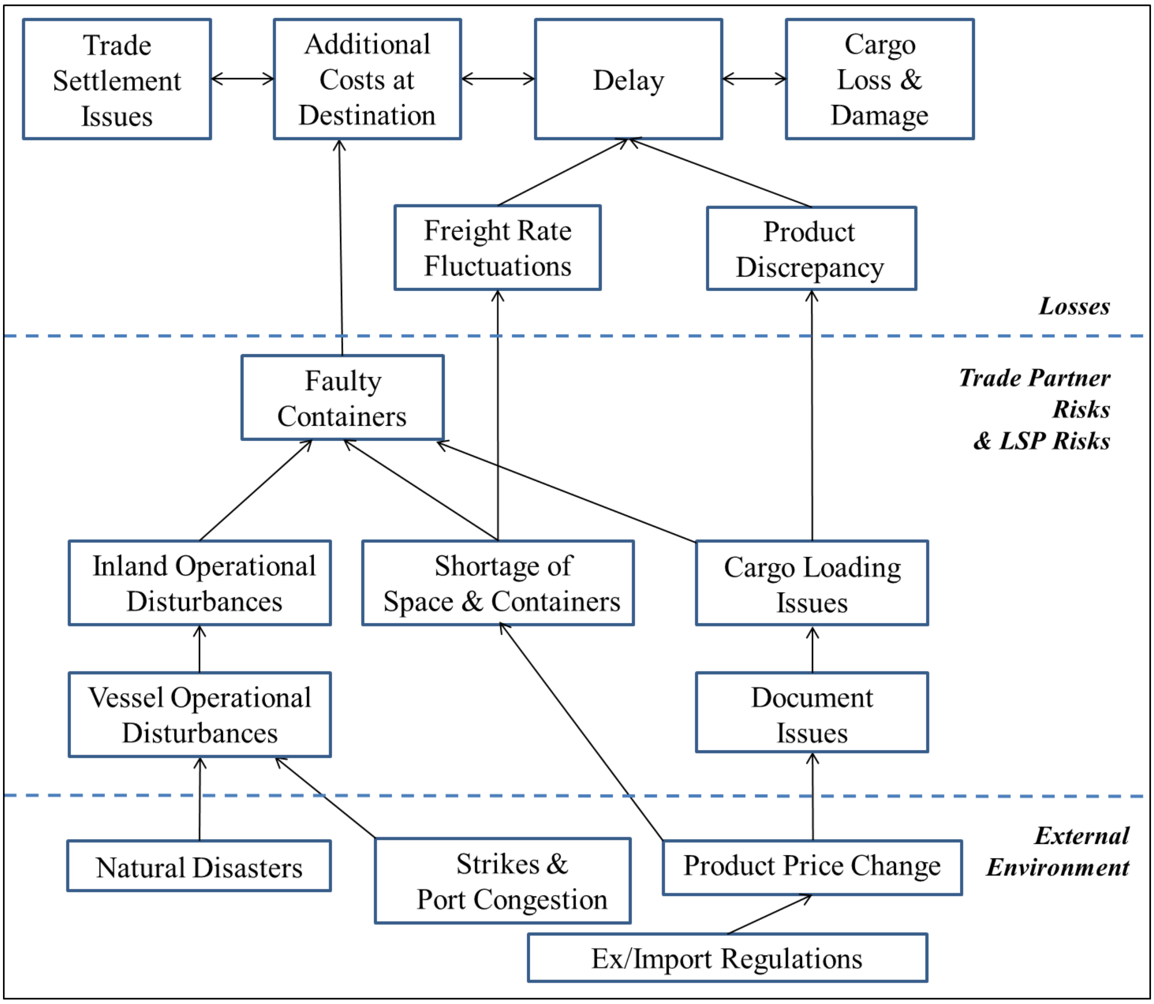
4.3.6. Digraph

From the reachability matrix and partitioned level supplemented by MICMAC analysis, a directed graph or digraph can be drawn by using nodes and arrows. In this stage, transitivity needs not to be taken into account because a series of arrows can sufficiently represent any indirect relationships. After being arranged vertically and horizontally according to the levels, risk elements were linked by arrows based on the reachability matrix.

4.3.7. ISM-based model

The digraph was later transformed into an ISM-based model by substituting element numbers with their original names of risk clusters. Figure 4-10 illustrates that most risk clusters relating to loss types interact with others although product discrepancy and freight rate fluctuations are excluded. Also, it shows that there is a clear division between trade partner risks and logistics service provider risks because it only interacts at the highest level. The external environment risks occupy the bottom end of this model, influencing most risk clusters.

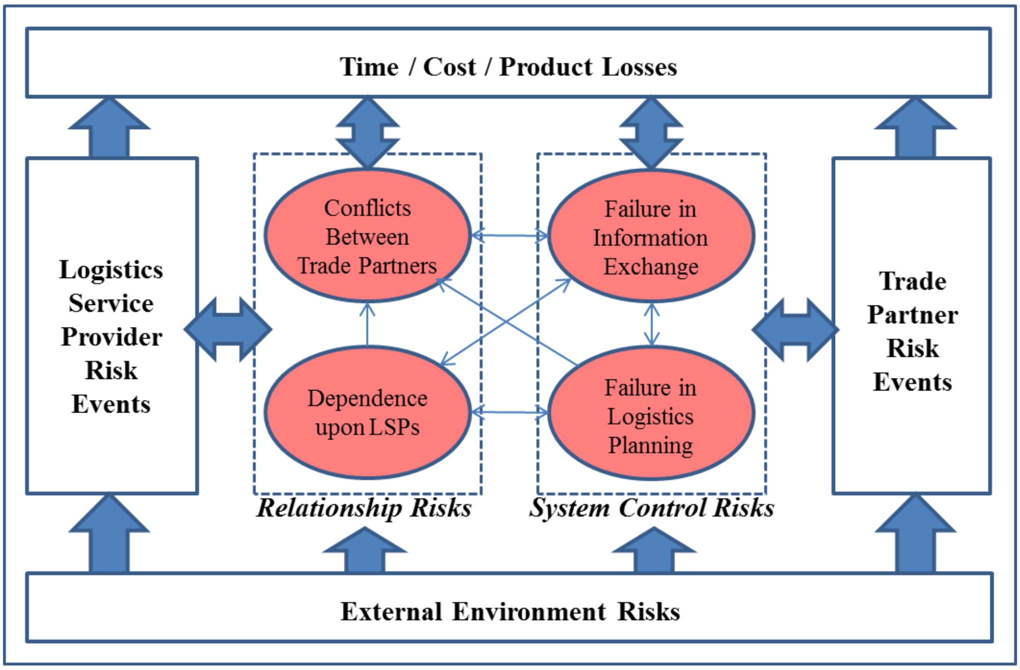
Figure 4-10. The ISM-based model of 16 risk clusters



(Source: Author)

In this respect, this final model confirms that exploratory findings on risk clusters have firm contextual backgrounds because, when minor causalities are ignored, there are four groups that show frequent interactions within the group, which is consistent with losses, logistics service provider risks, trade partner risks and external environment risks. It is likely that four risk clusters left out of this ISM-based model will create another group, but they will be discussed in the next section in detail in order to unfold their critical roles in international logistics.

Figure 4-11: The structure of risks in international logistics



(Source: Author)

When the four risk elements that were excluded from the reachability matrix are considered, the risk structure becomes more dynamic. Figure 4-11 added Conflicts with Trade Partners (8), Dependency upon LSPs (16), Failure in Information Exchange (17) and Failure in Logistics Control (18) to the ISM-based model of 16 risk elements in consideration of the contextual relationships of these four risk elements with the remaining 16 elements. For a parsimonious model, 16 risk elements were grouped into time/cost/product losses, LSP risk events, trade partner risk events and external environment risks as discussed above, and then the four elements were placed in Figure 4-11. Compared to Figure 4-10 which clearly demonstrates a hierarchical structure of risks with one-way relationships from the bottom to the top, these risk elements generate numerous feedback loops mediating the impact of losses on trade partner/LSP risks as shown in Figure 4-11. Their excessive transitivity found in the ISM was largely due to these feedback loops that may play a pivotal role to change even a small risk event to enormous consequences. They are also influential to each other, thus the connection only to one of these risk elements can create numerous transitivities that are mediated by the other three elements.

4.4. Discussion

The mixed methods approach combining focus group and ISM has empirically addressed the research questions by producing (1) diversified risks that can occur in international logistics, (2) risk clusters based on risk sources and loss types as well as (3) a structure of those risk clusters.

When practitioners were asked to present risks in focus group discussions, what they suggested was a mixture of risk sources, risk events and risk consequences. A given disruption or disturbance in their logistics operations generates other risk events which aggravate the situation. It otherwise creates a type of loss, which in turn causes other losses. As risks are linked with each other, a risk cannot stand alone without making a story of risk occurrence. It is comprehensible that a group stated that *"delay is everything"* because every risk event can eventually reach a consequence of delay by having a direct or indirect impact on delay. Likewise, logistics cost is a similar concept because every risk and loss is ultimately materialised as a type of cost that undermines the profit from conducting international logistics activities.

The empirical research about supply chain vulnerabilities carried out by Peck (2005) suggested that there are four discrete but inextricably linked levels of supply chain risks, namely:

(1) Level 1 – value stream/product or process;

(2) Level 2 – assets and infrastructure dependencies;

(3) Level 3 – organisations and inter-organisational networks; and

(4) Level 4 – the environment.

The first level denotes seamless workflows and information flows that enable organisations to maintain values in business. If there is inefficiency or sub-optimal fulfilment in the flows, value streams are disturbed generating supply chain risks. Credible and reliable information is fundamental in this process, which are expected to be achieved by trust and cooperation between supply chain entities.

The medium of transmitting values is described in Level 2 as assets and infrastructure. They consist of fixed assets (links and nodes) and mobile assets: for instance, transport is performed by mobile assets like ships and trucks which utilise fixed assets of links (pipeline, roads, rail and seaway) and nodes (port, terminus and airports). Infrastructure dependencies are generated when certain assets are selected to be used. The loss of those assets has a negative impact on Level 1 performance.

Level 3 expands the concepts of link and node to inter-organisational networks. The nodes here are organisations which own or manage the assets and also facilitate value streams while links delineate relationships and power dependencies between organisations. The trend of single sourcing to reduce the cost of buying companies is an exercise of their power, but simultaneously creates dependencies on the supplier, with making buying companies vulnerable to any disruptions to the supplier. Vertical or horizontal integrations may alter the current power-dependency state in the market, which suddenly forces some companies to encounter competition risks or supply risks. The powerful entity may execute risk transfer strategy as a risk mitigation measure, while simply forcing their partners to take expensive risk management measures. In any cases, complex inter-organisational networks will experience clashes of interests relating to risks and risk management, which definitely creates a vulnerable supply chain.

Macro-economics and natural environments external to supply chains constitute the final level. There are various elements in this level which encompass social, political, economic, and natural factors to list a few. Numerous instances address this level, such as strike in the west coast ports of the US (social), the 9/11 terrorist attack (political), oil crisis in the 70s (economic) and earthquakes in Japan (natural). These external disruptions occur very rarely but vastly interrupt supply chains.

As shown in the ISM-based model of Figure 4-10 and 4-11, the concept of risks from the practitioners' perspectives in international logistics also operates at several different hierarchies. The model clearly shows that time, cost and product losses account for the top hierarchy while risk events from the external environment constitute the bottom line of the risk structure. There are two parallel groups of risk clusters in the middle, which are risk events in relation to logistics service providers and trade partners. Last but not least, the centre of the model is taken by the relationship and system control risks which interact not only with risk events but also with losses. Compared with other hierarchies that have more or less one-way relationships from the bottom to the top, relationship and system control risks generate causal loops that enable losses to affect risk events.

In these circumstances, the structure of hierarchies, empirically derived from the findings of this research, is similar to Peck (2005) but also shows several discrepancies. For example, Peck (2005)'s model included information risks in Level 1 with other SCM values, but this research found that information risks play a different role in Level 2 with relationship risks. Also, this model shows that there is a one-way direction of relationships between Level 1, 3 and 4 compared to inter-relationships between all levels in Peck's model. In addition, Level 2 and Level 3 of Peck's model is combined into Level 3 in this model while creating another critical Level 2 which generates self-enhancing loops of logistics risks.

This may be generated by the contexts specific to international logistics, but will certainly be applicable to general supply chains where various entities are involved in creating a supply chain network. The risk structure shows that there are four distinctive levels of risks that managers in the industry perceive. These levels have been roughly anticipated in the clustering process of focus group discussions but precisely formulated by the ISM-based model. They are:

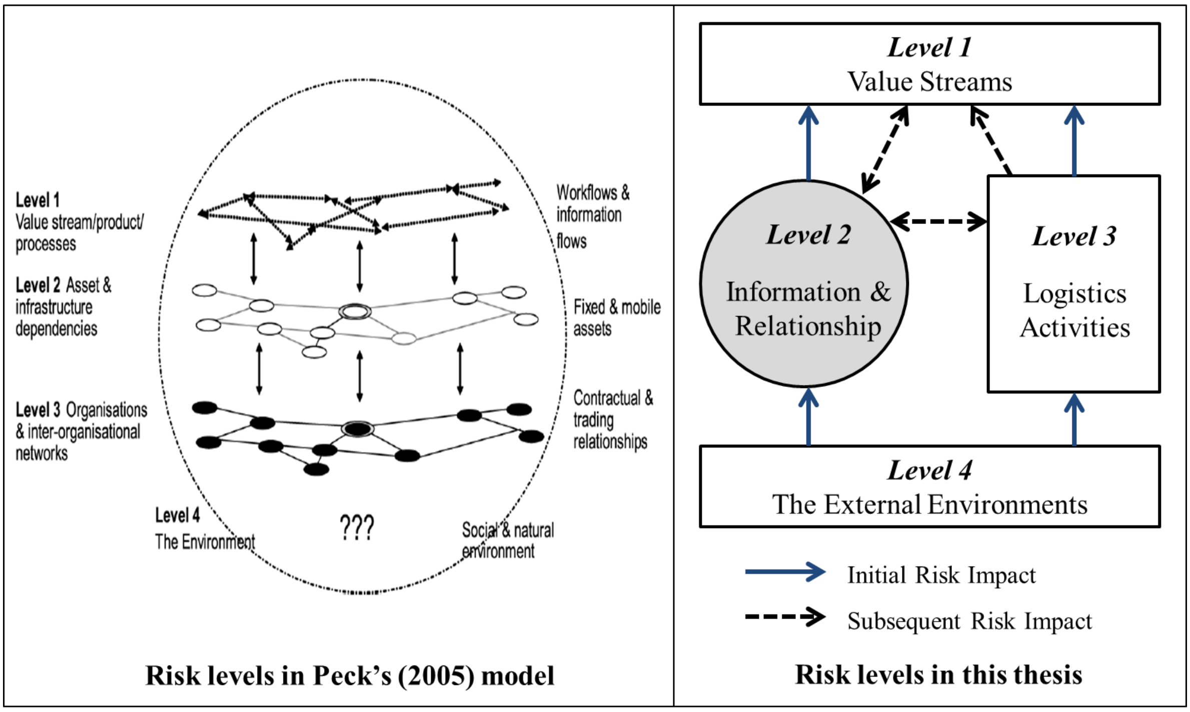
(1) Level 1 – value streams;

(2) Level 2 – information and relationships;

(3) Level 3 – logistics activities; and

(4) Level 4 – the external environment.

Figure 4-12: Comparison between Peck's model and the new model

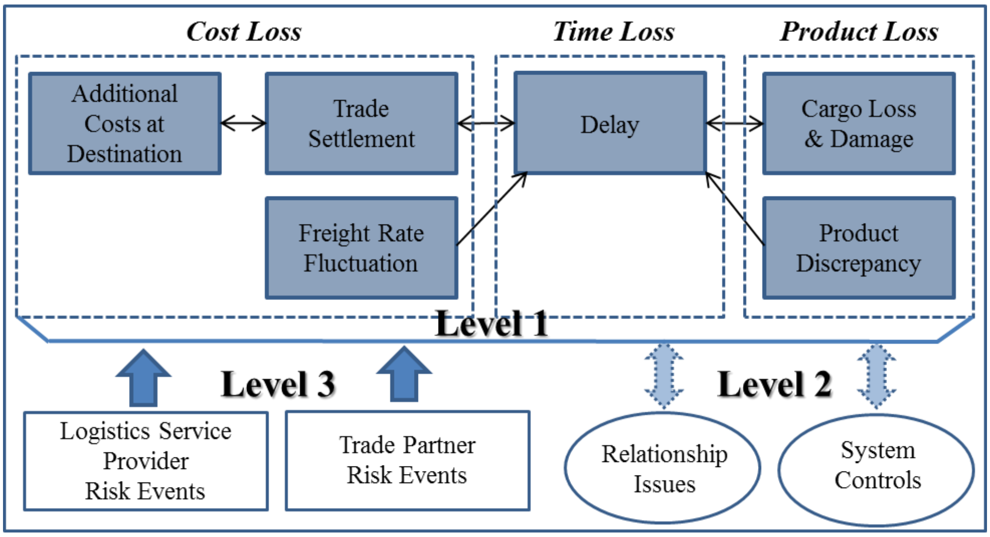


(Source: Adapted from Peck 2005)

4.4.1. Value streams (Level 1)

The top hierarchy in the risk structure was occupied by risk consequences associated with time, cost and product. The first level consists of risks that are deeply related to the values of international logistics. As found in the focus group, practitioners considered time, cost and product as the main logistics values. Level 1 consists of risk consequences that threat these values: *Delay* is the threat to time; *trade settlement issues*, *freight rate fluctuations* and *additional costs at destination* to cost and; *product discrepancy* and *cargo loss & damage* to product. Being consequences of other risks at the top of the hierarchy, they are dependent on risk events in the lower levels but still influential to Level 2 because they distort the relationships with other organisations as well as logistics information and planning. Although information is a critical value stream mentioned in myriad supply chain literature, it would be appropriate in SCRM research to place it in the Level 2 because it is not a consequence but a facilitator or an enhancer of risk events. Although Level 1 risks consist of risk consequences, they can worsen the risks in Level 3 by interacting with the information and relationships risks in Level 2, which eventually enhance the Level 1 risks themselves.

Figure 4-13: Interactions of Level 1 risks with other levels



(Source: Author)

Among the risk elements in this level, ‘*delay*’ was found to play a pivotal role to connect the three types of losses in international logistics. Any losses from ‘cost’ and ‘product’ have impact on delay with causing time to rectify the problems. Also, ‘delay’ can accumulate additional costs at destination, jeopardise the trade settlement between trade partners or aggravate cargo damage. This can be the reason why ‘delay’ was selected as the top risk event by the focus group participants (see Figure 4-13). Despite the great importance of time factor in international logistics, the responsibility of liner companies for the delay in transit time is normally exempted by international conventions such as Hague-Visby Rules which is the main governing framework of bills of lading (B/L). When considering the variability in the arrival time of sea transport, cargo owners need to pay special attentions to the possibility of time delay in order to prevent the spread of delay effect to other losses.

‘*Freight rate fluctuations*’ and ‘*product discrepancy*’ have some discrepancies with other risk elements in this level because they affect the time-delay but the reverse relationship doesn't exist. This is partly due to the timing of risk occurrence and risk detection. The risk relating to 'freight rate fluctuation' occurs before the cargo is loaded on board, which may incur time delay for re-negotiation between trade partners or for selecting the low quality service to maintain the cost level. It means that this risk is materialised in the exporting country leaving little chance of being affected by other losses. The characteristic of 'product discrepancy' risk is somewhat different because it occurs at the very beginning of the material flow by the exporter but can be detected at the end of the material flow by the importer. Once the goods are stuffed into a container with a seal, nobody knows what the real cargo is during logistics operations until the container is re-opened by the importer. To this end, there is no chance that the product discrepancy risk can be influenced by other losses. In these circumstances, the 'delay' emanating from 'product discrepancy' should be understood by re-procurement time due to wrong or deficient products.

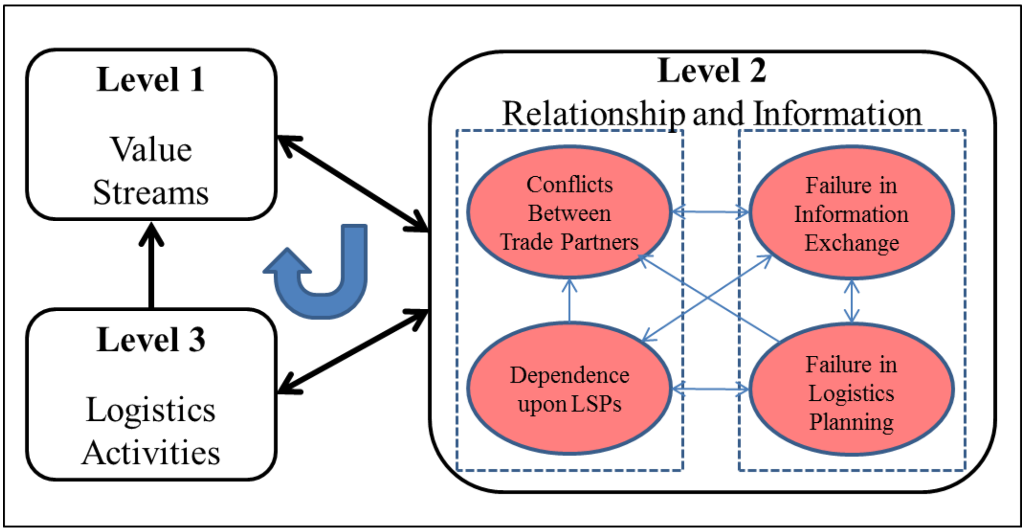
4.4.2. Information and Relationships (Level 2)

The risks in Level 2 are connected to the information and relationships within international logistics. This level embraces several risk clusters that were excluded from the initial ISM procedure since they generated too many indirect causal relationships among elements. They were relational risks (*conflicts with trade partners*, *dependency upon LSPs*) and system control risks (*failure in information exchange*, *failure in logistics control*). As shown in Figure 4-11 and Figure 4-14, these play a pivotal role in mediating risks generated by numerous feedback loops and interconnectedness with each other. In this respect, this level is significant as a generator and facilitator of various risks. According to Wilding (1998), the risks in Level 2 are delineated as deterministic chaos, parallel interactions and amplification that generate supply chain complexity and increase supply chain uncertainty. In line with this, one of the participants in the exporter group stated that:

> *"The most disturbing risk is the inaccuracy in forecasting and its entailing distorted communications. As our product is bulky and heavy, it has a batch size equivalent to one-month consumption, which requires an accurate forecast for*

the shipping schedule. However, when our customer (car manufacturer) abruptly changes its manufacturing plan, it sometimes requests for a hot delivery to its factory abroad. Since all the communications depend on correspondences via emails and phone calls between locations in the difference time zones, this situation makes our company vulnerable to promptly deal with the change."

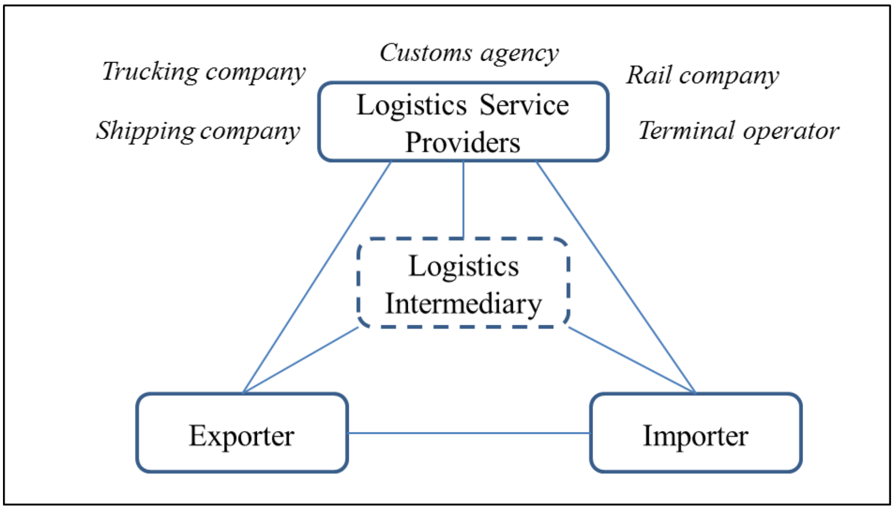
Figure 4-14: The risk spiral created by Level 2 risks



(Source: Author)

According to organisational information processing theory (Galbraith 1973), risk is derived from the gap between information processing needs and information processing capability. The magnitude of risks grows if information processing needs are augmented or information processing capability is reduced. When a disruption or disturbance occurs, the need for information processing soars as the irregular situation requires substantial amounts of extra data in order to adjust the logistics system. In international logistics, however, information is often dependent on other entities because they produce, process and provide a considerable portion of logistics information. In addition, logistics outsourcing and global sourcing makes shipper companies rely largely on other entities within their supply chain for their information processing capacity. A close relationship with trade partners and LSPs (Bode *et al.* 2011), therefore, is vital to secure the gap between information processing needs and information processing capacity. Effective risk management, therefore, has to entail full control over information and relationships so that a single risk event cannot trigger other risks derived by distorted information.

Figure 4-15: The basic inter-firm relationships in international logistics



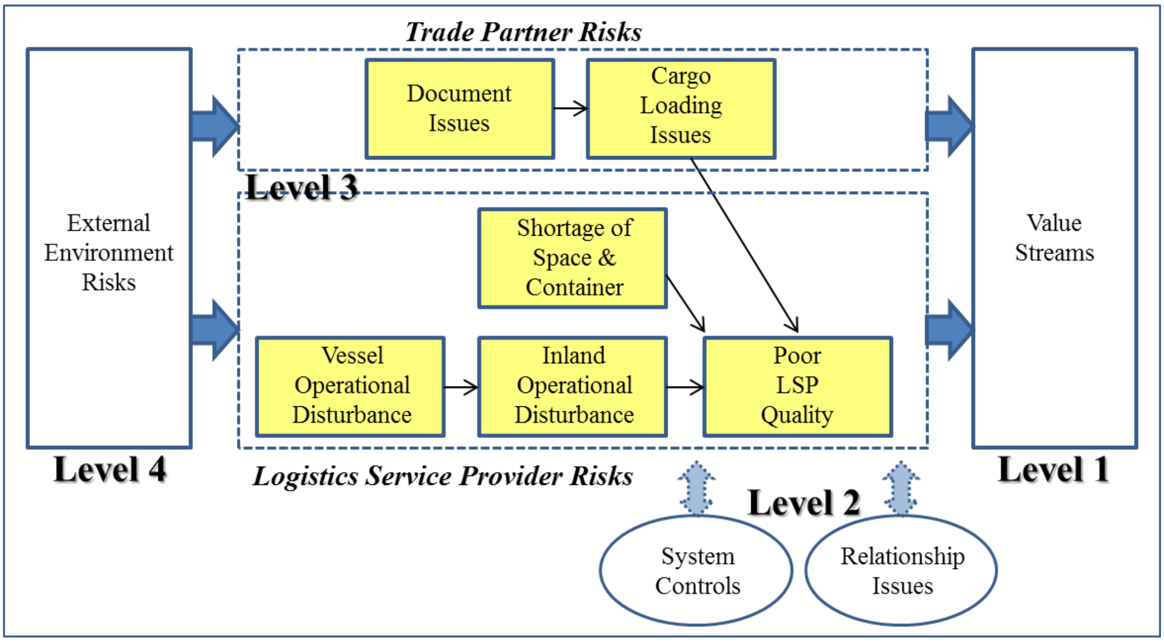
(Adapted from Bask 2001; Sanchez-Rodrigues *et al.* 2008)

According to the findings from Jüttner (2005), practitioners acknowledged the importance of risk sources linked to the inter-organisational relationships within supply chains because they are likely to affect the entire supply chain through rippling effects. As shown in Figure 4-16, the basic relationship in international logistics comprises of an exporter, an importer and at least one logistics service provider. Sometimes, a logistics intermediary as a logistics service integrator can be also included in this relationship. *Conflicts between trade partners* can arise between the exporter and the importer from both commercial and logistics issues. Any small debates on L/C terms, freight rate differences and other cost issues can generate damage to their mutual trust which has prolonging effects on the entire logistics process because there are geographical constraints to regain the trust very easily. Logistics information is a weapon to leverage profits in adversarial relationships by enhancing bounded rationality and opportunism (Williamson 1975) because the entities are interdependent to gather appropriate logistics information. In this manner, *dependence upon LSPs* can be a great issue because it means the loss of control over the LSPs which leads to the deficiency of logistics information.

4.4.3. Logistics activities (Level 3)

This level includes all the logistics activities of organisations and infrastructure involved in international logistics. The risks in this level have both high driving power and dependence in the MICMAC analysis, thereby connecting Level 1, Level 2 and Level 4. According to the ISM-based model, risks relating to activities in international logistics can be roughly separated into two types which emanate from two distinctive activities in international trade, that are commercial and logistics activities. However, it should be noted that most participants in focus group discussions preferred to use the terms like 'logistics service provider risks' and 'trade partner risks.'

Figure 4-16: Interactions of Level 3 risks with other levels



(Source: Author)

The division is associated loosely with responsibility for preventing and/or mitigating the risk events. To clarify who is the responsible party, shipper groups showed the perspective to separate risks at the trade partner's side from the other international logistics risks considering who should be the liable party. In this respect, trade partner risks encompass both commercial and logistics activities that can happen at the shipper's and consignee's side. From their perspective, other risks are to be resolved by LSPs regardless of the real causes because they are beyond exporters' or importers' responsibility.

LSP risks can happen at exporting countries, in transit or at importing countries. In this regard, some of these risks are concerns to exporters while others are issues to importers based on the place of risk occurrence and trade terms which constitute the title of a specific risk as well as the cargo. For instance, INCOTERMS C group in international trade state that the title and risk are transferred from exporters to importers at shipside in the loading port. On the contrary, any INCOTERMS D group makes exporters deal with any risks occurring on board as well.

4.4.3.1. Risks from LSP-related activities

Seven risk clusters labelled as LSP risks in the focus group were rearranged by ISM into three different levels. As a result, it is shown that pure LSP activities are '*vessel operation disturbances'*, '*inland operation disturbances'*, '*shortage of space & container capacity'* and '*poor LSP quality'*. Apart from these risks, '*dependence upon LSPs'* became relationship issues in Level 2, whereas '*freight rate fluctuations'* and '*additional costs at destinations'* were categorised as threats to value streams in Level 1.

There are two main risk areas in these activities. The first is the service availability issue which results in 'freight rate fluctuations'. Price of shipping service is determined by supply of vessel space and demand for the space which is derived from the volume and distance of international trade. When the shipping demand exceeds shipping supply at a certain port of loading, shortage of space and containers is materialised with causing freight rate increases. Due to the characteristics of shipping demand, 'shortage of space & container capacity' is affected by commercial-side external environment risks whereas other LSP-related risks are influenced by logistics-side external environment risks. Both space shortage and container shortage creates availability issue, but in general, focus group participants acknowledged that space shortage is a more serious risk than container shortage. This is because exporters have an opportunity to look for other LSPs in case of container shortage but have no option to choose an alternative LSP once the cargo is laden in the container of a LSP.

The second risk area is the variation in logistics service which causes additional costs as well as other losses. Recent development of vessel/vehicle technologies, process innovation in the transport industry and adoption of ICT dramatically reduced the level of variance in the service providing more reliable and expectable international logistics service. Nonetheless, there still exist disturbances and disruptions generated by logistics service providers. For instance, despite the emphasis on the JIT concept, more than a half of vessel schedules still record delay and longer transit times than announced. This may not be only caused by external environment factors but also by errors or inevitable decisions by LSPs, such as accident, port skip and transhipment. As well as vessel operations, inland operations in ports, rail and roads can generate disruptions. The variance in logistics service eventually leads to poor level of logistics service that is a lingering and continuous risk factor. One interesting finding is that this poor service can also be generated by trade partner risks because inaccurate documentation and inappropriate cargo stuffing can significantly disrupt logistics processes by requiring more time and resources to correct the errors.

4.4.3.2. Risks from trade partner-related activities

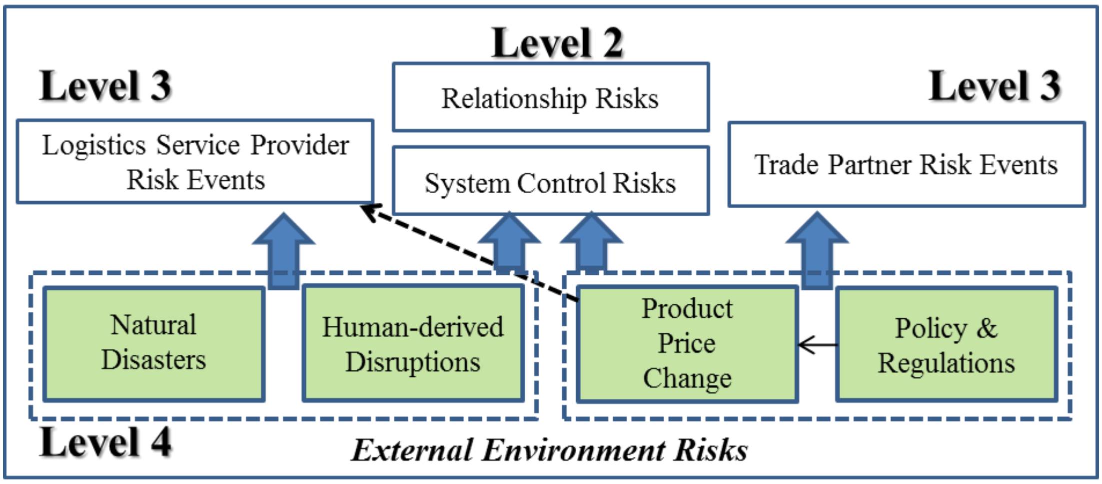
There are two main activities on the trade partner's side, '*shipping documentation issue'* and '*cargo loading issues'*, because ISM indicates that conflicts between trade partners belong to relationship issues (Level 2) and trade settlement to losses to value streams (Level 1). Shipping documentation is the primary activity that can generate various risks and risk consequences. Small errors in B/L data and other shipping documents may delay or stop the entire logistics process. Also delay in sending those documents to importers may incur additional costs at destination. Cargo loading is another activity that creates serious risks: overweight cargo can significantly disrupt inland transport at destination if the regulations prohibit the movement of such overweight cargo. Insecure shoring and lashing can damage both the cargo and the container, which may lead to accidents on board once cargo gets out of the container. Moreover, inaccurate temperature setting for reefer containers may cause cargo to be deteriorated. A unique risk consequence originated from trade partner activities is product discrepancy in terms of quantity and quality. This loss arises at the exporter's premise and is detected at the importer's premise: thus there is little chance of LSP's involvement in it. Product discrepancy may be mistakes but may also happen by malicious acts by exporters.

4.4.4. External environment (Level 4)

In international logistics, there exist roughly four types of external environment risks: '*natural disasters*', '*human-derived disruptions*', '*product price change*' and '*policy & regulations*'. They are common in risk events that are not controllable: some of them may be anticipated but cannot be completely avoided or mitigated at a firm or an inter-firm level. These include natural, social, political and macro-economic disruptions that may be hardly affected by other factors within a supply chain, which is why these risk clusters account for the lowest hierarchy of the risk structure. For instance, *natural disasters* are called in maritime logistics as 'force majeure' or 'act of God' which emphasises the vulnerability in predicting and controlling these risks by human-beings. As a consequence, the MICMAC analysis in Figure 4-17 describes that these four risk clusters belong to Group 4 with low dependence but high driving power.

International trade that generates international logistics is known to be comprised of logistics flows and commercial flows. A logistics flow is the physical distribution of material from exporter's premise to importer's premise whereas a commercial flow delineates a flow of money as well as any flows that support logistics flows. The logistics flow largely relies on logistics service providers because outsourcing of logistics functions is inevitable in international logistics. Contrarily, the commercial flow is secured by the activities between trade partners unless the activities are otherwise outsourced to logistics intermediaries or lead logistics providers. When it comes to the impacts of external environment risks on these two activities, *natural disasters* and *human-derived disruptions* are closely related to logistics flows while *product price change* and *policy & regulation* are more associated with commercial flows. *Product price change* may affect the service availability issues in logistics flows by determining the cargo volume, but its impact is limited compared to the impact on commercial flows. The relationships suggest that the interactions could be shown as in Figure 4-18.

Figure 4-17: Interactions of Level 4 risks with other levels



(Source: Author)

Natural disasters are a very straight-forward cluster of risks which consist of heavy rain, storms, earthquakes and other types of geological and meteorological risk events. They do not happen regularly but, once they occur, they have devastating impacts not least on logistics activities but on the entire supply chain. An earthquake in Kobe, Japan in 1995, for example, did not just destroying cargoes stored in the Kobe Port, but also disrupted all the logistics routes via the port. The cargoes had to be re-routed in the short run, but in the long run, logistics networks using the Kobe port had to modify their networks. *Human-derived disruptions*, such as strike, port congestion and terrors, have similar characteristics to natural disasters by negatively influencing critical infrastructure and, in turn, logistics flows. The port closure in the US West Coast in 2008, for instance, stopped all the flows of containerised cargoes which badly hit the companies of lean operations. Their impacts are lingering aftermaths to decrease confidence in using the disrupted infrastructure. These two environment risks are drivers of risks associated with logistics service providers because they negatively influence the flows of materials. There is no doubt that these risk factors bias logistics information and planning, which also deteriorate relationships with other supply chain entities.

Product price change originates from the fluctuation of product market and foreign exchange market. In general, a sudden hike or drop of product price matters to exporters and importers because the change may significantly undermine their profits and even generate losses from international trade. The fluctuation of foreign exchange market has the same effect by changing product price marked by a certain currency. At least, international trade that is not equally beneficial to all parties can augment relationship risks. Worse, this situation sometimes tempts shippers to consider unusual behaviours to reduce their losses. Delay, non-delivery of cargo and inserting delicate terms into shipping documents can be named as examples of these malicious behaviours which cause serious logistics disruptions. *Policy & regulations* delineate political decisions of individual countries and international communities that have a power to alter logistics activities, such as embargo, export/import quota and cumbersome processes in customs clearance. Some researchers distinguished policy risks from political risks, but they are similar in being generated by authorities, out of control from shippers' perspectives. It not just aggravates risks in other levels, but also influences *product price change* by manipulating either supply or demand of the product market.

4.5. Concluding Remarks

This chapter unpacked the individual risk events, risk clusters and the risk structure in international logistics operations, which eventually resulted in the four levels of risks. The main findings of this research are as follows.

(1) 88 risk events were identified by focus group discussion

(2) 20 risk clusters were generated by risk sources and loss types

(3) The ISM-based risk structure was created for a holistic analysis of risks

(4) Value stream (Level 1), Information and Relationships (Level 2), Logistics Activities (Level 3) and the External Environment (Level 4) were conceptualised from the findings.

(5) Risks relating to Information and Relationships (Level 2) were identified as the drivers of creating a risk spiral.

Risk identification and analysis provides a vital and valuable stepping stone to risk mitigation. In particular, it decides what risks should be mitigated and how they should be mitigated. Given the risk levels proposed, it is difficult to mitigate Level 4 risks because they are out of a firm's control. Since Level 1 risks are the consequence of risks at other levels, it is much more feasible to mitigate Level 2 and Level 3 risks to minimise negative consequences. In particular, the mitigation of Level 2 risks is essential to shrink the self-enhancing closed loops these risks can create. In these circumstances, the mitigation of risk in international logistics leads towards two key challenges:

(1) how to manage external relationships for the quality of logistics activities and for the accurate information relating to risks and risk management; and

(2) how to manage logistics information to break the risk spiral.

From these findings, it is important to investigate the risk management strategies and practices which are widely implemented for international logistics operations; this angle of investigation forms the foundation of the next two chapters.

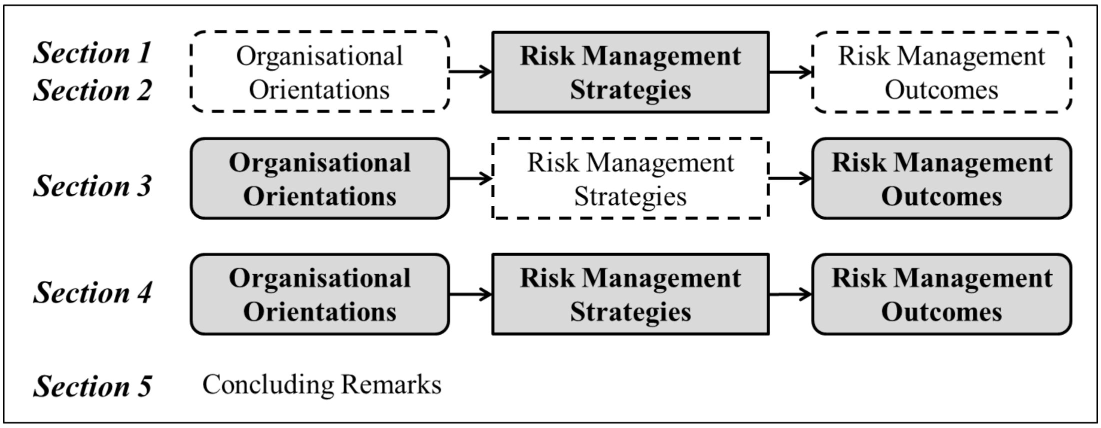
Chapter 5

Development of Risk Management Strategy Model

This chapter is dedicated to conceptualising risk management strategies for international logistics. Also, it aims to build a research model as to how these strategies are stimulated by organisational orientations and the positive outcomes that such strategies can bring about. For this purpose, the concepts of risk management strategies for international logistics are framed by information processing theory, taking logistics outsourcing into account. Interviews with logistics professionals and the review of SCRM literature populate the practices and initiatives to achieve these strategies. This research goes further than risk management strategies to look at (1) the enablers of the strategic implementation and (2) the outcomes of these strategies. Thus, the same research method is applied to exploring the antecedents and outcomes of the risk management strategies, which will generate research hypotheses and the research model. Khan and Burnes (2007, p. 211), in their literature review on SCRM studies, highlighted the great need "to devise robust and well-grounded models of supply chain risk management, which incorporate risk management tools and techniques." They also asserted that these models can only be achieved by studies on the comprehensive understanding of supply chain risks as well as by the broad and in-depth empirical research into the mechanisms of risk mitigation. This chapter strives to address this critical research gap in the previous research.

This chapter is outlined as shown in Figure 5-1. The initial interest of this research will shed light on the risk management strategies for international logistics. The first section will focus on a framework for risk management strategies by adapting Information Processing Theory (hereafter, IPT) by Galbraith (1973) to international logistics contexts. In the second section, this framework will be discussed more in detail based on the results of interviews with logistics practitioners as well as the review of extant research. After finishing the conceptualisation of risk management strategies, the third section will be devoted to finding out organisational orientations which can augment the level of strategic implementation, which will be followed by explaining the desired outcomes that the strategies must bring about. The last section will wrap up all these findings by proposing research hypotheses and developing a research model encompassing organisational orientations, risk management strategies and risk management outcomes. The last section will sum up the findings from the international logistics risk management perspective.

Figure 5-1: The outline of Chapter 5



5.1. A Framework for Risk Management Strategies

A thorough understanding of the analysis on the risk profiles and their interactions enable firms to select and implement strategies in response to those identified major risks (Zsidisin *et al.* 2000). The previous chapter showed that four levels of risks in international logistics are interconnected, thus create a self-amplified risk spiral around information and relationship risks (Level 2). Information and relationship risks create the complex risk structure by interacting with operational risks by trade partners and LSPs (Level 3) as well as with losses that have already been materialised (Level 1). Therefore, how to manage the information scattered across the logistics networks as well as the relationships with various entities engaged in the network is crucial to the firms involved in international logistics.

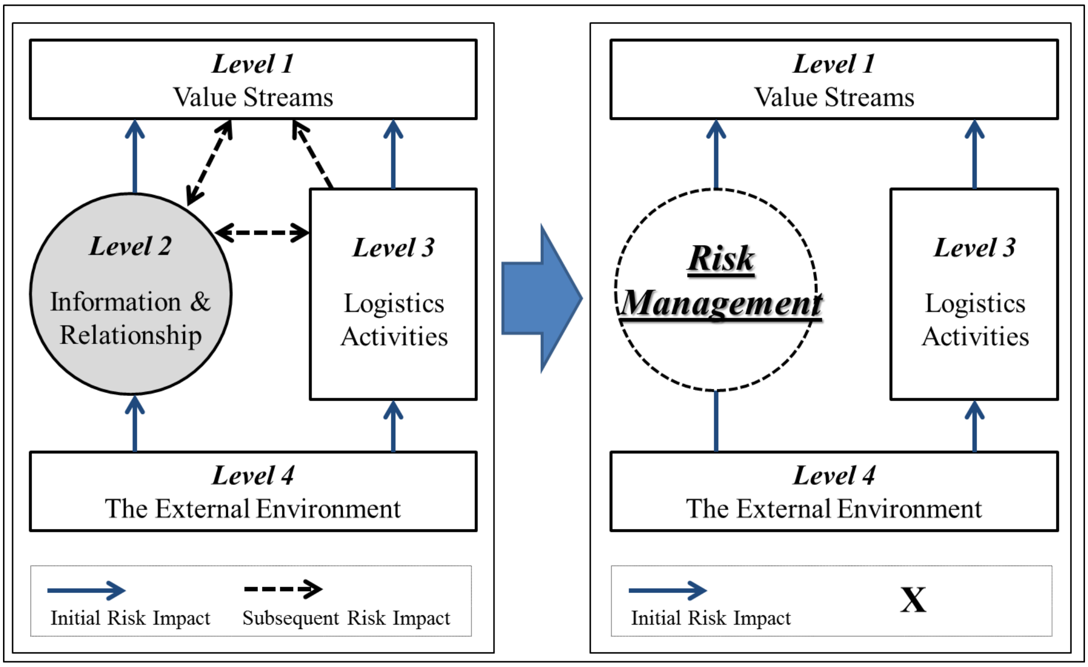
Risk mitigating strategies are "strategic moves organisations deliberately undertake to mitigate the uncertainties identified from the various risk sources” (Jüttner *et al.* 2003, p. 200). As Paulsson (2004) argued, supply chain risks can be categorised into operational disturbances, tactical disruptions and strategic uncertainty, thus the responses should also be differentiated by the operational, tactical and strategic levels (Ritchie and Brindley 2007b). Among them, the strategic dimension of risk mitigation indicates the aggregate of a series of operational and tactical decisions which lead to planned or emergent pattern (Mintzberg and Waters 1995). Due to the interconnectedness of international logistics risks, operational and tactical measures to mitigate certain risks may have limited effects to break the risk spiral.

Moreover, the adoption of particular strategies may curve the causes or impact of risks even when the firm is not able to manage the sources of risk exposures. In international logistics, the external environment risks and trading/logistics partners’ risks are often uncontrollable due to lots of constraints. Nonetheless, implementation of some strategies can enable firms to reduce the occurrence of risk events and the eventual impact from the events (Ritchie and Brindley 2007b). As discussed in the previous chapter, information and relationships risks play a great role in international logistics risks because they generate subsequent risk impact after the initial impact of a disruption by creating feedback loops of risks. These risks make international logistics risk clusters become interacted with each other, hence the risk impact is often amplified to the degree that a firm entirely loses its control over the logistics network.

In this regard, the risk management will be most effective when mitigating measures can minimise the level of information and relationships risks. According to Sheffi and Rice (2005), supply chain disruptions cause small initial impacts followed by catastrophic subsequent impacts. While the impacts through Level 4, Level 3 and Level 1 can be regarded as the initial impacts which finish at Level 1, the impacts around Level 2 will be considered as the subsequent impacts which will be enhanced more and more unless adequate measures are taken to break the risk spiral. As can be seen in Figure 5-2, managing information and relationships risks can eliminate subsequent impacts of a disruption, thus it reduces the duration and total impacts of a disruption. Without doubt, risks in Level 1, Level 3 and Level 4 should also be the objectives of risk management to prevent the initial impacts of logistics disruptions. However, this research focuses more on Level 2 risks on the assumption that international logistics risks are low-frequency-high-impact (LFHI) risks and that the high impacts emanate from Level 2 risks.

To build a theoretical framework for risk management strategies in response to information and relationships risks, this thesis adopts Information Processing Theory (IPT) by Galbraith (1973) and also expands the theory further to the inter-firm level. IPT seeks the cause of uncertainties from information processing, suggesting measures to mitigate these uncertainties. The expansion of this theory to the inter-firm level enables it to consider relationships among entities in the logistics network, and to propose solutions from the perspective of information-relationship interactions. This theory will provide the appropriate grounds to devise risk mitigation strategies to mainly deal with information and relationship risks by addressing the propensities of these risks.

Figure 5-2: The focus of international logistics risks mitigation



(Source: Author)

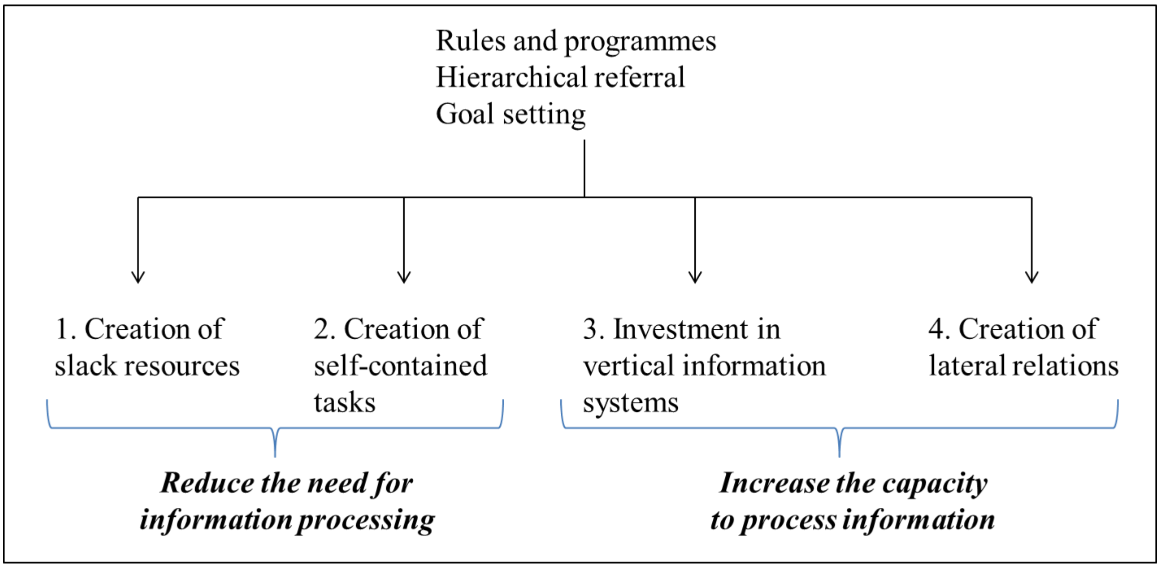
5.1.1. Information Processing Theory

Information Processing Theory raises a question, from the empirical findings of organisational studies, as to why uncertainty of task by organisational unit has an effect on the organisation forms and how to connect uncertainty with organisation designs. This theory starts from the proposition that “the greater the task uncertainty, the greater the amount of information that must be processed among decision makers during task execution in order to achieve a given level of performance” (Galbraith 1973, p. 4). Uncertainty, therefore, is defined as the gap between “the amount of information required to perform a task” and “the amount of information processes by the organisation” (Galbraith 1973, p. 5). This theory labels the former as information processing needs and the latter as information processing capability. In order to reduce uncertainty, an organisation may have strategies to reduce the information processing needs and/or the strategies to enhance the information processing capability. The effective management uncertainties, thus, require firms to match their information processing needs with their information processing capabilities (Tushman and Nadler 1978).

Galbraith (1973) has suggested that each strategy has at least two sub-strategies, as shown in Figure 5-3. When it comes to the strategies to reduce information processing needs, (1) creation of slack resources and (2) creation of self-contained task were exemplified. The strategy to create slack resources aims to reduce the occurrence of exceptions by absorbing the variability from expected outcomes by accumulating slack resources, such as labour, time and inventory, which eventually contribute to the reduction of information processing needs. Despite the additional cost for slack resources, the buffering effect significantly diminishes the information required to be processed during the task. In contrast, the strategy to create self-contained tasks emphasises that an organisation can provide all necessary resources to a self-contained unit to perform a task and to make a decision at the lower hierarchy. As this strategy moves the authority to the place where information is generated and handled, it can lower the possibility that an organisation suffers from overloaded decision-making processes, which will reduce the information processing needs of an organisation.

As for the strategies to enhance information processing capability, (1) investment in vertical information systems and (2) creation of lateral relations were proposed. The investment in vertical information systems accompanies the investment into the system to collect information at the original sources and to direct it to the appropriate places in a timely and accessible manner for decision-makers. It entails the cost of information processing resources, but it can enable an organisation to adopt the uncertain situations with adjusting the plans based on accurate information. The capability of information processing is significantly augmented by this investment. On the other hand, creation of lateral relations stimulates the communications across the lines of authority to make decisions at the point where information exists, which is a kind of decentralised decision by joint efforts at the lower level. It may use a liaison personnel or a coordinating team to find out the solutions for the uncertainty. The lateral relations can foster the capability of information processing of an organisation.

Figure 5-3: Four strategies in information processing theory



(Source: Galbraith 1973)

5.1.2. Intra-firm and inter-firm strategies

IPT focuses mainly on the design strategies of an organisation (Birkinshaw *et al.* 2001), but is also applicable to inter-organisational contexts (Hult *et al.* 2004). Prior to disseminating design strategies, it assumes a hierarchical organisation structure which is closely related to authority. In this setting, any unexpected events need to be referred upwards along the hierarchy for decision making. Frequent exceptions due to increased uncertainty, however, make the hierarchy overloaded, which in turn generate delays in decision making on the responses. Therefore, preventing the hierarchy from being overloaded is the main objective to consider the organisational design strategies.

The inter-firm settings in international logistics pose some similarities to the general organisational structure assumed by this theory. The organisations performing international logistics inevitably entail logistics outsourcing because they cannot conduct every single function of international logistics. Logistics outsourcing, by definition, is the practice of using external organisations to perform parts or all of the logistics functions which have been conducted in-house (Bowersox 1990; Lieb 1992). According to this definition, logistics outsourcing substitutes a functional unit of an organisation with logistics service providers. Moreover, suppliers in the global supply chain may take up some logistics functions for a focal organisation.

International logistics networks consist of a multitude of entities which have their own capabilities and competencies. Also, they take different functions in the network. Contrary to the single organisation model by Galbraith (1973), the entities in the logistics network are more or less interdependent with each other, and they act like an extended enterprise. The firms in this network, to this end, may always have two options in strategic approaches for effective and efficient network: the first option is the intra-firm approach and the second is the inter-firm approach (Khan and Burnes 2007). The former is the strategies that are initiated solely within a firm to enhance competency or performance. The latter, on the other hand, is collaborative, coordinated and even coercive strategies that invite other entities in the network to plan, implement and monitor activities with an aligned goal. Risk management strategies for international logistics will embrace both of these two approaches. Lavastre *et al.* (2012) described these strategies as risk attitude to secrecy and collaboration.

It is evident that any firms involved in international logistics must be concerned with the inter-firm risk mitigation because the risk outcome of one firm can be easily transformed into a risk event for another firm in the supply chain (Manuj and Mentzer 2008b). Bode *et al.* (2011) labelled inter-firm strategies as 'bridging', which is internal to the exchange relationships which directly governs the dependencies that may be created from logistics relationships. Bridging in this context can have a large spectrum from modifying the relationships achieved by formal acts to investing collaborative structures. In a similar vein, some researchers distinguish relationship management from other strategic/proactive purchasing behaviours (Khan and Burnes 2007). The former emphasises the loyalty to supply chain partners (Mitchell 1995; Puto *et al.* 1995) by building partnership, strategic alliances and supplier development (Zsidisin 2003), whereas the latter focuses on initiatives to force partners to meet the required standard, such as monitoring, auditing and certification.

It can be inferred from the literature that inter-firm risk management strategies can be achieved by outsourcing contract or relationship development given the relationship spectrum. Contract is a coercive way, regardless of explicit or implicit, to compel supply chain partners to involve themselves in risk management. The most extreme case is transferring consequences or management of risks to partner organisations. In this case, partners have no option but to prepare or mitigate risks to minimise their loss. This is particularly the case when logistics function is outsourced to logistics intermediaries or to transport companies. Early supplier involvement which makes the party proximate to information sources to act first is also a coercive measure. Tight monitoring of supplier performance is also an inter-firm strategy in that it allows little variation from the normal performance level. The contract can augment the risk management awareness of partners to meet the standard.

Another inter-firm strategy can be achieved by the development of logistics collaboration. The contract strategy solely depends on the risk management capability of partners, but in contrast, logistics collaboration aims to enhance the capability mutually. The partners can plan, implement and monitor risk management measures in a collaborative manner so that they can mutually prosper from the collaboration efforts. There are some attributes that materialise logistics collaboration which can be found in the literature on supply chain collaboration. These include communication, information sharing and aligned goals etc. When collaboration is well developed, logistics alliances and partnerships are also viable for further cooperation in the specified aspects in logistics operations.

5.1.3. Theoretical framework

From IPT, firms have strategies to reduce information processing needs and/or to enhance information processing capability. In the global logistics network contexts, these strategies can be either intra-organisational or inter-organisational, built upon the initiatives to engage other entities into the risk management process. Bode *et al.* (2011) developed their theoretical framework of organisational responses to supply chain disruptions based on IPT combined with Resource Dependence Theory. In the model, they suggested 'buffering' and 'bridging' as two organisational responses to disruptions. 'Buffering' is an effort to reduce a firm's exposure to disruptions by reducing information processing needs from a particular exchange relationship, which is exemplified by larger inventories, flexible processes and redundant suppliers (Tang 2006). 'Bridging', on the other hand, is an effort to enlarge a firm's influential boundaries by facilitating access to reliable and timely information, while encompassing both formal acts and collaborative structures.

Figure 5-4: The theoretical framework for risk management strategies

	Strategies to reduce information processing needs	***Strategies to enhance information processing capability***
Intra-firm strategies	**Type 1 Strategy**	**Type 2 Strategy**
Inter-firm strategies	**Type 3 Strategy**	**Type 4 Strategy**

(Source: Author)

This research proposes a different model from Bode *et al*'s (2011) although it is also based on IPT. The proposed model consists of four types of risk management strategies, created by one dimension of the primary approach to uncertainty (reducing information processing needs and enhancing information processing capability) and another dimension of the strategic scope (intra-firm and inter-firm strategies), as shown in Figure 5-3. The strategies suggested in the seminal work of Galbraith (1973) are fully reflected in this model when it is assumed that an organisational unit for international logistics operations is replaced by external entities through outsourcing. As a result, creation of self-contained task strategy and creation of lateral relations strategy can be initiated in the inter-organisational settings, as described in Figure 5-4. Galbraith (1973) indicated that these strategies will require considerable financial and human resources within a firm: however, in the inter-firm contexts, less resource are required because external organisations are already self-contained units and the lateral relations are what they need to pursue at any price.

5.2. Conceptualisation of Risk Management Strategies

Since a supply chain disruption has direct or indirect negative impacts on a firm's performance, the intervention with appropriate strategies and responses to tackle this relationship is required (Bode *et al.*, 2011). Tang (2006b) highlighted the benefits from implementing robust strategies are (1) reducing cost and/or improving customer satisfaction by managing regular fluctuations under normal conditions and (2) sustaining the normal operation level during and after a major disruption.

In order to conceptualise and populate each type of risk management strategies in the theoretical framework, case study interviews as well as a thorough literature review were undertaken. Eight companies, actively involved in international logistics, were invited to this research in order to hear their opinions on these strategies and their practices to achieve the aim of the strategies. In the case study interviews, the theoretical framework with four types of risk management strategies (Figure 5-4) were suggested and explained to the interviewees first. Then, they were requested to explain their risk management practices classified into a specific strategy type. After populating each type of strategies, most proper titles for these strategies to encapsulate the practices were also sought from the participants. The following sections unveil the findings from these case study interviews.

5.2.1. Type 1: Building a Stable Logistics Network

Type 1 strategy is, by nature, a proactive strategy that aims to minimise the probability of risk occurrence and, at the same time, to nullify the severity of the risks as much as possible. Firms pursuing this strategy tend to thoroughly review the logistics processes and redesign the logistics network with solution flexibility embedded. In this manner, this strategy is associated with the network re-engineering strategy (Christopher 2005; Christopher *et al.* 2011). The understanding of the logistics design from beginning to end becomes critical because it facilitates a firm's ability to quickly redesign the supply chain network and to recover from the disruptions (Blackhurst *et al.* 2011). It requires time- and resource-consuming activities; but they are rewarding because, once an appropriate logistics network is developed, the information processing needs generated from disruptions can be minimised by eliminating a chance of risk occurrence or by enabling the logistics operators to deal with the disruptions easily without overloading the corporate hierarchy. Therefore, the Type 1 strategy is labelled as "building a stable logistics network."

Most interviewees recognised this as a proactive strategy that aims to build a stable logistics network which is resistant to logistics disruptions. They agreed that the stability originated from disciplined processes and solution flexibility. The process with disciplines is often achieved by tight logistics quality management by risk management manuals which anticipate and reduce possible risks.

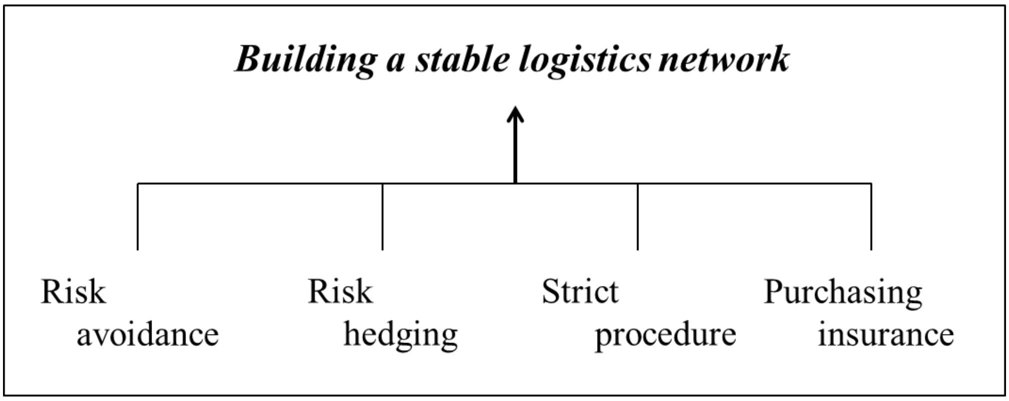
> *"There are various kinds of manuals related to international logistics. Due to these manuals, all the logistics operations of our branches go same as the head office's instructions. Yet if it comes to problems with more detailed operations then the relate team deals with it. If irregular cases occur, we respond with the manual first and after that we report them. Sometimes the manual gets changed according to the report. As those manuals are based on prior experience and many other cases happened before, if we follow it, we can prevent the majority of possible risks. (Company C)"*

Flexibility is delineated as the ability to "adapt to unexpected circumstances" and "to encounter, resolve and exploit an unexpected emergency or opportunity" (Skipper and Hanna 2009, p. 408). Flexible supply base and transportation enables a firm to manage supply under normal circumstances and to shift service provision or modes of logistics rapidly (Tang 2006). Solution flexibility particularly emphasises possessing several options that can be easily opted for. A parallel network is not easily disrupted because a disruption on one option becomes an independent event from the normal flows in another option.

> *"In logistics operations, flexibility is the key because there are too many exceptional and irregular cases, such as long lead time, dealing with urgent needs, delaying it or making it earlier than expected because of sourcing problem. The company has some guidelines to deal with the problems like this flexibly, yet it is just about principles. So, if you want some flexibility in individual case, it's totally up to preparing back-up solutions in advance and making skill to combine the available sources effectively. (Company E)"*

The redesign of a supply chain or a logistics network is the starting point for effective risk management (Colicchia and Strozzi 2012). Accordingly, there are numerous practices proposed to achieve this strategy, such as having multiple and dispersed suppliers, accumulating excessive capacity and inventory, postponing production, tightening quality management, avoiding specific geographical areas or suppliers, maintaining target costing, simplifying material and information flows, purchasing insurance, securing the network, to name a few. This strategy has been studied extensively by SCRM research (Mason-Jones and Towill 1998; Sheffi 2001; Zsidisin and Ellram 2003; Childerhouse and Towill 2004; Chopra and Sodhi 2004; Christopher and Peck 2004; Giunipero and Eltantawy 2004; Blackhurst *et al.* 2005; Prater 2005; Tang 2006; Faisal *et al.* 2007; Ritchie and Brindley 2007b; Sodhi and Lee 2007; Ellegaard 2008; Manuj and Mentzer 2008b; Zsidisin and Wagner 2010; Blackhurst *et al.* 2011; Christopher *et al.* 2011; Kam *et al.* 2011; Tang and Musa 2011; Colicchia and Strozzi 2012; Lavastre *et al.* 2012), but its application to international logistics needed a precaution. Though all the interviewed companies pursued this strategy, the practices they were implementing varied across companies. Also, some practices that are valid to SCM were not appropriate in the international logistics contexts. The interviewees indicated that some of the practices are frequently and commonly used in international logistics operations, which are risk avoidance, risk hedging, strict procedure and purchasing insurance.

Figure 5-5: Type 1 strategy and its practices



(Source: Author)

5.2.1.1. Risk avoidance

Risk avoidance delineates removing supply chain options that are risky in geopolitical or operational circumstances (Mason-Jones and Towill 1998; Sheffi 2001; Lavastre *et al.* 2012). The objective of this practice is fundamental elimination of risks from a certain product, geopolitical market, supplier or customer, currencies, materials and technologies which is deemed to be unacceptable (Jüttner *et al.* 2003; Manuj and Mentzer 2008b). This practice entails decisions to find out the root causes and eliminate them (Ellegaard 2008).

There can be numerous combinations of links and nodes whilst moving goods from place A to place B, particularly in consideration of international logistics which requires multimodal transport. In the route choice of multimodal transport, cost factor is the main element unless the quality is maintained. Piercy and Ballou (1978) argued that modal selection is the optimisation of trade-offs between cost and quality. It is in line with McGinnis (1989) which defined the decision factors in modal choice as 'cost' and 'non-cost' factors. The non-cost factors encompass reliability, transit time, loss and damage, shipper market consideration, carrier consideration and product characteristics. The consideration of risks in international logistics is one of the non-cost factors, which can be assessed objectively or subjectively by using experience and confidence (Banomyong and Beresford 2001). This evaluation of non-cost factors sometimes leads to avoidance of a certain route or mode due to high level of risk.

> *"Mainly the part of our product goes to the subsidiary which is located abroad; in this case we can't avoid the dangers. Yet, as we still have risks at exporting parts, we prefer the route that has less risk. For instance, at the very first moment of doing our international logistics, we considered three modes: Shipping, Air and TSR. TSR was cheaper than Air, and had competitiveness in transit time. However, there was possibility of suspending our train because of political situations of Russia; also the cargo tracking was frequently imperfect. So we don't use it any more. (Company F)"*

> *"Avoiding specified cargo or route is already in the company's manual. So, those exclusions, which are on the manual by the head office, are to be followed by the operation team. (Company C)"*

Avoidance of geopolitical risks is also critical in internal logistics operations. If the region where logistics operations are executed is prone to natural disasters or political instability, the operations can be seriously disrupted leaving the firms vulnerable in dealing with the risks. In this case, avoidance of the geopolitical region can be the best option.

> *"If the geopolitical risks are high, then we won't establish our branch in that region or even won't attempt any sourcing and selling. Meantime, our company's sourcing divides into two kinds: inter-company sourcing and third-party sourcing. For the former one, it is undeniable to exclude sourcing in the region 100% despite the high risk, but in the case of the third-party sourcing, we try to find mutual solutions at the first instance, but when they are impossible to be achieved, we could possibly terminate our contract with the third-party supplier. (Company E)"*

The main advantage of risk avoidance practice is that the probability of risk occurrence can be reduced to zero by ensuring that the risk does not exist anymore (Manuj and Mentzer 2008b). However, if the removed network has generated considerable profit, an analysis on benefit and cost with teams of interests will be required. A firm has to evaluate the risks of their supply chain networks and to decide what should be avoided and how they should be replaced.

5.2.1.2. Risk Hedging

Risk hedging is the foremost practice for supply chain design strategy to spread risks across multiple and dispersed suppliers (Jüttner *et al.* 2003). This is also one of the most advocated risk mitigating practices by SCRM research (Mason-Jones and Towill 1998; Zsidisin *et al.* 2000; Sheffi 2001; Zsidisin and Ellram 2003; Childerhouse and Towill 2004; Chopra and Sodhi 2004; Giunipero and Eltantawy 2004; Tang 2006; Khan and Burnes 2007; Sodhi and Lee 2007; Ellegaard 2008; Zsidisin and Wagner 2010; Kam *et al.* 2011; Tang and Musa 2011; Lavastre *et al.* 2012). Originally, it refers to a financial strategy to mix investment with different levels of risks so that the risk can be aggregated to a moderate level. In the supply chain, heading means the portfolio of a globally dispersed multiple suppliers and facilities in order to prevent a single event from disrupting the entire supply chain (Manuj and Mentzer 2008b). Researchers have warned about the vulnerability from sole suppliers, despite its advantage in cost saving by the economies of scale, because the sole supplier can be the weakest link that can paralyse the supply chain. To this end, firms are advised to have "qualified back-up suppliers" (Manuj and Mentzer 2008b) in case of disruption occurrence. Though hedging is an expensive tactic due to maintaining multiple suppliers, it can dramatically reduce uncertainties by providing several options to minimise disruptions (Manuj and Mentzer 2008b).

> *In the case of supplying compatible raw materials, let's say sugar for instance, it doesn't matter from which it is imported. So, to reduce the logistics risk, we can get it from multiple suppliers which are globally dispersed. (Company E)"*

Maintaining a globally dispersed network of suppliers and facilities can be the hedging in global supply chain management contexts because a disruption cannot affect all of the entities with the same magnitude (Manuj and Mentzer 2008b). For instance, back-up suppliers and dual sourcing are frequently used methods by practitioners to hedge the risks. Hedging comes at cost because maintaining multiple suppliers require more investment than having a single supplier. Therefore, it is thought that implementation of hedging can be justified when the quality and process controls are strong or when the supply chain faces high risks.

Hedging can offset the risk of capacity constraints of liner shipping due to a surge in shipping demand in the peak period. In addition, if a transport route or mode is disrupted by natural disasters or man-made disruptions, such as strike, the use of back-up routes and back-up logistics provider can hedge the impact of risks from these disruptions. There are several ways to ensure the flexible transportation in order for a firm to hedge logistics risks (Tang 2006). The first is multimodal transportation which relies on a multitude of different transport modes rather than depending solely on one mode. For instance, the transport of cargo from Scotland to Greece can be completed by at least six different combinations of transport modes (Beresford 1999). The second is multi-carrier transportation with hiring various transport companies in case of disruptions so that a company can swiftly switch from one carrier to another. The last is multiple routes to avoid the shutdown of one link or node in the logistics network.

> *"We, basically, use two different shipping companies in every route. It's just because, to use the other one in case one is disrupted, yet the company can also compare the freight rate that fluctuates too often. (Company A)"*

> *"If we want to cut the cost, we can concentrate on one shipping company. But in this case it creates dependency and we can't deal with the problems if the shipping company has a problem. So using multiple shipping companies is basic of the basics. Also, because of various freight rates, to maintain cost competitiveness we have no choice but to use multiple shipping companies. (Company B)"*

> *"In most cases we use a Korean shipping company for logistics quality, but for price competitiveness we use foreign shipping companies. It's basically to satisfy*

the customers' different needs, yet, in case of space shortage or sudden increase of freight rate we can change the company with ease if we have multiple shipping companies at hand. (Company H)"

5.2.1.3. Strict procedure

Strict procedure is a generic countermeasure for a firm to deal with uncertainties from international logistics. Unless a firm is highly globalised with having branches across the world, it is located in one place while operating logistics all around the world. In these circumstances, nobody can be sure how much impact a small change in practice can bring about by making disruptions to logistics operations. In addition, the change can affect the behaviour of supply chain partners or make it hard for the partners to deal with the change. By nature, international logistics operation has conservative characteristics. Despite the advance of a seaway bill and electronic bill of lading, the titles of most cargoes are still transferred by a paper bill of lading. Every company has detailed instructions on the operations, which often prohibits the discretion of operators without the permission of managers or even top management.

"In business, there are principles and exceptions. It is true that allowing exceptions may open the chances to the new business and to make more profit that cannot be expected when we follow the principles. However, it is also true that we are not sure what will happen as the results of the exceptions. When it comes to international logistics, we have bitter memories when allowing some exceptions. Even if we think it is okay, it made our partners frustrated and perplexed with the changes, and it led to serious delay in the process or even resulted in the return of the cargo. (Company H)."

This strict procedure is the way to achieve the standard and expected results from the operations. The primary objective of international logistics is to move goods from nation A to nation B within the targeted time and cost frame and without any defects. Although unexpected disruptions, such as natural disasters and terrorist attacks, cannot be prevented, any operational variations within a company can be easily controlled by the strict procedure. This is also important in the outsourcing situations because the compliance of strict procedures can diffuse through the supply chain by making suppliers respect the procedure seriously.

> *"Strict procedure is a fundamental method of our operations. We have already developed the standards and the handling procedure to deal with the occurrence of various risks. The procedure tries to induce reasonable decisions by using both product quality management and targeting costing. This is a global procedure but some divisions of the company have their own rules of it. (Company E)"*

> *"As our international logistics is restricted to certain destination, making a standard procedure is not that much difficult. We establish the standard procedure with checking and sharing the changes in demand forecasting and lead-time in advance. As quality assurance is the most important and cost structure is the area to be improved, it is possible for us to pay additional fee not to decrease the logistics quality due to a set of troubles within logistics operations. (Company F)"*

The procedure can encompass various aspects of the operations. In the interviews, security, quality management, prevention of loss and damage and simplified cargo flow were mentioned to ensure a disciplined process of international logistics operations.

> *"As we handle various kinds of cargo, we have different processes for each one. Fragile cargoes, for instances, we need to put those in tilt & tap containers when we ship them. If it comes to transport the luxuries by the wheels, we put escort to them and transport those non-stop, or we hire two drivers to reduce the risk of robbery. We have it in our rules. (Company B)"*

> *"In our case, the most danger that can happen to us is the damages to our products. So, we are on our way to develop the manual for container stuffing. Although it may take some time to develop because of the various kinds of goods*

we produce, we try to put cargoes as many as we could in a single container without any possible danger of destruction by wobbling. (Company G)"

Some procedures can include a Plan B or contingency plan to appropriately respond to the expected risk events. A pre-defined risk management plan reduces the shock from the initial impact of the risk and then prepares for the subsequent effects that a risk can cause.

"When disruptions disable the normal process (fire, disasters), Plan B which is pre-defined in the procedure is automatically implemented. If the disruption is too vast, the proposal to redesign logistics system is to be supplemented to the contingency plan. (Company D)"

"The guideline for plan B has also been developed well, and we can manage the possible risks as with executing risk simulations beforehand. (Company E)"

Lavastre *et al.* (2012) surveyed the effectiveness of 21 risk mitigating methods which included some items relating to strict procedure, such as introduction of strict and formal procedures that are consistently respected, activity planning using Advanced Planning System and establishment of emergency scenarios. The result showed that these measures were named 7^{th}, 8^{th} and 6^{th} in the ranking respectively, having the average of 4.82-4.89 out of 7. Nonetheless, SCRM studies appear not to place much emphasis on this practice. It may be partly because having a strict procedure is thought to limit the flexibility of a company's operations. However, the interviews demonstrated it is also important to reduce risks from variability in logistics operations by having strict procedures for the disciplined logistics process.

5.2.1.4. Purchasing insurance

Insurance is a way of transferring financial risk to an external company which pools similar risks. In lieu of paying a small premium, the financial loss can be covered by the insurance. Although this practice has a direct impact on financial loss, this can result in relieving other interconnected risk areas by easily resolving the financial issues between exporter and importer. International transport maintains exemptions and limitations of a transporter's liabilities while transporting customer's goods. When it comes to liner shipping, the fine print at the back of the bill of lading (B/L) comes into effect when there is a conflict between shippers and liner companies. Although new international conventions like the Hamburg Rule and the Rotterdam Rule are replacing the clauses in the B/L, the Hague-Visby Rule is still an overarching convention that regulates the liabilities of liner companies. According to the Hague-Visby Rule, liner companies shall not be responsible for the loss of or damage to the cargo arising from:

(1) Act, neglect, or default of the master, mariner, pilot, or the servants of the carrier in the navigation or in the management of the ship;

(2) Fire, unless caused by the actual fault or privity of the carrier;

(3) Perils, dangers and accidents of the sea or other navigable waters;

(4) Act of God;

(5) Act of war;

(6) Act of public enemies;

(7) Arrest or restraint of princes, rulers or people, or seizure under legal process;

(8) Quarantine restrictions;

(9) Act or omission of the shipper or owner of the goods, his agent or representative;

(10) Strikes or lockouts or stoppage or restraint of labour from whatever cause, whether partial or general;

(11) Riots and civil commotions;

(12) Saving or attempting to save life or property at sea;

(13) Wastage in bulk of weight or any other loss or damage arising from inherent defect, quality or vice of the goods;

(14) Insufficiency of packing;

(15) Insufficiency or inadequacy of marks;

(16) Latent defects not discoverable by due diligence; and

(17) Any other cause arising without the actual fault or privity of the carrier, or without the fault or neglect of the agents or servants of the carrier, but the burden of proof shall be on the

person claiming the benefit of this exception to show that neither the actual fault or privity of the carrier nor the fault or neglect of the agents or servants of the carrier contributed to the loss or damage.

Even though the liability of liner companies is not exempted from the aforementioned clauses, they can still limit their responsibility to 667 SDR (IMF Special Drawing Right; 1 SDR = about 0.9 Sterling Pound) per package or 2 SDR per kilogramme when the number of units and cargo weight are presented in the B/L. To this end, cargo insurance in international logistics has been well developed to reduce the impact of the risks. The coverage of insurance is defined by Institute Cargo Clause (ICC) A, B and C which can be selected by exporters or importers in consideration of the premium rate and the required coverages.

> *"At first, we ask our customers as to whether they had any kind of insurance, if they don't, we advise them to buy one. In most cases, customers don't have their insurance for their cargo because of the lack of understanding on the regulations about the liability limitation of carriers in relation to cargo transport. So, when we explain about the importance of it, most of customers purchase the cargo insurance. (Company B)"*

Some of the case companies even purchase excessive cover that can perfectly cancel the financial consequence of risks. This can maintain a stable logistics network because it never damages the business relationship with trading partners and logistics service providers that may be otherwise influenced by conflicts on the financial issues. Also, there is no damage to the corporate profit; therefore no disruptions to normal operations can be made.

> *"Throughout the procedure, we make sure that every cargo needs to have insurance on it. If we could expect any additional liability, additional insurance for this liability must be purchased, as well. (Company D)"*

> *"There are some cargoes that ordinary cargo insurance cannot cover its commodity price. In this case, we try to cover it 100% with an additional purchase of insurance. (Company C)"*

Risk insurance appears in the SCRM literature (Ritchie and Brindley 2007b), but not as often as other practices. This may be attributed to the differences between general SCM and international logistics operations. Specifically, the aim of international transport is more straightforward than SCM, thus it is easier to assess financial risks arising from the transport and to create insurances based on the assessment.

5.2.1.5. Other Practices

Although emphasised in the SCRM literature, some practices were not considered in the international logistics context by interviewees, which are buffering and vertical integration. This is partly because of the characteristics of international logistics where inventory is generally incurred as the form of in-transit inventory and where the buffer is regarded as additional costs. In addition, when prevalent outsourcing trends to avoid huge amount of investment into logistics assets is considered, vertical integration is not a feasible option in international logistics operations. However, since it can still be valid to supply chain management focusing on manufacturing, it is worth mentioning several practices that have not appeared in the interviews.

The first practice was **buffering**. As the most common way to deal with a range of supply chain risks, many SCRM studies considered the building of a buffer or holding reserves including excess inventory, capacity and funds (Zsidisin *et al.* 2000; Chopra and Sodhi 2004; Spekman and Davis 2004; Tang 2006) in order to absorb the shock from disruptions. Firms are inclined to construct barriers against risk exposure using various buffers because limited resources and the inability to assess and mitigate possible risks deter them from implementing practices to actively reduce the likelihood and impact of risks (Zsidisin *et al.* 2000). "Buffer activities do not directly reduce the chance of desirable incidents with suppliers from occurring, but can buy time for the purchasing firm to come up with a solution to their incoming supply problem" (Zsidisin *et al.* 2000, p.196-197). In particular, these studies focused on the excess inventory which can prevent any disturbances to the production even when the material flows were disrupted by any causes (Ellegaard 2008). In this regard, a buffer was regarded as the primary way of risk management which many manufacturing firms are heavily reliant upon (Blackhurst *et al.* 2011). Bode *et al.* (2011) also emphasised that buffering is one of the best responses to reduce information processing needs which are external to the exchange relationships but internal to the organisation. However, buffering practice is often criticised as a traditional approach that must be replaced by other strategic risk management, mainly because extra costs incurred by this practice limit the efficiency and performance of a firm (Zsidisin *et al.* 2000; Giunipero and Eltantawy 2004). In other words, holding reserves is effective in preparing delays of delivery by suppliers whereas undisciplined accumulation of reserves undermine the corporate profit by driving the cost up (Chopra and Sodhi 2004).

The second practice was **vertical integration**. Vertical integration is a powerful tool to reduce risks stemming from supply chain partners by making once-outsourced functions under the control of the focal company by ownership. It can be both supply and demand side risk management because it may take the feature of forward and backward integration (Manuj and Mentzer 2008b). The flow of information is improved because vertical integration reduces the numbers of nodes in the supply chain. It also enables the focal firm to expand its power and manage uncertainty (Giunipero and Eltantawy 2004) by controlling processes, systems, methods and decisions (Manuj and Mentzer 2008b). When a serious uncertainty lies in the outsourced functions, this practice is an excellent measure to control the uncertainty. As a consequence of increased size and influences, vertical integration plays a role to push suppliers to provide better service with lower costs (Giunipero and Eltantawy 2004). Vertical integration, however, can be a financial burden to the company because it converts variable costs into fixed costs (Manuj and Mentzer 2008b). It is also against the current trend of disintegration to augment the flexibility of a supply chain in reacting to environmental changes (Manuj and Mentzer 2008b).

Jüttner *et al.* (2003) distinguished flexibility from control by stating that control attempts to increase the predictability of contingencies whereas flexibility augments responsiveness, raising examples like postponement, multiple sourcing and local sourcing. They exemplified vertical integration, stockpiling and buffer inventory, maintaining excess capacity and imposing contractual obligations to suppliers as control strategies which treat uncertainties by seeking control of various risk sources. Although control strategies were found to be the most prevalent strategies in their empirical research, the interviews in this research revealed that flexibility is more emphasised than control in international logistics operations unless the control is related to external entities (Type 3 strategy).

5.2.2. Type 2: Leveraging Logistics Information

The second SCRM strategy focuses rather on the capability to process the information needed, and therefore respond adequately to risk events. Interviewees identified that the primary corporate strategy to enhance information processing capability is leveraging logistics information which encompasses collection, management and usage of the information. They indicated that the ability to respond to risk events and redesign the network promptly must be built upon accurate and real-time information available to all staff. In particular, they cautioned against information distortion by entities involved in the long international logistics network as well as delayed decision-making due to insufficient and imminent information. Therefore, leading companies in international logistics operations have heavily invested in an integrated logistics information system that can incorporate end-to-end logistics information from supply chain partners and even customers.

This strategy is closely associated with the concept of visibility enhancement which many studies have advocated (Sheffi 2001; Childerhouse and Towill 2004; Sodhi and Lee 2007; Blackhurst *et al.* 2011; Kam *et al.* 2011; Tang and Musa 2011). The primary benefit from increased visibility is that it can show where the risk is present and how disruptions reproduce through the logistics networks. Visibility was emphasised by researchers because increased visibility of demand information can minimise the bullwhip effect from information distortion across supply chain members (Chopra and Sodhi 2004). Increased visibility makes it possible to monitor the supply chains in real-time and to make a timely decision on the mitigation in both predictive and reactive manners (Blackhurst *et al.* 2011). The degree of transparency and the degree of obscurity are two generic determinants that affect the perception of vulnerability in supply chains (Svensson 2004). If the accuracy of information is diffused across the supply chain, the degree of transparency will also be increased. To this end, practitioners consider visibility or network transparency as the way to overcome the increasing complexity and dynamics in contemporary supply networks, which is supported by the 43.8% of survey respondents who often or always undertake activities to improve supply chain visibility (Jüttner 2006).

Visibility is also linked with the knowledge on how the logistics network is designed, how the network will react to disruptions and how to effectively utilise the resources located through the logistics networks (Blackhurst *et al.* 2011). Firms may regularly monitor their supply chain nodes in real-time so that they can discover disruptions and give warning signs prior to the occurrence of disruptions, which eventually results in the implementation of responses to avoid the disruptions (Blackhurst *et al.* 2011).

To sum up, Caridi *et al.* (2014, p.2) highlighted several dimensions of visibility which had been speculated by other researchers:

(1) Visibility means that important information is readily available to those who need it, inside and outside the organisation, for monitoring, controlling and changing supply chain strategy and operations, from service acquisitions to delivery. (Schoenthaler 2003)

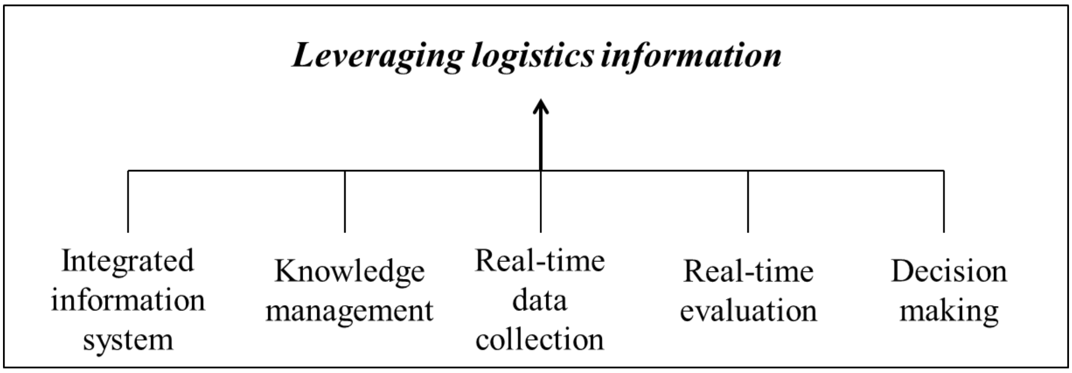
(2) Visibility is the extent to which actors within a supply chain have access to or share information which they consider as key or useful to their operations and which they consider will be of mutual benefit. (Barratt and Oke 2007)

(3) Visibility is the ability to be alerted to exceptions in supply chain execution, and to enable action based on this information. (McCrea 2005)

(4) Visibility is capturing and analysing supply chain data that informs decision-making, mitigates risk and improves processes. (Tohamy 2003)

Although visibility enhancement was the strategic direction that interviewed companies unanimously pursued, the methods to achieve and utilise visibility in consideration of risk management differed across companies. In essence, visibility is one tool or capability for risk management: rather, how to leverage logistics information obtained from visibility appeared to be vital in order to manage international logistics risks. To this end, companies have diverse ways to enhance their capability to leverage logistics information for risk management. Some of them rely heavily on cutting-edge integrated information system making huge investment, whereas others foster capability by accelerating the speed of information dissemination or thoroughly analysing handy information. It is revealed that how to use the information is as important as how to collect and integrate the information. Type 2 strategy, therefore, goes beyond the pursuit of visibility to leveraging the full potential of logistics information by implementing practices shown in Figure 5-6.

Figure 5-6: Type 2 strategy and its practices



(Source: Author)

5.2.2.1. Integrated information system

An integrated information system is referred to as the platform that is able to fulfil logistics visibility. The visibility of shipment data enables manufacturers to avoid the shut-down of factories due to part shortages as well as retailers to avoid loss of sales due to unavailable items (Sheffi 2001). The improvement in information and communication technology enhances a firm's visibility in association with inventory and product flows (Kam *et al.* 2011).

Interviewed companies agreed that a platform to collect, store and share logistics information is a pre-requisite to fully leverage the information. Equipping an integrated information system, therefore, emerged as the most prioritised practice. Often, it was considered as what can augment their logistics quality.

> *"In logistics operations, information and visibility is fundamental. We have developed an integrated intelligence system since 2000 to connect the information from the market demand through logistics flows to suppliers. Due to this development, production management of the factories and demand management of marketing branches could be harmonised. Also, the system has*

done a great job in overcoming the inefficiency of logistics in connecting production and demand. (Company C)"

"To transfer our business from 3PL to 4PL, we invested a lot in the ICT. As a result, we have our own integrated logistics system which can be shown through a single window. Also, it cannot only indicate the basic information like ETA but also provide an exact location and amount of a certain cargo. If any problem occurs at the logistics management, we have the capability of detecting and dealing with it ASAP with the system. (Company B)"

Although most case companies agreed to the necessity of an integrated information system, the level of adopting the system varied across case companies. The main obstacle is the 'opportunity cost of the investment' into the system (Blackhurst *et al.* 2008). In particular, small companies found it difficult to consider the integrated system because of the amount of finance investment in relation to their revenue. Even to a large company, the investment decision was not an easy task.

"Although we have a system called 'integrated information system,' the system support is poor. Even, we use the SAP system for basic uses only; it seems that the reason why we are doing this is about 'the opportunity cost of investment'. As logistics information is not integrated into the SAP system, it depends on our own developed system, using the information from 3PL providers. Yet, this information needs to be integrated by managers, thus it's impossible to be presented through a single window like dashboard. (Company E)"

"We use ERP for materials management and movement, but we don't have any logistics system. It's because, basically, if we would like to integrate logistics information, we need to hire more and invest more. As most of our international logistics are outsourced to a freight forwarder, we use the information which is available at the freight forwarder's website. (Company F)"

"For a small company like us, developing a system related to international logistics is almost impossible. Instead, by using the container number provided by

our freight forwarding company, we can easily track our cargo via the shipping company's website. (Company G)"

5.2.2.2. Knowledge management

The knowledge created by logistics information can be diffused within the organisation by enhancing capability that human capital resources can bring about. According to the empirical study by Blackhurst *et al.* (2011), firms acknowledged that adequate education and training within a supply chain as well as post-disruption analysis can play an important role in increasing resilience. As educated employees are key in risk management, employees are required to understand all aspects of the supply chain and to equip themselves with the necessary skills to make a timely and appropriate risk management decision. The effect of this education and training can be maximised with the dissemination of past experiences. A part of the past experiences will include the successful handling of disruptions which comes with post-disruption analysis as to how and why the handlings were successful. Lessons drawn from the sub-optimal responses to disruptions can also constitute the past experiences which are worth being disseminated through the supply chain.

Knowledge management is the capacity to learn from past disruptions (Scholten *et al.* 2014), thereby being regarded as an important property of resilience (Ponomarov and Holcomb 2009). Indeed, knowledge and understanding of supply chain structures and risk propensities has been empathised by a number of researchers as a key risk management factor (Giunipero and Eltantawy 2004; Faisal *et al.* 2007; Ritchie and Brindley 2007b; Ellegaard 2008; Zsidisin and Wagner 2010; Blackhurst *et al.* 2011; Christopher *et al.* 2011; Jüttner and Maklan 2011; Pettit *et al.* 2011; Scholten *et al.* 2014). Although the way of managing knowledge can vary across companies and the effectiveness of method may also differ, case study companies unanimously voiced that management of disruption-related knowledge is an undisputed activity to mitigate future risks. Most companies prefer a regular meeting to share and report irregular cases so that all the staff in the department can aware the risks.

"On every Friday at five in the afternoon, we have a weekly meeting to share irregular cases during the week. Basically, it's to share everyone's idea and to

> *find solutions. The reason why we are doing this is to react ASAP when a similar problem occurs. (Company B)"*

> *"For the major risk issues, we have a weekly discussion. With cooperating with the operation team and the supporting team, we deduct points of improvement and solutions for the issues. (Company C)"*

> *"We have a presentation of risk events at the monthly staff meeting. As our company has a culture of transparent operations, we share most causes of danger that we have experienced. If it is a big issue, however, we bring it to an enterprise-wide meeting. (Company E)"*

In a similar vein, any attempts to manage risks are also evaluated by feedback to find out best practices. It is usual that knowledge management results in the diffusion of the practices to all the departments in the organisation.

> *"When a risk management initiative is implemented, the improvement has to be reviewed with feedback, which is eventually reviewed by the top management. In this process, the best practices are shared by all branches over the world being reflected into the existing manuals or being disseminated as critical operations information. (Company C)"*

> *"We do some research on risk case studies and prevention measures in our internal knowledge portal. Issues related to logistics or customers are reported as a form of 'Correct Action Reports', which is made to be shared enterprise-wide. (Company F)"*

The media of knowledge diffusion were also varied, including but not limited to the bulletins and notices, manuals, corporate portal and letters. One minor issue in this process was that some critical knowledge is blocked to staff at the lower hierarchy in the organisation due to the confidentiality category. In particular, even if the knowledge is accumulated in the corporate system, it is not very certain that managers read and understand the knowledge to apply it in practice. To this end, knowledge management should accompany some measures to ensure that all staff take part in the progress through knowledge management.

> *"The case sharing system for risk knowledge can be accessed subject to the level of hierarchy in the organisation. However, if it is critical for the entire organisation, mailing and training are followed so that every staff can read and understand. (Company D)"*

> *"When the loss of an irregular case gets higher than 1,000 US dollars, we register the case to our logistics system and report it to the head office. The head office conducts a case study of the problem, and then they register the result back to the system to share the case with branches all over the world. (Company B)"*

5.2.2.3. Real-time Data Collection

Collection of real-time data is the key element of logistics information processing. Logistics data can include but is not limited to the location of goods, inventory level, estimated time of arrival, causes of disruptions and so forth. Traditionally, international logistics was far from real-time data. The estimated time of departure and arrival was in days rather than in hours, and the location of the cargo during transit was totally unknown. Now the paradigm has shifted because liner companies frequently update the exact location of their vessels and shipper companies also pursue real-time updates of their material flows.

The primary data collection methods have evolved from manual tallying through barcodes to QR codes. At present, the application of RFID and GPS to international logistics is also imminent. The interviewees also emphasised the adoption of cutting-edge technologies to enhance the quality of their logistics information by collecting the most up-to-date information.

> *"For the timely collection of logistics information, we use QR codes. We are able to get precise information with just scanning QR codes at each logistics stage. (Company B)."*

> *"At present, we are using QR codes to collect information; but we are going to use RFID to do the same task. (Company C)"*

According to the recent survey by EFT (2014), the biggest challenge in the contemporary supply chain appeared to be timeliness of information. In particular, the majority of the respondents mentioned GPS, Barcodes and RFID when they were asked as to what type of technology is already used or planned to increase real time information. Most of them agreed that the real time visibility technology is required in order (1) to improve customer service with better information, (2) to improve speed, delivery, timeframes through data analytics collected, (3) to provide customers with more frequent updates on shipment pick-up and delivery, (4) to strengthen competitive differentiation through new service capabilities and (5) to ensure product integrity or quality of cargo in-transit (ETF 2014, p. 8).

5.2.2.4. Real-time evaluation & Decision making

The reason why a firm strives to collect real-time data and process them through an integrated system and knowledge management will be to enhance the corporate capability for accurate risk evaluation and appropriate decision making.

> *"As far as I know, logistics information and knowledge is everywhere. All we need is the capability to combine the information and make the right decision to tackle the risks at the early stage. Some staff have this capability from their experience, and others from gathering as much relevant information as possible by contacting various sources. Without this capability, they can't do anything through being scared by the possible disastrous result that their actions can bring about. (Company H)"*

Although this capability often comes from accumulated knowledge and experience in handling various risks, firms can also foster this capability by training.

> *"The information like, part of the solved case, the best practice learnt from certain factory's idea and method, how to do benchmarking, all these kinds are also shared. In case we need to secure employee's flexibility in controlling logistics risks, the company offers some training as well. (Company E)"*

5.2.3. Type 3: Leveraging Outsourcing Contracts

Logistics outsourcing is inevitable in international logistics operations. In particular, for some critical functions in international logistics, such as sea transport and terminal handling, there is no other option but to be outsourced to professional companies. Moreover, since firms have been shifting strategies from vertical integration of activities to focusing on core competencies, outsourcing of other logistics functions has also become a trend (Zsidisin *et al.* 2000). Outsourcing is a common practice to reduce cost, but losses could outweigh the expected benefits when it fails to effectively manage outsourcing risks (Kam *et al.* 2011) stemming from loss of control and relationship issues (Zsidisin *et al.* 2000). Therefore, Smeltzer and Siferd (1998) insisted that proactive supply management is risk management.

As Kam *et al.* (2011) argued, outsourcing risk management is regarded as the measure to minimise outsourcing failures rather than to achieve outsourcing success. Even one interviewee described their logistics outsourcing as:

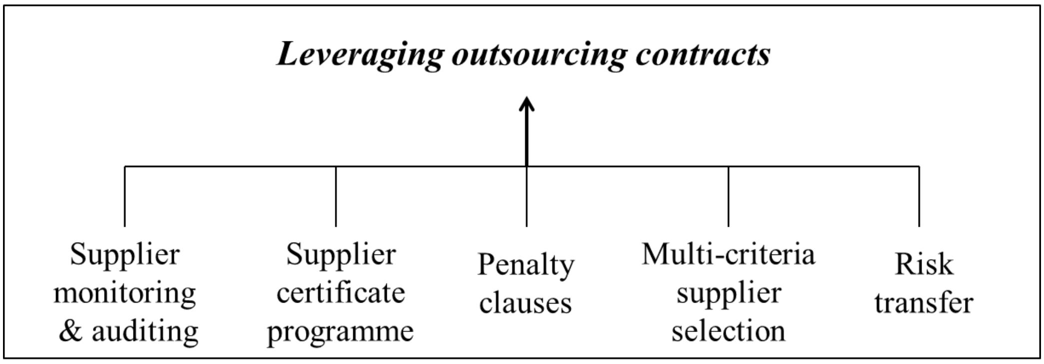
> *"Yes, our customers have mark sheets to evaluate our performance in logistics operations. But the thing is the maximum score of the mark sheet is 0 while the minimum is -100. When we are very successful in doing the logistics operations, we can get zero mark because it is what we are supposed to do. If the operations face some irregular disruptions, our mark is falling to somewhere between 0 and -100. So, we apply the same criteria to our logistics service providers. In this case, outsourcing risk management is a necessity not to get the negative mark in our performance. (Company H)"*

Boundary spanning efforts to influence the suppliers, thus, is critical to mitigate the risks (Ellegaard 2008). Ellegaard (2008) suggested that suppliers' behaviours will be influenced by such practices as supplier certification, quality management programmes, target costing, supplier development, penalty clauses and performance guarantees (Mitchell 1995; Smeltzer and Sifert 1998; Svensson 2000; Zsidisin and Ellram 2003; Spekman and Davis 2004). In a similar vein to the literature, interviewees agreed that the outsourcing of logistics functions should not create variability from their logistics standard, thereby requiring measures to influence their suppliers. The 'suppliers' in this context encompass both product suppliers and logistics service providers which are in charge of a portion of logistics functions for the focal firm's sake. They thought that outsourcing contracts, whether they are explicit or implicit, is the art of regulating suppliers to constantly meet the logistics requirements.

> *"We have a number of strict manuals for hiring logistics service providers. They include 'to-dos' and 'not-to-dos' when selecting a provider. Also, they pre-defined the contract clauses that must be incorporated: if the clauses are not accepted, we cannot proceed with the outsourcing. Sometimes, I personally feel that this manual is too harsh to pursue the best business opportunities due to its strictness. But I believe that it is one of the best ways to eliminate any possible outsourcing risks from the beginning. (Company D)"*

Agency theory, which concerns the problems arising when a party delegates work to another party (Zsidisin and Ellram 2003), considers that risk management can be achieved by both outcome- and behaviour-based contracts (Eisenhardt 1989; Choi and Liker 1995; Lassar and Kerr 1996). Whereas outcome-based management emphasises the results regardless of how they are achieved, behaviour-based management focuses on processes which intervene the tasks and activities operated by the agencies (Zsidisin and Ellram 2003). The risk management with leveraging outsourcing contracts possess these two ways of management. The case companies suggested that monitoring and auditing, certification programme, penalty, multi-criteria supplier selection and risk transfer can achieve outcome-based and behaviour-based risk management.

Figure 5-7: Type 3 strategy and its practices



(Source: Author)

5.2.3.1. Monitoring and auditing

Firms monitor and audit individual nodes within their supply chains to anticipate the most susceptible node to risks and to enable them to employ appropriate measures to avoid disruptions together with their partners (Blackhurst *et al.* 2011). In addition, the constant supplier monitoring generates the knowledge of external risks that are often hidden due to the deficiency of control (Zsidisin and Wagner 2010). The successful supplier monitoring and auditing ensures the control of supplier's variation in performance outcomes and risky behaviours, thereby achieving risk management objectives (Prater 2005; Khan and Burnes 2007; Ellegaard 2008; Wagner and Bode 2008; Kam *et al.* 2011). The case study companies agreed the necessity of this practice.

> *"Usually, we recognise the problem just before it happens or after it happens. If the logistics management or the monitoring were well functioned, there are many cases that wouldn't be led to the risks or problems. So, logistics managers should play a leading role in creating logistics contracts to avoid problematic causes in advance, which include continuous monitoring. (Company E)"*

> *"If we just stay in the office, it's difficult to know how the supplier manages the logistics. By unexpectedly visiting trucking companies which we use or by working together in the same office with partners located abroad for several weeks, we can do auditing the logistics operations of suppliers. Making a*

> *decision about supplier only with the outcomes is like holding a timed bomb. Giving them a signal of continuous monitoring makes them to do fewer mistakes even in minor logistics operations. (Company H)"*

5.2.3.2. Supplier certification

Supplier certification can be used to allocate specific tasks to the most appropriate supplier (Kam *et al.* 2011), thereby reducing risks from the incompetency of suppliers. The likelihood of detrimental events can be reduced by supplier certification and quality management programme (Zsidisin *et al.* 2000) because it motivates suppliers to comply with the quality requirement. As the certificate does not last forever, it also makes suppliers try their utmost during the contract period to minimise disruptions for future business (Zsidisin and Ellram 2003; Khan and Burnes 2007; Zsidisin and Wagner 2010; Tang and Musa 2011). The certification programme can be either explicit or implicit. In any case, qualified suppliers can be favoured over unqualified ones when participating in bidding for outsourcing contracts.

> *"Only registered companies can participate in the bidding process for outsourcing. For new comers, they are able to register after the support team assess multi-dimensions of their quality. (Company D)"*

> *"Although it's not explicit, yet we have it. In other words, for some verified suppliers we give them a status, which is like a certificate, and we deal only with them. For other companies, we don't offer them any particular business opportunities, but we maintain casual relationships just in case. (Company H)"*

> *"In bidding process, we send the invitation only to the companies we have verified. It's not like giving them a special certificate, yet it has a same effect as if we are using a certificate programme. (Company C)"*

5.2.3.3. Penalty clauses

A penalty clause in outsourcing contracts is a powerful tool to force suppliers to abide by the performance level set in the contracts. For instance, an apparel company studied by Kam *et al.*

(2011) mandated their suppliers (1) to transport all products by air in case of production delay, (2) to provide payment discount in case of late delivery and quality failure and (3) to compensate all the losses from late delivery and/or poor quality. Although penalty clauses are often discussed in the literature with rewards or incentives (Sodhi and Lee 2007; Ellegaard 2008; Lavastre *et al.* 2012), stand-alone penalty clauses are prevalent in practice unless there is a collaborative partnership with the supplier. The interviews also revealed that case firms only use penalty clauses without considering any incentives, and some of them have executed the penalty clauses before. Nevertheless, they thought that it was effective to reduce risks arising from suppliers.

> *"We include the agreements about quality and delivery in our contract. If the service level is out of these agreements, we are able to claim officially. In this way, the financial loss from cargo damage, for example, have been easily reimbursed without much conflict (Company E)"*

> *"Although it is not comprehensive, we have penalty clauses in selected irregular cases. For example, we have a strict rule which indicates that, for, suppliers need to compensate in case of cargo loss or delay caused by the gross negligence of suppliers. (Company B)"*

5.2.3.4. Multi-criteria supplier selection

Dependable, responsive and problem-solving suppliers are valued in the supply chain, which is why companies develop multi-criteria to carefully select their suppliers (Ellegaard 2008). Poor judgement in supplier selection can lead a firm to have great responsibility for the delay and missed shipment that its supplier can generate (Smeltzer and Siferd 1998). Selecting firms with a robust logistics process can reduce the overall risks, which is why firms dedicate more time and effort to the supplier selection process (Zsidisin and Wagner 2010). It is critical in selecting service providers to adopt multiple criteria, such as logistics criterion, technology criterion, business criterion and relationship criterion (Kam *et al.* 2011), in order to minimise the risks from outsourcing and ensure the consistent level of logistics operations. In the interviews, it was found that every case company had their own criteria to select suppliers. For instance, Company A used criteria of revenue, reputation and business experience, while Company D used strategic strengths, financial status and experience as the supplier selection criteria. They tended to consider various qualities of suppliers as to whether they can achieve the performance level without making serious risks.

> *"Quality, cost, reliability are three important criteria for us. No matter how cheap their services are, unless they can meet up with our demand for quality, then they are not appropriate. Reliability has a great effect on the next contract. We have four standards for reliability, which are (1) whether they can support our logistics operations based on our demand, (2) whether this company can create less irregular cases, (3) whether they can maintain a consistent level of performance and (4) whether their customer service is satisfactory. (Company E)"*

> *"In supplier selection, we set up the criteria with utilising our prior experience in logistics disruptions. In other words, we don't use a shipping company that cancelled or did some trans-shipment too often. Moreover, we use a logistics company which is experienced in logistics operations in our trading countries or has a branch in the country because, unless otherwise, it can't deal with disruptions properly. The reason why we can't use the cheaper one is that, it is highly likely to give us huge burden of expense and responsibility. (Company F)"*

5.2.3.5. Risk transfer

When the growing trend of outsourcing is considered, adding specific contract clauses to share and transfer risks in can be employed as an alternative to controlling all the risks in the logistics operations (Manuj and Mentzer 2008b). Early supplier involvement (Zsidisin and Wagner 2010; Tang and Musa 2011) is another type of risk transfer because it makes suppliers be responsible for dealing with the initial risk impact. Transfer of risks is a coercive measure to transfer costs and responsibility to suppliers (Zsidisin *et al.* 2000; Khan and Burnes 2007; Ellegarrd 2008). Therefore, this practice largely depends on the power that a firm possesses within the supply chain.

> *"In fact, this method is impossible when the company is not large enough either in the size or power they have. We are in a position to receive the transferred risks from our customers, but to transfer risks to the LSPs we use. (Company B)"*

> *"Risk transfer, early supplier involvement and buffer transfer and reward/penalty practices are all implemented by car manufacturers against their suppliers. We don't have any option but to implement the same practices to lower-tier suppliers in order to meet the standard. (Company A)"*

Ritchie and Brindley (2007b) described the risk transfer situation as follows.

"*When dealing with a network of interrelationships within the typical supply chain, the risk is associated with the entire supply chain itself. Potentially, all members within a network will be exposed to the risks although the direct impact may be ameliorated or modified by the actions taken by others in the chain. Thus, from one perspective there is a benefit from all partners engaging in the risk management activities, although from another there may be a sense of encouraging others to undertake the costs of such risk management activities rather than your own organisation* (Ritchie and Brindley 2007, p. 310)."

The interviewees also agree that they tried to transfer risks to some degree to their suppliers. This was because they believe that suppliers know best about the risks and suppliers have to solve problems in their custody. Risk transfer may be included in the contract, but can be also implemented implicitly with the mutual agreements between the parties.

> *"Even though we didn't have a specific agreement, we have to tell our LSPs to handle the problems in the first place and to show our intention that we will really leave the issue to LSPs to carry it out. If we don't do so, those little details of logistics issues come to us, and if this keeps happening, we need to deal with all the problems that we actually don't know. (Company H)"*

> *"When we renew the contract with LSPs, we reflect the expenses which occurred with irregular issues throughout the last contract year. This policy automatically leads LSPs to do early involvement and take responsibility for disruptions.*

> *Although risk transfer wasn't on the contract, this policy affects as if it is a risk transfer clause. (Company C)"*

5.2.4. Type 4: Developing Logistics Collaboration

Whereas the Type 3 strategy can be applied to any kinds of inter-firm relationships, the Type 4 strategy specifies collaborative relationships among partners to enhance the information processing capability. Compared to unilateral control strategies, co-operation strategies pursue joint agreement and implementation to reduce uncertainty (Jüttner *et al*. 2003). It has been debated as to whether long-term relationships with a few key suppliers reduces or increases risks (Khan and Burnes 2007). Although the majority of studies argued that these relationships are effective in managing risks (Zsidisin 2003), some maintained that they increase over-dependence on one supplier, thereby enhancing risks (Smeltzer and Siferd 1998). Nonetheless, it is acknowledged that there has been a progression in risk management strategies from the individual responses within a firm to the more co-operative responses since 2000 (Kleindorfer and Saad 2005; Ritchie and Brindley 2007b). If a shared understanding of probable risk events among supply chain partners can enable firms to reduce or better prepare supply chain risks, collective risk responses to risks like information sharing, aligning incentives and risk sharing were recommended (Faisal *et al.* 2006).

The construction industry in the UK, for example, has maintained industry-wide and government supported initiatives for risk management since 1990s. The core of the recommended strategy is developing a long-term sustainable partnership based on high levels of mutual trust, which is supported by several approaches, such as agreement on mutual objectives, advanced commitment to processes and procedures as well as commitment to continuous improvement (Ritchie and Brindley 2007b). Likewise, relationship management, based on trust, loyalty, commitment and mutual fairness, is the prevalent strategy in international logistics. Even SMEs with a low frequency of interactions with SC partners exploited relationship management as the prioritised risk management initiative. Ellegaard (2008), however, specified the differences between relation maintenance and relationship development. While the latter incorporates high interaction frequencies and activity expansion, the former is described as less active and less boundary spanning. Logistics collaboration refers to the latter concept which entails a high degree of interdependence between partners, generate flexibility and responsibility from trust, commitment and risk sharing attitude (Faisal *et al.* 2006).

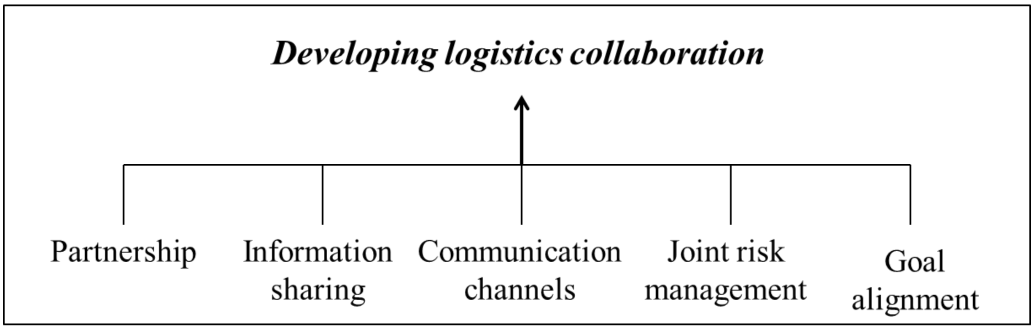
10 out of 11 interviewees in this research acknowledged that the single most important strategy in international logistics would be developing logistics collaboration because their logistics competencies heavily depend on the collaboration with their partners who perform logistics operations. They, in particular, paid attention to the limitation of a firm's capability in international logistics which can be overcome by closer relationships with partners. The investment in collaboration development was deemed to be particularly effective when the logistics operations were disrupted because a firm cannot singlehandedly manage the increasing needs for processing risk-related information.

> *"It's difficult for a single company to build a suitable international logistics system coping with the massive changes in the market. Especially, as the logistics are getting changed from the distribution-centred logistics to the customer-centred logistics, there are problems for a company to embrace all the information in various kinds of forms and channels. So we have emphasised the importance of collaboration for the last decade to exchange the consistence information from suppliers to the market through collaborative planning, replenishment forecasting, goal alignment and joint planning. As for information flows, we have secured the communication channels through EDI, web-based system and regular meetings, thus exchange information very closely and frequently with partners. In particular, we share the areas of potential risks as well as developing solutions with our partner companies. (Company C)"*

> *"Partners are located closest to the information relating to risks. 'How to draw the information' is the matter of relationships. If the partnership is well founded, we could have the accurate or sometimes even 'classified' information. And 'how to use the information' is the matter of our capability. Often, we need to ask for help from the partner since our capability is not sufficient to handle the information. When this happens, it goes way back to the relationship issue.*

Whether they do our work as if it is theirs, is the important point to estimate our partnership. (Company H)"

Figure 5-8: Type 4 strategy and its practices



(Source: Author)

Given the definition of supply chain collaboration, logistics collaboration can be delineated by several sub-components. According to Cao *et al.* (2010), supply chain collaboration comprises of (1) information sharing, (2) goal congruence, (3) decision synchronisation, (4) incentive alignment, (5) resource sharing, (6) collaborative communication and (7) joint knowledge creation. Similarly, Nyaga *et al.* (2010) insisted that the representative collaborative activities are information sharing, joint relationship effort and dedicated investment. Ramanathan and Gunasekaran (2014) focused more on the process in supply chain collaboration, thus argued that collaborative planning, collaborative execution and collaborative decision-making are the elements of successful collaboration. This study combines the findings from previous studies and case study interviews, and then suggests that the development of logistics collaboration depends on partnership, information sharing, communication channels, joint risk management and goal alignment.

5.2.4.1. Partnership

It is vital to maintain closer relationships with key suppliers which can provide solutions to various risk events and enhance the competencies of the focal company by playing a role as an extension of the firm's operations (Giunipero and Eltantawy 2004). Building a long-term and exclusive relationship based on trust is the way to retain advantages from outsourcing (Kam *et al.* 2011). As relationships with supply chain partners are the biggest concern for some firms, they develop high levels of trust with key suppliers or try to understand the capacity restriction of suppliers in order to consider alternative suppliers (Blackhurst *et al.* 2011). However, managing an exclusive relationship and maintaining both formal and informal relationships are considered to be critical elements of a partnership (Sabherwal 1999; Kern and Willcocks 2001; Ross and Westerman 2004). An exclusive and long-term partnership has been discussed as one of the most effective risk management measures for the supply chain (Zsidisin *et al.* 2000; Childerhouse and Towill 2004; Khan and Burnes 2007; Ritchie and Brindley 2007b; Lavastre *et al.* 2012). Specifically, the partnership can remove uncertainties from opportunistic behaviours and can foster long-term risk management plans.

> *"Honestly, as a logistics intermediary, it is far better for us to be approved as a sole partner of customers. If they do, we can upgrade our quality of logistics service as well as price competitive, and these efforts eventually leads to customers' competitiveness in logistics. Not to mention, in controlling the risk, it is undeniable to take more care about the cargoes of companies that we are in partnership with. (Company H)"*

> *"As the experience in handling our cargo is undeniably an important issue, changing partner is a risk to us. Therefore we need to have a long-term partnership with logistics companies (Company F)"*

5.2.4.2. Information sharing

Information sharing is a crucial element for integrating supply chain entities from end to end (Zhenxin *et al.* 2001) and a pre-requisite of effective communication and coordination (Lee and Whang 2000) which is essential to organisational success (Hahn *et al.* 2000). Information sharing means "the extent to which a firm shares a variety of relevant, accurate, complete and confidential ideas, plans and procedures with its partners in a timely manner (Cao *et al.* 2010, p. 6618). Prater (2005) identified that information sharing is a direct response to amplification effects from information distortion like the bullwhip effect, propositioning the links between inventory, information sharing and system performance. Therefore, information sharing was labelled as the core of the supply chain collaboration (Lee and Whang 2001; Min *et al.* 2005; Chopra and Meindl 2007).

> *"Sharing information with partners is an important element to maintain partnerships. We even share 'classified' information related to the innovation plan or risk with our partners. When it comes to information sharing, we must have a firm agreement about confidentiality. I think that the trust arising from these confidential issues strengthens the relationships. (Company E)"*

> *"When the cargo is shipped away, there is no available way for us to control it. By saying that, we can easily find the reason why we need to maintain a good relationship with partners who control the movement of the cargo in lieu of us. When the problem occurs to our cargo, the more we hear from them, the more we are capable of. If it's possible, then it would be most desirable to deal with the risk together. (Company H)"*

5.2.4.3. Communication channels

Having predefined communication protocols and channels in case of disruptions enables firms to quickly and effectively distribute the necessary information without confusion and to prevent any delays in deploying mitigation tactics (Blackhurst *et al.* 2011). The collaborative communications have features like higher frequency, bi-directional flows, formal and informal modes and enhanced indirect influences (Mohr and Nevin 1990; Goffin *et al.* 2006; Cao *et al.* 2010).

> *"In the past, we used information sharing system just to control the quality of product. At present it is the system which contains almost every bit of SCM and it determines the procurement situation in real-time. Also, this plays a role as a formal communication channels with partners. Our customer company can access our system directly to get what they need, as well as we are now able to reduce the stock by getting information from them. (Company A)"*

> *"We frequently share with our logistics partners the information as to when cargoes will be shipped, where they are, how much time will be spent, how much spaces and containers we need. As our IT platform has yet to be interfaced with our partners' platforms, we primarily use email for important issues and use phone calls for urgent issues as the communication channels. Our partners exactly know which staffs in our company should be contracted in case of disruptions. (Company F)"*

5.2.4.4. Joint risk management

Joint efforts of supply chain partners dramatically reduce risks in the processes (Giunipero and Eltantawy 2004). They can be joint contingency planning (Mason-Jones and Towill 1998; Ritchie and Brindley 2007b), joint visibility enhancement (Mason-Jones and Towill 1998; Giunipero and Eltantawy 2004) and even joint learning and training (Ritchie and Brindley 2007b; Ellegaard 2008; Kam *et al.* 2011). Joint risk management leads to orchestrated decisions on logistics planning and operations (Cao *et al.* 2010), thereby diminishing chaos after disruptions. Moreover, partners in collaboration can create knowledge by knowledge exploration and knowledge exploitation (Cao *et al.* 2010). This knowledge creation process does not only ensure sustained competitive advantages (Harland *et al.* 2004), but also generates creative risk management measures that a single firm cannot expect. Case study companies emphasised the role of liaison teams to achieve joint risk management because they take the responsibility for planning and operations with the partners. Once the liaison team is set up, it can actively engage in joint risk management. In this case, appropriate authority for decision making should be given to the team.

> *"As the key account team deals with logistics planning or undertaking of partner companies, the role of this team is very important. We keep upgrading our consistency of logistics management by assigning this team as a communication channel, thereby engendering joint risk management (Company D)"*

> *"Our company's business model has signified which team should cooperate with the external logistics companies and also has designed the process that a joint*

> *planning should follow to control the risk. In the joint management process, our partners and we make plans and generate solutions together with using several business tools, such as simulation. (Company E)"*

5.2.4.5. Goal alignment

Goal alignment is delineated as the situation where a firm can achieve its internal objective by accomplishing the goals of its logistics networks because those two objectives are well aligned. To this end, mutual understanding about expectations (Goffin *et al.* 2006), strategic direction and visions (Lambert *et al.* 1999) of partners should proceed to goal alignment. The understanding of these elements is critical to risk management because they can lead to changes in the current business model, which may, in turn, generate unexpected vulnerability and uncertainties. Goal alignment, therefore, happens when partnerships are being built or a new business is on the verge of trading.

> *"In the past it was just an ordinary business relationship, yet 2-3 years ago, when our customer got interested in SCM, they invited their suppliers, including us, quarterly to hold seminars. In the seminar we could listen about the global supply chain of our customer and how each supplier could contribute to it. Of course, we have some discussions about the difficulties and uncertainties that may occur during the management or to make a future plan for supporting the customer. (Company A)"*

> *"Recently we gave our classified information about our new business to one of our partner logistics companies, even before we launched it. Now that the partner marvellously re-engineered their current logistics networks to accommodate the new business, both our partner and we can successfully run the business without any major disturbances (Company C)."*

5.3. Antecedents and Outcomes

Focusing on risk management strategies in the previous section, the antecedents and outcomes of such risk management strategies are of interest in this research. This section, thus, will discuss several organisational orientations as stimuli of risk management strategies, and the desired outcomes of risk management strategies will be dealt with later.

5.3.1. Organisational Orientations

As firms pursue stability in the internal and external operations, they have motives to implement some responses once disruptions occur. Bode *et al.* (2011) referred to this motive as 'stability motive' which can be interpreted as risk mitigating initiatives. They asserted that both external resources (i.e., control, power and vulnerability) and internal processes (i.e., information and smooth functioning) are the factors that bring about the stability motive. In addition, interpretative postures, such as inter-firm trust and prior experience of a firm are intertwined in deciding a specific kind of response. On the other hand, Manuj and Mentzer (2008b) suggested that there are three major factors that can affect the selection of a risk management strategy, which are temporal focus, supply chain flexibility and supply chain environment.

In their research to explore the antecedents of agility, Braunscheidel and Suresh (2009) empirically validated that organisational orientations positively influence organisational practices, such as internal integration, external integration and external flexibility, and eventually affect the level of a firm's supply chain agility. In a similar vein, this research builds a research model comprising of organisational orientation, risk management strategies and firm capability as demonstrated in Figure 3-10. This framework is also in line with the Context-Mechanism-Outcome logic, suggested by Pawson (2002).

Organisational orientation is the cultural aspect of a firm that is associated with an organisation's management system and practices that reinforce values and beliefs in the culture (Denison 1990). For instance regarding a firm's strategic orientations, entrepreneurial orientation explains entrepreneurial decision-making styles, methods and practices (Lumpkin and Dess 1996), thereby facilitating managerial processes and actions that affect the performance (Wiklund and Shepherd 2003). Firms with high entrepreneurial orientation tend to be proactive and innovative (Lumpkin and Dess 1996). They strive to support creative ideas apart from the established practices and to create sustainable advantages ahead of competitors by anticipating and acting on future needs. These firms are also referred to as active firms (Daft and Weick 1984) that pay close attention to the environment, act proactively and learn from their experiences. Another example of organisational orientations is market orientation. Market orientation encompasses customer orientation, competitor orientation and inter-functional coordination, all of which can generate corporate behaviours that are required for creating customer value (Narver and Slater 1990). Firms with market-driven culture gather and disseminate information about customers and competitors through sufficient understanding of them to create superior value and competitive advantage (Braunscheidel and Suresh 2009). The knowledge of the market enables firms to be responsive to the demands of the market place, thereby achieving better outcomes.

Building upon SCRM research and interviews with practitioners, this research posits three organisational orientations, namely disruption, customer and quality orientation, as antecedents of implementing risk management strategies in the international logistics contexts.

5.3.1.1. Disruption orientation

Disruption orientation is defined as “a firm’s general awareness and consciousness of, concerns about, seriousness toward and recognition of opportunity to learn from (supply chain) disruptions. (Bode *et al.* 2011, p. 837). It is regarded as the fundamental prerequisite to create a risk management culture which comprises of a conscious focus on managing risks and the establishment of business-wide risk awareness (Christopher *et al.* 2011). This culture, therefore, helps firms incorporate risk assessment into the decision making process (Christopher and Peck 2004). It is obvious that the way a firm deals with risks relies on the risk type and the level of preparedness of a firm.

According to Daft and Weick (1984), firms can be distinguished by 'active firms' and 'passive firms.' The active firms are attentive to the environment, behave proactively and, most importantly, try to learn from their experiences. At the opposite end, there are passive firms which do not just accept the environment as given whilst interpreting it within constraints but also are reluctant to search for information or to respond to environmental events (Bode *et al.* 2011). Disruption orientation is a typical corporate culture of active firms which leads firms to risk awareness and recognition. This is closely associated with the sensitivity to risk events. As the perceived risk is getting higher, firms become more risk-averse, which in turn stimulates those firms to become active in implementing risk management strategies.

Some of the case study firms emphasised the importance of experience in international logistics operations. The experience is built upon the resolution of a number of irregular cases and embedded on every decision making which may accompany various risks. To this end, Zsidisin *et al.* (2000, p. 196) argued that "purchasing organisations that have had a significant supply risk become a reality that would be more likely to have greater involvement in conducting risk assessments and contingency planning than firms that have not experienced such problems."

In their empirical study on the impact of supply chain disruption orientation on the responses to disruptions, Bode *et al.* (2011) showed that disruption orientation affects the strengths of two different risk mitigating responses. In pursuit of expanding the findings of Bode *et al.* (2011), the hypotheses of this research were generated to test the effects of logistics disruption orientation on the four logistics risk management strategies. Compared to Bode *et al.* (2011) who used buffering and bridging responses, this study excluded the buffering practice from the set of strategies and specified bridging responses into two distinctive inter-firm strategies. To this end, it will be interesting to see the roles of disruption orientation on risk management strategies in the international logistics contexts.

5.3.1.2. Customer orientation

One of the main objectives of supply chain management is customer value and customer satisfaction. To develop supply chain strategies, the members in the supply chain constantly need to focus on the end-customers and create value for the customers (Gaudenzi and

Borghesi 2006). Indeed, the driver of supply chain management for the past decades has been customers' demand for a variety of products with shorter lead time (Draaijer 1992). In this regard, a supply chain or a logistics network needs to foster customer orientation which makes it possible to sufficiently understand the buyers to continuously create superior value for them (Braunsheidel and Suresh 2009). The international logistics network is adjusted by customers' demands not just encompassing the routes and destinations, but also including an information system and the degree of collaboration.

When it comes to risk management, some case study companies specifically highlighted the customer orientation stemming from stakeholder pressure (Freeman 1984). The capability to manage stakeholder pressure is generally known to be the catalyst for the improvement in competitive posture (Rueda-Manzanares *et al.* 2008). This is also true of risk management because stakeholder pressure plays a role in the coercive initiatives to risk management strategies. For instance, Company A, had to develop an integrated information system due to the pressure from car manufacturers, and force lower-tier suppliers to have the same information sharing platforms. Company E, in a similar vein, incorporated socially-responsible sourcing and fair trades into supply chain risk management because of the global pressures from end-users and governments.

Other companies were concerned with the fluctuation of customer demand and the fast product life cycle, which was the reason for developing customer orientation. This tendency was found in the companies relating to the consumer electronics industry. Company C has therefore strived to understand the consumer market so that it can reduce inventories and obsolescence from manufacturing and logistics. Company B, whose main customer is an electronics company, shared the same purpose of risk management as Company C. Company H, on the other hand, built long-term and strong partnerships with partner freight forwarding companies to get to know the requirements of the remotely-located consignees. As for Company D, all the requirements from customers are written down as a contract, and the service level in the contract is liaised with their transport or warehouse companies to draw the outsourcing contracts.

5.3.1.3. Quality orientation

Brindley (2004) suggested that the primary motivations of firms' risk management are (1) global competition, (2) technological change and (3) the continuous search for competitive advantage. Particularly in order to achieve sustainable competitive advantages (Porter 1990), firms should have qualities, such as flexibility, innovation, speed, time and reliability (Corbett and van Wassenhove 1993; Miller and Roth 1994; Chen and Paulraj 2004), beyond low costs. Quality orientation is the corporate culture which places a firm’s competitive priorities in logistics qualities rather than in logistics costs, thereby minimising variability in performance and the occurrence of disruptions that can usually arise from low-cost logistics service.

In a study to compare outsourcing risk management of two apparel retailers, Kam *et al.* (2011) found out that the choice of risk mitigating approaches relies on the value that the retailer perceives to be most important. The case study specified two key value drivers, namely (1) product quality and (2) newness and variety, which led to emphasis on different approaches for risk management. Indeed, quality-related issues are critical in risk management, thus the emphasis on the quality is often considered as being a risk management enhancer. "Quality-related risks can cause significant detrimental effects on supply chain, with a cascading effect through the supply chain to final consumers. Each link within a supply chain is dependent on the other links to meet product or service requirements” (Giunipero and Eltantawy 2004, p. 704).

Jüttner *et al.* (2003) argued that risk management strategies must be investigated in relation to risk drivers, particularly based on supply chain trade-off decisions, such as (1) repeatability vs. unpredictability, (2) the lowest bidder vs. the known supplier, (3) centralisation vs. dispersion, (4) collaboration vs secrecy and (5) redundancy vs. efficiency (Sheffi 2001). Nevertheless, they argue that the foremost trade-off decision lies between managing risk and delivering value because they think that managing risks incurs extra costs which undermine the value in the supply chain represented by total costs. However, value is multi-dimensional and cannot be evaluated only by costs.

The interviews showed that risk management is deeply related to quality management to reach a certain level of logistics standard. If total costs are assumed, proactive quality management by using risk management initiatives must not be underestimated because it can eliminate any unnecessary costs occurring from risk consequences, such as obsolescence, claims and emergent delivery. In the discourses about intra-firm strategies, case study companies reiterated the importance of manuals to maintain or even improve the quality of their logistics operations. They also acknowledged that the majority of the quality can be fulfilled by external organisations, such as trading or logistics partners, thereby requiring inter-firm risk management strategies.

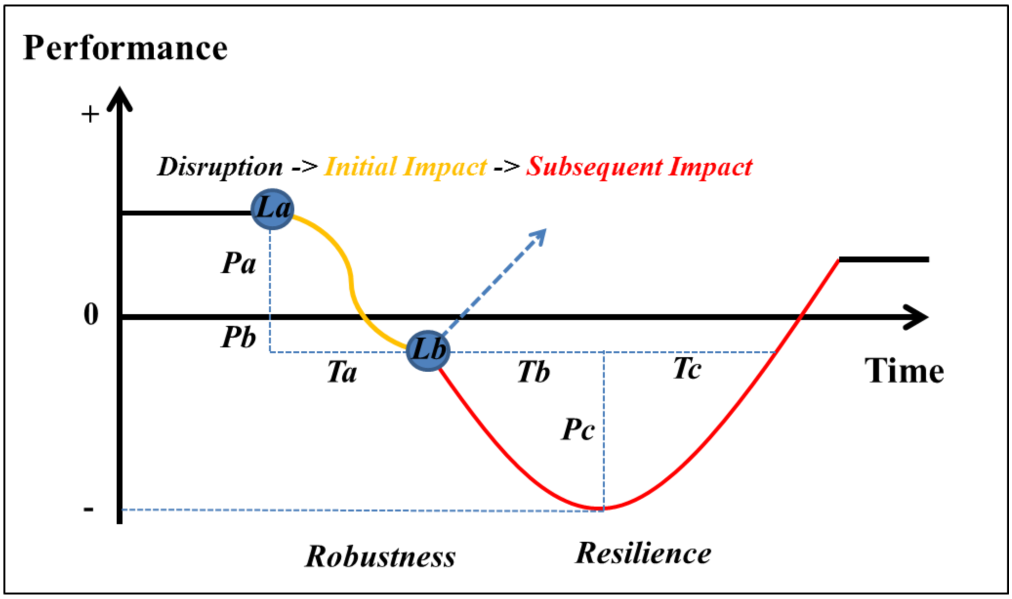
5.3.2. Risk management outcomes

The risk management capability achieved by effective supply chain strategies may reduce the systematic risks as well as the unsystematic risks because it does not just suppress the likelihood of risks occurring from risk sources, but also controls the speed and duration of risks after the occurrence irrespective of the sources of risks (Ritchie and Brindley 2007b). Barney (1991) insisted that a firm foster capabilities using the potential of resources, which in turn leads to sustained competitive advantage. Blackhurst *et al.* (2011) investigated the mechanisms that have an impact on a firm's resilience (capability) and suggested that there are several resilience enhancers comprising of (1) physical capital resources, (2) human capital resources and (3) organisational and inter-organisational capital resources.

In Chapter 2, a variety of risk management outcomes considered in SCRM research was explained. However, extant research paid special attention to capabilities, such as robustness and resilience because the ultimate goal of SCRM is to have robust and resilient supply chains (Colicchia and Strozzi 2012). These two concepts are often understood interchangeably: for instance, Tang (2006, p. 36) asserted that "having a robust supply chain strategy could make a firm become more resilient," which has a nuance that robustness is a sub-set of resilience. In these circumstances, Klibi *et al.* (2010) provided distinctions between these two capabilities. According to their definitions, robustness is the quality of a supply chain network to remain effective in all plausible futures, whereas resilience is the quality to provide the means to avoid disruptions as much as possible and to bounce back quickly when fit. However, since they added one more capability, responsiveness, to these two concepts, the distinction is still not clear-cut.

This thesis modifies the current views of robustness and resilience by adding international logistics contexts and robustness as a separate firm capability. Figure 5-9 illustrates the model of disruption stages adapted from Sheffi and Rice (2005). This model considers three elements of disruptions, namely likelihood (*La* and *Lb*), performance losses (*Pa*, *Pb* and *Pc*) and time (*Ta*, *Tb* and *Tc*). Although the majority of research agrees that risk consists of potential losses and likelihood of those losses, Manuj and Mentzer (2008b) argued from interviews with practitioners that there are more risk dimensions that are important in global supply chains, which are speed of events, speed of losses, the time for detection of the events and frequency. It should be highlighted that those dimensions are closely related to the time factor. The capability to deal with the time for a firm's sake is a key element of robustness and resilience.

Figure 5-9: A new model of disruption stages



(Source: Adapted from Sheffi and Rice 2005)

Robustness is, in essence, the capability to resist and sustain (Asbjørnslett 2008). The main quality of robustness is therefore "to withstand disruptions" (Tang 2006). To this end, robustness plays its role to determine the initial impact of risks. A robust logistics network can provide sustainable value creation in case of any future scenarios (Klibi *et al.* 2010). The logistics networks with excellent risk management can anticipate and prepare risk events, thus minimise or even avoid the occurrence of risks (*La*). In case of disruptions, they prepare slack resources (*Pa*) so that the performance level cannot be below the tolerance threshold. In manufacturing, these slack resources are called safety stocks or inventories, but in international logistics, they can be interpreted as flexibility with multiple solutions. As the real losses emanate from the performance level below the tolerance threshold, the main objective of robust logistics networks is, unless the disruption can be avoided, to minimise the real losses in performance (*Pb*). Time factor is also critical because robustness 'buys' sufficient time (*Ta*) for the networks to decide, prepare and implement countermeasures in order to prevent subsequent risk events and to bounce back to the normal performance level.

On the contrary, resilience is an adaptive capability to respond, recover and retain (Ponomarov and Holcomb 2009). One common element found in various definitions of resilience is its 'promptness' (Christopher and Peck 2004; Sheffi and Rice 2005; Klibi *et al.* 2010; Pettit *et al.* 2010). Resilience, in essence, originates from short response time (*Tb*) and short recovery time (*Tc*). For this purpose, the logistics network needs to adapt to the disruptive situations by quickly re-engineering logistics processes (Christopher and Peck 2004) promptly and adequately responding to the disruptions (Ponomarov and Holcomb 2009). The shorter this time becomes, the less impact a logistics network experiences. Thus, resilience also aims to minimise the negative impacts from disruptive events (*Pc*). Due to its reactive nature to mitigate unexpected risk events, resilience mainly plays a great role in the subsequent risk impact. However, a network with high responsiveness is able to implement appropriate countermeasures even in the initial impact phase, eliminating the likelihood of subsequent risk impact (*Lb*). As a consequent, resilient logistics networks can survive and even reach more desirable conditions (Sheffi and Rice 2005; Zsidisin *et al.* 2005).

To summarise, robust and resilient logistics network will significantly reduce not just the likelihood of initial and subsequent risk impacts but also the losses from disruptions. The implementation of risk management strategies and practices eventually aims at engendering robustness and resilience within the network.

5.4. Risk Management Strategy Model

With the constructs developed in previous sections, a research model to predict and confirm the relationships between organisational orientations, risk management strategies and risk management outcomes can be derived. In general, a research model consists of measurement model and structural model. The former is concerned with how the constructs can be measured, whereas the latter is based on the research hypotheses about the relationships between constructs.

5.4.1. Measurement model

The development of scale items is critical to ensure content validity which requires the items to cover the major content of a construct (Churchill 1979). For instrument development for the measurement model, this study followed the instructions of Hensley (1999). In particular, it conducted Q-sorting along with pre-pilot study and pilot study in order to improve the initial construct validity as well as reliability (Li *et al.* 2005). To assess the degree of these qualities, it adopted Moore and Benbasat's (1991) method which measures how many items are placed in the right target constructs.

The process was as follows. Firstly, the operational definition of each construct was generated based on the relevant literature. Secondly, the definitions were given to 11 interviewees in the case study to have comments and feedback that can eventually modify operational definitions, if necessary. Thirdly, the initial questions to ask about the risk mitigating practices, three organisational orientations, robustness and resilience were generated. Fourthly, Q-sorting was conducted with 5 experts and 5 non-experts in international logistics by asking them to classify scale items into appropriate constructs. Fifthly, given the feedbacks from Q-sorting process, questions for the questionnaire were created. Sixthly, the questionnaire was translated into Korean by a professional bi-lingual translator and then back-translated by another translator to check as to whether the translation was correct. Lastly, given the feedback from 16 industry experts for the pilot study, the final questionnaire was developed. As a consequence of this instrument development process, the final measurement items can be drawn. The questionnaire asked survey participants to indicate to what extent they pursue each risk management practice. The scale started from 1 (Not at all) through 4 (moderately) to 7 (very much).

5.4.1.1. Risk management strategies

The scale instruments for the four types of risk management strategies were developed by the risk mitigating practices explained in Section 5.2. Although there have been studies which measured risk management strategies with scale items, the newness of the strategic framework used in this research constrained the application of the previous research to develop scale instruments. Therefore, this study attempted to convert risk mitigating practices into scale items that can appropriately measure the risk management strategy constructs.

(1) Building a stable logistics network (SL) strategy

This intra-firm strategy has four practices: risk avoidance, risk hedging, strict procedure and purchasing insurance. These practices focus on reducing information processing needs by providing solution flexibility and disciplined process in preparation and in case of disruptions (see Table 5-1).

Table 5-1: The scale instruments of SL strategy

Building a stable logistics network (SL strategy)		
SL1	*Avoidance*	We strive to avoid any risky geo-political areas, transport modes or transport routes.
SL2	*Hedging*	We strive to have multiple transport modes/routes or supply chain partners as back-ups in case of disruption.
SL3	*Strict Procedure*	We strive to devise and abide by a standard procedure and process for logistics.
SL4	*Insurance*	We strive to purchase an insurance that can entirely cover the losses from international logistics.
Reference		Jüttner *et al.* (2003); Tang (2006); Kam *et al.* (2011)

(2) Leveraging logistics information (LI) strategy

This is another intra-firm strategy which consists of five practices related to logistics information: integrated information system, real-time evaluation, decision-making, real-time data collection and knowledge management. How to enhance a firm's capability for information processing is the main concern of these practices (see Table 5-2).

Table 5-2: The scale instruments of LI strategy

Leveraging logistics information (LI strategy)		
LI1	*Integrated Information System*	We strive to improve visibility by investing into an integrated information system that can transparently monitor the entire logistics processes.
LI2	*Real-time Evaluation*	We strive to foster the internal capability to pursue real time evaluation on causes and effects of risks.
LI3	*Decision Making*	We strive to foster the internal capability to make an appropriate decision on the responses to disruptions based on the logistics information.
LI4	*Real-time Data Collection*	We strive to have an information system that can collect and disseminate the variety of data needed along the logistics process in real-time.
LI5	*Knowledge Management*	We strive to foster the internal risk management capability by accumulating and distributing the knowledge/experience/skills.
Reference		Childerhouse and Towill (2004); Faisal *et al.* (2007); Ritchie and Brindley (2007b); Schoenherr *et al.* (2008); Kam *et al.* (2011)

(3) Leveraging outsourcing contracts (OC) strategy

The first intra-firm strategy is associated with leveraging outsourcing contracts by practices like supplier monitoring and auditing, supplier certification programme, penalty clauses, multi-criteria supplier selection and risk transfer clauses. Since a well-defined contract diminishes the chance of performance variability both in normal and disrupted circumstances, these practices contribute to reducing information processing needs (see Table 5-3).

(4) Developing logistics collaboration (LC) strategy

The second inter-firm strategy is about logistics collaboration, and comprises the key components of collaboration: partnership, information sharing, communication channels, joint management and goal alignment. These practices aim to enhance information processing capability in case of disruptions (see Table 5-4).

Table 5-3: The scale instruments of OC strategy

Leveraging outsourcing contracts (OC strategy)		
OC1	*Monitor & Audit*	We strive to consistently monitor and audit supply chain partners' processes and performance as stated in the contract.
OC2	*Certification*	We strive to use approved supply chain partners that consistently meet the quality level by operating a certification programme.
OC3	*Penalty*	We strive to incorporate performance guarantees and associated penalty clauses into the outsourcing contracts.
OC4	*Multi-criteria Selection*	We strive to use multiple criteria in contracting with supply chain partners in order to allocate specific tasks to the most appropriate partner.
OC5	*Risk Transfer*	We strive to make supply chain partners responsible to develop risk mitigation plans and to involve at the initial stage of risk occurrence.
Reference		Zsidisin *et al.* (2000); Zsidisin and Ellram (2003); Khan and Burnes (2007); Ellegaard (2008); Kam *et al.* (2011)

Table 5-4: The scale instruments of LC strategy

Developing logistics collaboration (LC strategy)		
LC1	*Partnership*	We strive to create a long-term, exclusive and closer partnership with key supply chain partners based on trust.
LC2	*Information Sharing*	We strive to share critical, complete and even confidential information with our supply chain partners for risk management.
LC3	*Communication Channels*	We strive to set up various communication channels with our supply chain partners in order to enhance the frequency and quality of communication.
LC4	*Joint Management*	We strive to jointly create risk management knowledge and plan risk management strategies with our supply chain partners.
LC5	*Goal Alignment*	We strive to align logistics objectives and performance level with our supply chain partners and support them to meet the objectives.
Reference		Giunipero and Eltantawy (2004); Faisal *et al.* (2007); Ellegaard (2008); Cao *et al.* (2010); Kam *et al.* (2011); Lavastre *et al.* (2012); Piboonrungroj (2013)

5.4.1.2. Organisational orientations

The measurement models of organisational orientations in this research have adopted the existing models as much as possible to ensure content validity. As for disruption orientation (DO), the scale items developed by Bode *et al.* (2011) were applied with minor alterations to highlight the international logistics circumstances. The instruments for customer orientation (CO) are based on the scale items developed by Chen and Paulraj (2004) and Braunsheidel and Suresh (2009). The measurement items for quality orientation (QO) adopted the measurement model by Chen and Paulraj (2004).

Table 5-5: The measurement items for organisational orientations

Org. Orientation	Abb.	Scale Items	Reference
Disruption Orientation	**DO1**	We feel the need to be alert for possible logistics disruptions at all times.	Bode *et al.* (2011)
	DO2	Logistics disruptions show us where we can improve.	
	DO3	We recognise that logistics disruptions are always looming.	
	DO4	After a logistics disruption has occurred, it is analysed thoroughly.	
Customer Orientation	**CO1**	We anticipate, understand and respond to customers' needs and wants in logistics operations.	Chen & Paulraj (2004); Braunsheidel & Suresh (2009)
	CO2	We evaluate and follow-up customer complaints and feedback in our logistics operations.	
	CO3	We interact with customers to create greater values in our logistics standards.	
	CO4	Satisfying customer needs is the main objective of our logistics operations.	
Quality Orientation	**QO1**	Our logistics strategy cannot be described as the one to transport products with the lowest price.	Chen & Paulraj (2004)
	QO2	Our logistics strategy is based on quality performance rather than price.	
	QO3	Our logistics strategy places greater emphasis on reliability than price.	
	QO4	Our logistics strategy places greater emphasis on flexibility than price.	

5.4.1.3. Risk management outcomes

Robustness and resilience was considered as the outcomes of risk management strategies. The conceptualisation in Section 5.3.2 was fully reflected in the development of scale instruments. The scale items considered the factors in risk assessment, such as likelihood, impact and time.

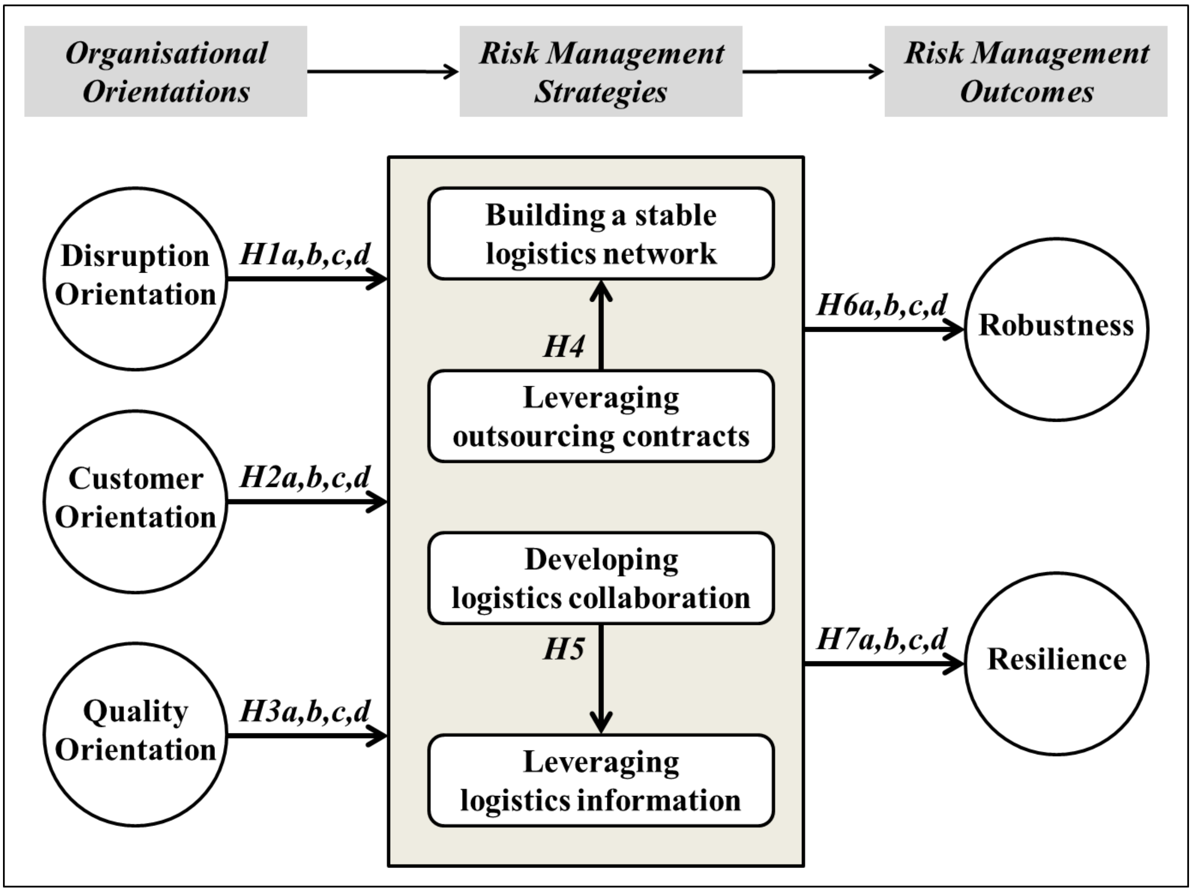
Table 5-6: The measurement items for robustness and resilience

Outcomes	Abb.	Scale Items	Reference
Robustness	**RB1**	We are able to remain effective and sustain logistics operations even when internal/external disruptions occur.	Tang (2006); Pan & Nagi (2010); Wallace and Choi (2011)
	RB2	We are able to avoid or minimise risk occurrence by anticipating and preparing for them.	
	RB3	We are able to absorb a significant level of negative impacts from recurrent risks.	
	RB4	We are able to have sufficient time in considering the most effective reactions even when disruption occurs.	
Resilience	**RS1**	We are able to adapt to the disruptive situations by quickly re-engineering logistics processes.	Bakshi & Kleindorfer (2009); Ponomarov & Holcomb (2009); Klibi *et al.* (2010); Pettit *et al.* (2010)
	RS2	We are able to promptly and adequately respond to logistics disruptions.	
	RS3	We are able to quickly recover from disruptions to the previous performance level or to a more desirable level.	
	RS4	We are able to reduce the extent of negative impacts from disruptions by minimising the sustaining time of the disruptions with quick responses.	

5.4.2. Structural model

The structural model is a set of hypotheses to be validated by statistical analyses. Basically, the structural model in this study comprises of the hypothetical relationships of three components, which are organisational orientations, risk management strategies and risk management outcomes. Since previous sections explained the variables within these components, this section focuses on the hypothetical relationships. Figure 5-10 illustrates the overview of the structural model.

Figure 5-10: The overview of the structural model



(Source: Author)

5.4.2.1. Organisational orientations – Risk management strategies

The literature and case study interviews revealed that there are some organisational cultures that stimulate the implementation of risk management strategies. They were disruption orientation (DO), customer orientation (CO) and quality orientation (QO). As these orientations are considered as the antecedents of both SCM and SCRM (Chen and Paulraj 2004; Braunsheidel and Suresh 2009; Bode *et al.* 2011), it is not difficult to hypothesise that these orientations have positive impacts on general risk management. However, the real issue is on which risk management strategies given each orientation have an effect. This study assumes that a certain orientation will foster specific strategies because the focuses of the organisational orientations differ. In this regard, the investment into the relationships between organisational orientations and risk management strategies has a feature of predictive study rather than confirmatory study. Thus, it is not expected that every hypothesis can be supported; rather, rejected hypotheses can cast important insights into the roles of corporate cultures in risk management. This part of the research model consists of three large hypotheses and twelve sub-hypotheses which look at relationships between three organisational orientations and four risk management strategies.

Hypothesis 1: Disruption orientation (DO) has a positive impact on the implementation of risk management strategies

H1a: DO has a positive impact on the implementation of SL strategy.

H1b: DO has a positive impact on the implementation of LI strategy.

H1c: DO has a positive impact on the implementation of OC strategy.

H1d: DO has a positive impact on the implementation of LC strategy.

Hypothesis 2: Customer Orientation (CO) has a positive impact on the implementation of risk management strategies.

H2a: CO has a positive impact on the implementation of SL strategy.

H2b: CO has a positive impact on the implementation of LI strategy.

H2c: CO has a positive impact on the implementation of OC strategy.

H2d: CO has a positive impact on the implementation of LC strategy.

Hypothesis 3: Quality Orientation (QO) has a positive impact on the implementation of risk management strategies.

H3a: QO has a positive impact on the implementation of SL strategy.

H3b: QO has a positive impact on the implementation of LI strategy.

H3c: QO has a positive impact on the implementation of OC strategy.

H3d: QO has a positive impact on the implementation of LC strategy.

5.4.2.2. Inter-firm risk management strategies – Intra-firm risk management strategies

The second part of the research model focuses on the relationships within the risk management strategies. Specifically, it aims to look at the effect of inter-firm risk management strategies on intra-firm risk management strategies.

In fact, two strategies to reduce information processing needs in international logistics have a close association with each other. For instance, risk avoidance may have two types, as suggested by Manuj and Mentzer (2008b): the first type drives the overall possibilities of risk events to zero by avoiding products, suppliers and geographical areas with high risks, and the second type prevents the adverse events by ensuring the quality by site/product audit and approval. A firm needs to select internal, external or both strategies in order to achieve a desired logistics network which can avoid the need for excessive information processing as not to overload the corporate hierarchy.

In their factor analysis of risk management practices, Zsidisin and Wagner (2010) found that auditing supplier's internal processes and systems, monitoring the financial condition of suppliers and supplier certificate programmes have distinctions from other practices relating to augment redundancy. They labelled these three practices as 'flexibility' because they can uncover problems in sourcing from far-off locations in advance to possess more time to find appropriate solutions. The disciplined process and flexible solutions that are required for Type 1 (LS) strategy largely depend on the successful implementation of Type 3 (OC) strategy because outsourcing of logistics functions is prevalent in international logistics.

The situation is similar to the strategies to enhance information processing capability. As Waters (2007) argued, the main objective of collaboration is to obtain accurate information. The problem with logistics information is that it is difficult to push the visibility line beyond the entity under direct transactions (Svensson 2004). As for manufacturers, transparency is ensured until the first-tier supplier/customer, but it is not certain beyond that point. Joint efforts and collaboration include but are not limited to improving visibility and understanding, sharing risk-related information and preparing a supply chain continuity plan (Jüttner *et al.* 2003).

As a result, this study hypothesises that inter-firm risk management strategies have positive impacts on intra-firm strategies as follows.

Hypothesis 4: 'Leveraging outsourcing contract (OC)' strategy has a positive impact on 'Building a stable logistics network (SL)' strategy.

Hypothesis 5: 'Developing logistics collaboration (LC)' strategy has a positive impact on 'Leveraging logistics information (LI)' strategy.

5.4.2.3. Risk management strategies – risk management outcomes

This relationship posits that the international logistics risks will be decreased through risk management strategies that impact both robustness and resilience as the outcomes. The hypotheses outlined below investigate whether each risk management strategy has an effect on robustness and resilience. Every strategy has its own primary objectives in risk management, and their effects on robustness and resilience may also differ.

Hypothesis 6: Risk management strategies have a positive impact on logistics robustness.

H6a: SL strategy has a positive impact on robustness.

H6b: LI strategy has a positive impact on robustness.

H6c: OC strategy has a positive impact on robustness.

H6d: LC strategy has a positive impact on robustness.

Hypothesis 7: Risk management strategies have a positive impact on logistics resilience.

H7a: SL strategy has a positive impact on resilience.

H7b: LI strategy has a positive impact on resilience.

H7c: OC strategy has a positive impact on resilience.

H7d: LC strategy has a positive impact on resilience.

5.5. Concluding Remarks

Zsidisin *et al.* (2000) identified that most companies did not do enough to mitigate supply-related risks and less than a half of sample companies prepared a formal contingency planning process. This is partly attributed to little time or resource that they invest into risk management due to the return on investment, lack of knowledge, lack of experience and a justification problem when a risk never materialised. The fact that the majority of companies invest little time and resource also appeared in Rice and Caniato (2003) and Zsidisin *et al.* (2004). Although there are so many reasons for firms not to take commensurable initiatives to supply chain risks, Tang (2006) summarised the underlying reasons as follows based on Rice and Caniato (2003) and Zsidisin *et al.* (2000): (1) Firms underestimate the risk; (2) firms are not familiar with risk management; (3) firms find it difficult to justify risk management strategies in the cost/benefit analysis.

However, the case study interviews in this study revealed that large manufacturers and logistics intermediaries are actively engaged in risk analysis and mitigation. Comparison showed that small and medium-sized manufacturers recognised the logistics risks as disruptions with low frequency, large manufacturers considered them as a kind of disturbance to their material flows within supply chain which must be tackled in advance. As for logistics intermediaries, implementation of risk management strategies was regarded as a competitive advantage which can appeal to their customers.

Zisidin *et al.* (2000) also suggested that a paradox between the recognition of the importance of risk management ("nice things to do") and the lack of taking required actions for risk management. Christopher *et al.* (2011) also insisted that most companies do not implement strategies to mitigate global sourcing risks in a systematic and holistic manner. Rather it was argued that there was a high variability of practices using a number of informal approaches to deal with the risks.

In the case study interviews of this research, however, firms were found to initiate a part of or all risk management suggested although their degree of investment can vary. In practice, case study firms were concerned about an overload of decision making and information processing that a single logistics disruption can bring about. Therefore, in consideration of the “worst-case scenario”, they needed to do something proactively and prepare something to react quickly. In this sense, the concept of "total cost" (Ellram and Siferd 1998) was partially incorporated into their selection of strategies because the dedicated logistics teams must deal with all the risk occurrences which significantly increases the work load and corporate resources. The evaluation of the worst-case scenarios works well because the accumulation of irregular cases and disruptions made them aware of the eventual consequences that are generated by even a single disruptive event (Zsidisin *et al.* 2000).

This chapter provided a set of risk management strategies and practices based on information processing theory, a rigorous literature review and case study interviews. From the findings in Chapter 4, it was assumed that risk management strategies in international logistics must effectively mitigate the failure in information and relationship which can create the self-enhancing loops of risks.

Although the four strategies and 19 practices were found in an empirical manner, this chapter could not precisely answer to what degree these strategies are implemented in international logistics businesses due to the limited sample size. Rather, a large-scale survey will help demonstrate the answers. In addition, this chapter also proposed a research model with the hypotheses about the relationships between organisational orientations, risk management strategies and risk management outcomes. These hypotheses should be also tested by statistical analyses of survey data.

Chapter 6

Validation of Risk Management Strategy Model

This chapter demonstrates the empirical results of a questionnaire survey on (1) risk management strategies, (2) organisational orientations that can influence the strategies, and (3) the outcomes of the strategies. It also presents the validation process for the constructs in the research model that was conceptualised in the previous chapter. In this chapter, the responses from a large-scale survey are analysed by several statistical analysis techniques. The analysis results aim to shed light on:

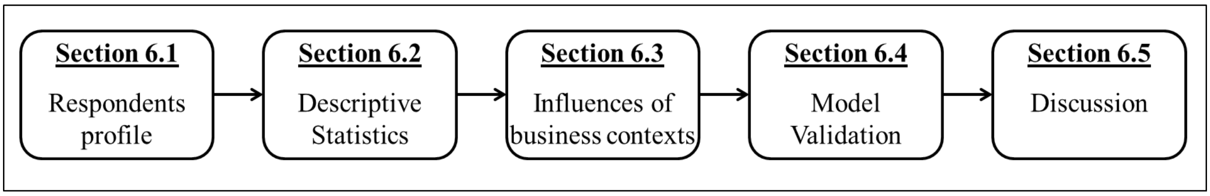
(1) the extent to which firms implement risk management strategies;

(2) the differences in the implementation of risk management strategies and its consequences subject to several business contexts; and

(3) the validation of the research model comprising of organisational orientation, risk management strategies and their desired outcomes.

More specifically, the first topic area focuses solely on the risk management strategies proposed in this research, while the second and third topics deal with the business contexts and corporate culture in association with risk management as well as the effectiveness of risk management strategies. For this purpose, diverse but suitable statistical techniques, such as descriptive statistics, ANOVA and Partial Least Square Structural Equation Modelling (PLS-SEM), will be applied in a sequence. This chapter will start by explaining the profile of survey respondents, and then cover topics outlined above in the following sections. Section 6.2 will provide the descriptive statistics of survey data which show the extent to which risk management strategies and practices are implemented. In Section 6.3, some business contexts will be considered as to whether they can generate differences in strategic implementation and robust/resilient logistics networks. The results of PLS-SEM will be presented in Section 6.4, which can validate the research model proposed. The discussion in Section 6.5 will generate insights from these findings by linking the statistical results with the extant literature.

Figure 6-1: The outline of Chapter 6



6.1. The profile of survey respondents

The questionnaire survey was conducted for five weeks from March to April 2014 with users of international logistics in South Korea. As explained in Chapter 3, the sample groups consisted of shippers (exporters and importers) and logistics intermediaries taking account of their roles in international logistics. The online questionnaires were sent to 1,224 companies via e-mail. Two reminders followed to encourage them to participate in the survey. As a result of data collection for five weeks, 174 usable responses were received, yielding a response rate of 14.2% which is a satisfactory sample size for PLS-SEM (Chin 1998). This sample size and response rate was also similar to the most recent SCRM research which applied PLS-SEM (162 samples and 14.1% response rate in Kern *et al.*, 2012). There were no missing data or incomplete questionnaires among these 174 responses.

The non-response bias was assessed by adopting the method suggested by Armstrong and Overton (1977), and the result indicated no evidence of the non-response bias. This is the selective extrapolation method which assumes that participants who respond late have the same traits as the non-respondents. This research compared the first quartile and the last quartile of respondents by using two nonparametric tests of difference: the Mann-Whitney U Test and the Wilcoxon Signed-Rank Test. As these tests compare the sum of ranks without considering outliers and normality, they are more generally applicable in comparing group differences at earlier stages. The results demonstrated that there was no difference between these two groups at the 5% significance level except for one item (LI3) out of 39 items. Therefore, it can be concluded that there is unlikely to be any critical bias from non-response in this dataset.

Table 6-1 demonstrates the industry profile of the respondents who completed the questionnaire survey. The response rates of the two groups are very similar (14.7% and 13.7%), suggesting that the responses were not biased in terms of one group responding significantly more than the other. In the shipper group, finished goods manufacturers accounted for 51.1% of respondents followed by trading companies and agents (30%). The majority of respondents in the logistics intermediary group labelled their business as international freight forwarder (64.3%) while others defined their business as a non-asset-based 3PL provider or other logistics intermediary.

Table 6-1: The industry profile of survey respondents

Group	**Industry**	**Response**	**Total (Response Rate)**
Shipper Group	Finished Goods Manufacturer	46	90 (14.7%)
	Half-finished Goods Manufacturer	14	
	Material Exporter/Importer	3	
	Trading Company and Agent	27	
Logistics Intermediary Group	International Freight Forwarder	54	84 (13.7%)
	Non-asset-based 3PL Provider	15	
	Other logistics intermediaries	15	
Total			174 (14.2%)

The size of the participant companies was evaluated by the annual sales and the number of staff. According to Table 6-2, the medians of the annual sales and the number of staff lie in the \$100M - \$499M range and 25-100 range respectively; this indicates that the majority of participating firms are small and medium-sized firms. This is partly owing to the large proportion of trading companies and international freight forwarders whose company size is not necessarily large enough. Notwithstanding the small and medium company size, they handled quite large volumes of cargo via sea transport because more than half of the respondents said that their monthly cargo volume is more than 100 containers, irrespective of

TEU and FEU. Even 39.1% of the companies transport more than 400 containers per month. To this end, it can be inferred that the participating firms have sufficient experiences of and involvement in international logistics. The details of cargo volume per month are shown in Table 6-3.

Table 6-2: Annual sales and the number of staff of survey respondents

Sales in 2013	Frequency	%	Number of staff	Frequency	%
Less than $100M	57	32.8%	Less than 25	41	23.6%
$100M - $499M	45	25.9%	25 – 100	56	32.2%
$500M - $999M	58	33.3%	101 – 300	27	15.5%
More than $1B	14	8.0%	301 – 1000	24	13.8%
			1001 – 5000	15	8.6%
			More than 5000	11	6.3%
Total	**174**	**100%**	**Total**	**174**	**100%**

Table 6-3: Monthly cargo volume of survey respondents

Monthly Cargo Volume	Less than 5 TEUs	5 – 20 TEUs	21 – 50 TEUs	51 – 100 TEUs	101 – 400 TEUs	More than 400 TEUs	Total
Frequency	13	12	26	23	32	68	174
%	7.5%	6.9%	14.9%	13.2%	18.4%	39.1%	100%

The respondents were expected to have expertise in international logistics design, strategy and operations, thus this survey constrained the target participants to the presidents, logistics executives or logistics professionals. 87% of the respondents are at manager level or higher, which evidences that most respondents are deemed to be experts in logistics operations. When they were asked about their logistics career expressed by number of years in international logistics operations, the average experience was approximately 10 years.

Table 6-4: Position and logistics career of survey respondents

Position	Frequency	%	Logistics Career	Frequency	%
CEO/President	16	9.2%	More than 20 years	21	12.1%
Executive/Director	13	7.5%	16 – 19 years	13	7.5%
Senior Manager	44	25.3%	12 – 15 years	24	13.8%
Manager	79	45.4%	8 – 11 years	39	22.4%
Operator	22	12.6%	4 – 7 years	49	28.1%
			Less than 4 years	28	16.1%
Total	**174**	**100%**	**Total**	**174**	**100%**

6.2. Descriptive Statistics

This section provides the descriptive statistics of risk management strategies and presents to what extent they are implemented in practice. In addition, the descriptive statistics of other constructs are also provided.

6.2.1. Implementation of risk management strategies

The respondents were asked the extent to which their companies pursue the logistics risk management strategies and practices outlined in the questionnaire. The questionnaire suggested four distinctive strategies as well as practices to reflect the strategies. The measurement here used a 7-point Likert Scale with the spectrum from 1 (not at all) to 7 (very much) to assess the statements like ‘we strive to do something.’ Therefore, the high mean value in a strategy represents that the level of implementing the strategy is also high.

Table 6-5 indicates the mean values and standard deviations of these risk management strategies. From the mean value, it is found that the strategy of “building a stable logistics network” (SL) is most frequently implemented by respondent companies, which is followed by “developing logistics collaboration” (LC) strategy and “leveraging outsourcing contracts” (OC) strategy with only marginal differences in the mean values. However, the mean value shows that the employment of the strategy to “leverage logistics information” (LI) is some way behind the other strategies.

Table 6-5: The degree of strategic implementation

Risk Management Strategies	Mean	Std. Dev.
Building a stable logistics network (SL)	4.96	1.58
Leveraging logistics information (LI)	4.31	1.71
Leveraging outsourcing contracts (OC)	4.88	1.53
Developing logistics collaboration (LC)	4.93	1.35

6.2.1.1. Strategy 1: Building a Stable Logistics Network (SL)

This strategy aims to minimise the information processing needs by implementing intra-firm strategies that can provide solution flexibility and disciplined procedures in the logistics network. Risk avoidance, risk hedging, standard procedures and insurance were selected as the practical initiatives to serve this strategy as gleaned from the interviews with practitioners. As shown in Table 6-5, this strategy outweighs other risk mitigating strategies, which is consistent with the majority of SCRM research which suggested more tactical/operational measures relating to this strategy than those to other strategies (see, for example, Zsidisin and Ellram 2003, Christopher and Peck 2004, Giunipero and Eltantawy 2004 and Manuj and Mentzer 2008b). The higher standard deviation than other strategies shows that the implementation level of this strategy may vary across companies subject to their business circumstances.

Out of the four initiatives, standard procedures for logistics operations (SL3) were implemented to the highest degree with the least standard deviation, as can be seen in Table 6-6. This result can be interpreted to mean that the majority of companies have created a rule or manual to maintain the performance level of international logistics and also to minimise the variability stemming from the inconsistency in the logistics process. Purchasing insurance (SL4) was another preferred initiative, whose mean value is over 5, because it can reduce the impact of risks relating to cargo damage and loss perfectly or proportionately subject to the insurance coverage.

Table 6-6: The descriptive statistics of practices for SL strategy

Items	Statistics		Responses						
	Mean	S.D.	1	2	3	4	5	6	7
(SL1) We strive to avoid any risky geo-political areas, transport modes or transport routes.	4.98	1.61	4	14	16	24	36	49	31
(SL2) We strive to have multiple transport modes/routes or supply chain partners as back-ups in case of disruption.	4.80	1.62	5	18	14	26	40	49	22
(SL3) We strive to devise and abide by a standard procedure and process for logistics.	5.17	1.43	1	10	11	30	40	49	33
(SL4) We strive to purchase an insurance that can entirely cover the losses from international logistics.	5.04	1.65	3	15	16	18	24	52	36

Interviews with practitioners have revealed that some companies have constraints on their risk avoidance (SL1) and risk hedging (SL2) measures due to the scale of international business, inter-company transactions and the need for specific goods/services. To this end, firms sometimes have to accept unfavourable logistics options despite acknowledging possible risks. Although the avoidance and hedging practices were found to be in the bottom half of this list, their mean values are still high compared to mitigating measures belonging to other strategies. It can be inferred that companies involved in international logistics strive to have discipline and flexibility in selecting logistics options in case of disruptions to a node or a link in their logistics networks.

6.2.1.2. Strategy 2: Leveraging Logistics Information (LI)

Adequate management and utilisation of logistics information will enhance the capability of a firm to process information. The literature and interviews have suggested that an integrated information system can be used for accumulating real-time information, analysing risks, deciding counter-measures and distributing knowledge on risks across the organisation. The major drawback of this strategy is the vast amount of financial resources it requires. To this end, interviews have revealed that SMEs were more dependent on the information provided by their partners than on their own logistics information system. The result shown in Table 6-5 is in line with this drawback, specifying that the degree of implementation of LI strategy is far lower than other three strategies. Moreover, the highest standard deviation (1.71) indicates that the implementation level varies greatly across the business contexts, compared to other risk mitigating strategies. Some companies may perceive this strategy as optional while prioritising other strategies.

In particular, Table 6-7 demonstrates firms' reluctance to invest in an integrated information system (LI1) and to the risk analysis from the integrated information (LI2). Though they often do not equip themselves with an expensive integrated system, it appears as though they use alternative ways to collect real-time information (LI4) as well as to make risk-mitigating decisions and to disseminate risk-related knowledge/experience/skills (LI5). Nevertheless, the implementation levels of these initiatives (mean values from 4.09 to 4.52) are still lower than other risk management practices (mean values from 4.67 to 5.52). This implies that firms' risk management capability depends not on the internal information processing capability but on the external supports from supply chain partners, such as providers of logistics service. In addition, it can be inferred that companies may rely more on employees' personal capability to deal with risks than on the corporate capability built upon objective logistics information. In this regard, they can collect information, make decisions and disseminate accumulated knowledge to some degree, but cannot trigger proper investment of finance and human resources into an integrated system and proactive risk evaluation.

Table 6-7: The descriptive statistics of practices for LI strategy

Items	Statistics		Responses						
	Mean	S.D.	1	2	3	4	5	6	7
(LI1) We strive to improve visibility by investing into an integrated information system that can transparently monitor the entire logistics processes.	4.11	1.86	13	30	28	28	27	25	23
(LI2) We strive to foster the internal capability to pursue real time evaluation on causes and effects of risks by integrated information management.	4.09	1.78	10	30	33	29	23	32	17
(LI3) We strive to foster the internal capability to make an appropriate decision on the responses to disruptions based on the logistics information.	4.36	1.68	9	18	32	28	30	43	14
(SL4) We strive to have an information system that can collect and disseminate the variety of data needed along the logistics process in real-time.	4.52	1.58	6	14	30	29	39	41	15
(SL5) We strive to foster the internal risk management capability by accumulating and distributing the knowledge/experience/skills based on the integrated information management.	4.46	1.62	8	16	27	28	41	40	14

Harland *et al.* (2007) once pointed out that information integration in supply chains is not well advanced (Fawcett and Magnan 2002) although information integration is considered to be critical to performance as well as it can be backed by the development of e-Business and ICT. The statistics shows that this statement deems to be partially valid in international logistics risk management because the mean value of LI strategy is above the mid-point but lower than those of other risk management strategies.

6.2.1.3. Strategy 3: Leveraging Outsourcing Contracts (OC)

This inter-organisational strategy pursues the reduction of information processing needs by tightly controlling the outcomes and behaviours of suppliers to meet the quality standard in logistics operations. For this purpose, a firm incorporates some coercive measures into contracts, such as auditing and monitoring, a supplier certification programme, penalty clauses, multi-criteria supplier selection and risk transfer. If a firm has sufficient power to impose these clauses in the contract, this strategy can be an inexpensive but still effective risk management measure. As seen in Table 6-5, this strategy is implemented at a considerable level (mean value of 4.88), marginally behind SL and LC strategies.

Table 6-8: The descriptive statistics of practices for OC strategy

Items	Statistics		Responses						
	Mean	S.D.	1	2	3	4	5	6	7
(OC1) We strive to consistently monitor and audit supply chain partners' processes and performance as stated in the contract.	5.06	1.44	5	5	9	36	50	38	31
(OC2) We strive to use approved supply chain partners that consistently meet the quality level by operating a certification programme.	4.74	1.73	9	15	17	27	37	41	28
(OC3) We strive to incorporate performance guarantees and associated penalty clauses into the outsourcing contracts.	4.67	1.58	8	9	23	29	48	37	20
(OC4) We strive to use multiple criteria in contracting with supply chain partners in order to allocate specific tasks to the most appropriate partner.	4.91	1.49	3	9	17	35	46	35	29
(OC5) We strive to make supply chain partners responsible to develop risk mitigation plans and to involve at the initial stage of risk occurrence.	5.01	1.41	2	11	11	28	54	43	25

Among the practices, monitoring and auditing supply chain partners' processes and performance (OC1) was found to be the primary practice in this strategy. It can be deduced therefore that the majority of firms pay considerable attention to the risks stemming from their suppliers, thus strive to eliminate those risks proactively by closely looking at suppliers' logistics outcomes and behaviours. Risk transfer and early supplier involvement practices (OC5) was also prevalent in the practice with the mean value over 5, which means that many firms successfully impose the initial responsibility for risk management on their suppliers. Multiple criteria to select the most appropriate supplier (OC4) were also adopted by the firms to a considerable level. On the other hand, a supplier certification programme and penalty clauses were least implemented within this strategy. These are, in fact, coercive measures that either deprive a supplier's of a chance to do business (OC2) or impose monetary compensations on suppliers (OC3). Firms look to be relatively reluctant to execute these coercive measures, rather depending on softer and more agreeable measures such as OC1 and OC4 that can accomplish the same effectiveness.

6.2.1.4. Strategy 4: Developing Logistics Collaboration (LC)

Logistics collaboration development is an inter-firm strategy to enhance the information processing capability with the support of supply chain partners. In a complex logistics network, supply chain partners manage a significant portion of logistics functions of a firm. Thus, collaboration becomes a critical strategy to incorporate and internalise partners' capability for international logistics operations. In a similar vein, risk management relies on logistics collaboration because the partners are closer to risk sources, thereby having the immediate capability to tackle the risks. Also, since logistics collaboration satisfies the mutual needs of a firm and its partners, the implementation of this strategy does not require much effort and/or resources. In these circumstances, Table 6-5 indicates that LC strategy is the second most preferable strategy, only second to SL strategy, with the minimum standard deviation. In the interviews, many companies agreed that LC strategy is a pre-condition in international logistics.

In more detail, creating a partnership (LC1) with key partners was selected as the most prevailing practice with the notable mean value of 5.52, higher than any other risk mitigating practices (see Table 6-9). On the contrary, the level of information sharing (LC2), creating communication channels (LC3), joint risk management (LC4) and goal alignment (LC5) was much smaller than the degree of creating a partnership (LC1). Some researchers have criticised that, in supply chain management, the rhetoric sometimes overwhelms the actual practices. A partnership, from this perspective, falls into this rhetoric to describe a firm's efforts to build collaborative relationships, whereas other practices are burdensome details to achieve logistics collaboration. Some authors also highlighted the subjective understanding of collaboration because practitioners are often ambiguous as to how and what to collaborate

(Barratt and Oliveira 2001). In this sense, the major barrier of implementing logistics collaboration is lack of attention to designing how they are going to cooperate in respect of which aspects. This can be the reason why LC1 stands out from other practices although their mean values are also very high.

Table 6-9: The descriptive statistics of practices for LC strategy

Items	Statistics		Responses						
	Mean	S.D.	1	2	3	4	5	6	7
(LC1) We strive to create a long-term, exclusive and closer partnership with key supply chain partners based on trust.	5.52	1.24	1	4	6	23	36	67	37
(LC2) We strive to share critical, complete and even confidential information with our supply chain partners for risk management.	4.68	1.44	3	11	20	46	34	45	15
(LC3) We strive to set up various communication channels with our supply chain partners in order to enhance the frequency and quality of communication.	4.79	1.35	2	6	25	33	53	38	17
(LC4) We strive to jointly create risk management knowledge and plan risk management strategies with our supply chain partners.	4.76	1.41	3	6	25	37	45	40	18
(LC5) We strive to align logistics objectives and performance level with our supply chain partners and support them to meet the objectives.	4.89	1.31	1	6	21	34	51	44	17

6.2.1.5. Top 10 risk management practices

Table 6-10 selects the top 10 risk mitigating practices by combining all the measures suggested in this research. When the mean values are compared, creating a partnership (LC1), standard procedures and processes (SL3), supplier monitoring and auditing (OC1), insurance purchasing (SL4) and risk transfer (OC5) were found to be top 5 practices that are most implemented with the minimum mean value of 5.01. All four practices in the SL strategy were listed in the top 10 while three practices from OC and LC strategies respectively were included in the list. On the other hand, no initiatives aiming at LI strategy were selected as expected in Table 6-5.

These results can be interpreted as indicating that the primary corporate strategy to mitigate international logistics risks is building a stable logistics network with intra-firm efforts in order to minimise logistics uncertainties by reducing the need for information processing. The practices relating to inter-firm strategies (leveraging outsourcing contracts and developing logistics collaboration) can be selectively adopted to reduce the level of logistics uncertainty. In contrast, the intra-firm capability built upon leveraging logistics information draws less attention as a risk mitigating strategy than other strategies.

Table 6-10: Top 10 risk mitigating measures

No	Practices	Statistics		Responses						
		Mean	S.D.	1	2	3	4	5	6	7
1	(LC1) Partnership	5.52	1.24	1	4	6	23	36	67	37
2	(SL3) Standard procedures	5.17	1.43	1	10	11	30	40	49	33
3	(OC1) Monitor and audit	5.06	1.44	5	5	9	36	50	38	31
4	(SL4) Insurance	5.04	1.65	3	15	16	18	24	52	36
5	(OC5) Risk transfer	5.01	1.41	2	11	11	28	54	43	25
6	(SL1) Risk avoidance	4.98	1.61	4	14	16	24	36	49	31
7	(OC4) Multi-criteria selection	4.91	1.49	3	9	17	35	46	35	29
8	(LC5) Goal alignment	4.89	1.31	1	6	21	34	51	44	17
9	(SL2) Risk hedging	4.80	1.62	5	18	14	26	40	49	22
10	(LC3) Communication channels	4.79	1.35	2	6	25	33	53	38	17

6.2.2. The level of organisational orientations

The risk management strategy model in this research includes organisational orientations as the antecedents of risk management strategies. Disruption orientation (DO), customer orientation (CO) and quality orientation (QO) were, therefore, hypothesised to positively influence the implementation of risk mitigating strategies. The survey respondents were asked the degree of their agreement to the scale items for organisational orientations with the 7-point Likert-scale from 1 (strongly disagree) to 7 (strongly agree). The results in Table 6-11 show that respondent companies were highly oriented with logistics disruptions, customers and logistics quality with the mean values from 4.93 to 5.39 which are well over the mid-point of 4. More specifically, the mean value for customer orientation was relatively higher than for the other two orientations, whereas quality orientation was the least among the three orientations. This is partly because customer orientation is the most universal orientation which can be easily applicable to general supply chain management which seeks customer value (Johansson *et al.* 1993). Corporate social responsibility literature also shows that customer is the main stakeholder which affect a company's risk management initiatives (Park and Ghauri 2015). Although the measurement scale was different, Bode *et al.* (2011) showed similar results (3.94 out of 5) for disruption orientation. There were no studies to compare the mean value of other two constructs.

Table 6-11: The descriptive statistics of organisational orientations

Items	Statistics		Responses						
	Mean	S.D.	1	2	3	4	5	6	7
Disruption Orientation (DO)	**5.30**	**1.07**							
(DO1) We feel the need to be alert for possible logistics disruptions at all times.	5.46	1.27	0	3	11	26	38	55	41
(DO2) Logistics disruptions show us where we can improve.	5.18	1.31	1	6	11	31	45	54	26
(DO3) We recognise that logistics disruptions are always looming.	5.48	1.25	1	2	5	34	37	52	43
(DO4) After a logistics disruption has occurred, it is analysed thoroughly.	5.10	1.54	4	8	17	24	40	47	34
Customer Orientation (CO)	**5.39**	**1.17**							
(CO1) We anticipate, understand and respond to customers' needs and wants in logistics operations.	5.33	1.32	1	6	9	23	49	51	35
(CO2) We evaluate and follow-up customer complaints and feedback in our logistics operations.	5.30	1.32	1	6	11	23	44	58	31
(CO3) We interact with customers to create greater values in our logistics standards.	5.10	1.48	2	9	18	24	39	52	30
(CO4) Satisfying customer needs is the main objective of our logistics operations.	5.82	1.32	1	3	8	15	31	45	71
Quality Orientation (QO)	**4.93**	**1.21**							
(QO1) Our logistics strategy cannot be described as the one to transport products with the lowest price.	5.56	1.44	3	8	6	14	31	65	47
(QO2) Our logistics strategy is based on quality performance rather than price.	4.90	1.48	4	8	19	32	41	47	23
(QO3) Our logistics strategy places greater emphasis on reliability than price.	4.74	1.43	3	8	21	43	45	33	21
(QO4) Our logistics strategy places greater emphasis on flexibility than price.	4.53	1.44	3	9	31	44	40	30	17

6.2.3. The level of risk management outcomes

The research model proposed risk management outcomes to evaluate the effectiveness of implementing risk management strategies. The outcomes are associated with robustness and resilience capability inherent to the logistics network that a firm possesses. In summary, robustness delineates the capability to resist and sustain while resilience means the capability to adapt and retain (Asbjørnslett 2008). If the logistics network is robust, the likelihood of logistics disruptions occurring can be significantly decreased and, similarly so can their initial impact. On the other hand, if the logistics network is resilient enough, a firm can quickly respond to disruptions and recover to a desired performance level.

Table 6-12: The descriptive statistics of logistics robustness and resilience

Items	Statistics		Responses						
	Mean	S.D.	1	2	3	4	5	6	7
Robustness	**4.81**	**1.24**							
(RB1) Our logistics network is able to remain effective and sustain logistics operations even when internal/external disruptions occur.	4.95	1.38	3	9	15	23	58	48	18
(RB2) Our logistics network is able to avoid or minimise risk occurrence by anticipating and preparing for them.	4.63	1.46	4	10	25	36	47	36	16
(RB3) Our logistics network is able to absorb a significant level of negative impacts from recurrent risks.	4.94	1.25	2	4	18	30	59	47	14
(RB4) Our logistics network is able to have sufficient time in considering the most effective reactions even when disruption occurs.	4.71	1.42	2	15	18	32	47	49	11
Resilience	**4.91**	**1.24**							
(RS1) Our logistics network is able to adapt to the disruptive situations by quickly re-engineering logistics processes.	4.80	1.38	2	7	25	36	37	54	13
(RS2) Our logistics network is able to promptly and adequately respond to logistics disruptions.	5.00	1.32	0	7	20	31	41	58	17
(RS3) Our logistics network is able to quickly recover from disruptions to the previous performance level or to a more desirable level.	4.87	1.33	0	7	24	34	45	47	17
(RS4) Our logistics network is able to reduce the extent of negative impacts from disruptions by minimising the sustaining time of the disruptions with quick responses.	4.97	1.32	0	8	16	35	51	42	22

Therefore, the research model hypothesised that risk management strategies have positive impacts on robustness and resilience logistics. Similar to the way of evaluating organisational orientations, the survey respondents were requested to assess the statements about robustness and resilience in their logistics with using the scales from 1 (strongly disagree) to 7 (strongly agree). Table 6-12 demonstrates the descriptive statistics of the risk management outcomes. In consideration of the mean value of 4.81 for robustness and 4.91 for resilience, it can be inferred that respondents are quite confident in their international logistics. The mean value is also quite similar to that of risk management strategies ranging from 4.31 to 4.96. Since there was no study which used the same constructs and measurement items, the comparison of mean value with other studies was not possible. However, this result implies that companies have built these capabilities to a large degree in order to survive, adapt and sustain in their international logistics operations.

6.3. Strategy Implementation and Business Contexts

Strategic priority varies across companies. Even if risk management strategies are beneficial to reduce regular disturbances and major disruptions, they still need to face challenges in cost/benefit analysis, strategic fit of the strategy and proactive execution (Tang 2006). Some researchers also paid attention to the business contexts of a firm which have an impact on the selection and implementation of risk management strategies (Craighead *et al.* 2007; Manuj and Mentzer 2008a). For instance, SMEs tend to spend limited time and resources in acquiring knowledge, hence possess limited information (Ellegaard 2008). To this end, their knowledge of risk management initiatives depends on the experience of interacting with existing suppliers and assumptions regarding potential losses. Risk perception can be influenced by factors like company size, product characteristics, job function and buyer demographics (Mitchell 1995); this may be partly because these factors have different impacts on various risk management strategies and their outcomes.

This section focuses on the differences in the implemented strategies and practices subject to several business contexts. In this regard, industry, company size (annual sales and the number of employees) and available resources (human and financial resources) will be tested as the business contexts which can generate the differences. These business contexts have been discussed by previous research (Mitchell 1995; Craighead *et al.* 2007; Ellegaard 2008; Manuj and Mentzer 2008a), thus it is meaningful to empirically test their significance in risk management. For this purpose, the analysis of variance (ANOVA) technique was adopted to analyse the survey data.

6.3.1. Industry

Shippers and logistics intermediaries are commonly responsible for the international cargo flows from an exporter's warehouse to an importer's warehouse by incorporating logistics services from various asset-based logistics service providers. However, the role of international logistics in their business is quite different because international logistics is not just a function to achieve their sales to shippers, but an entire business to logistics intermediaries. The strategic focus can create a great difference in strategic implementation.

Table 6-13: Differences in implementation of risk mitigating practices between the shipper group and the logistics intermediary group

Strategy	Practices	Shipper Group (N=90)	Logistics Intermediary Group (N=84)	F-statistics	p-value
Building a stable logistics network (SL)	SL1	4.99	4.98	0.003	0.959
	SL2	4.30	5.33	19.579	***
	SL3	4.77	5.52	15.721	***
	SL4	4.72	5.22	15.095	***
Leveraging logistics information (LI)	LI1	3.49	4.77	23.493	***
	LI2	3.51	4.70	21.910	***
	LI3	3.83	4.93	20.463	***
	LI4	4.06	5.01	17.449	***
	LI5	4.00	4.95	16.380	***
Leveraging outsourcing contracts (OC)	OC1	4.79	5.36	7.009	**
	OC2	4.47	5.04	4.827	*
	OC3	4.49	4.87	2.559	0.112
	OC4	4.74	5.10	2.443	0.085
	OC5	4.83	5.20	2.993	**
Developing logistics collaboration (LC)	LC1	5.26	5.80	8.622	**
	LC2	4.32	5.06	12.078	**
	LC3	4.46	5.14	11.902	**
	LC4	4.50	5.05	6.826	*
	LC5	4.58	5.21	10.809	**

***: $p<0.001$, **: $p<0.01$, *: $p<0.05$

Table 6-13 demonstrates the mean difference in each risk management practice between the shipper group and the logistics intermediary group. This finding reports that the latter group is more willing to implement risk management initiatives than the former group is. The exceptions were found in risk avoidance (SL1), penalty clauses (OC3) and multi-criteria supplier selection (OC4) whose group mean differences were not statistically significance. In particular, the mean value of SL1 for the shipper group was higher than that for logistics intermediaries group, which shows that risk avoidance is an option for the shippers rather than for logistics intermediaries.

When it comes to the logistics network robustness and resilience, there were significant differences between the two groups although the mean values for each group all exceeded the mid-point of 4. Thus it can be inferred that logistics intermediaries have to implement various risk mitigating initiatives under the pressure of their customers seeking more value out of logistics outsourcing, which resulted in more desirable logistics outcomes than shippers can achieve by themselves. This finding is also important to the research model to be validated in Section 6.3 because customer orientation, whether it is voluntary or enforced, was hypothesised to influence the level of implementation of risk management strategies. In addition, it can lead to logistics robustness and resilience as a consequence of the risk management.

Table 6-14: Differences in robustness and resilience between the shipper group and the logistics intermediary group

Outcome	Scale Items	Shipper Group	Logistics Intermediary Group	F-statistics	p-value
Robustness	RB1	4.53	5.40	19.003	***
	RB2	4.23	5.06	15.146	***
	RB3	4.59	5.31	15.540	***
	RB4	4.21	5.25	26.642	***
Resilience	RS1	4.43	5.19	14.044	***
	RS2	4.59	5.44	20.185	***
	RS3	4.56	5.21	11.324	**
	RS4	4.64	5.32	12.191	**

***: p<0.001, **: p<0.01, *: p<0.05

6.3.2. Company size

The company size can be evaluated by, for example, annual sales or by the number of employees. In Korea, companies are segregated into small, medium and large companies in order to determine the level of tax allowance and government subsidies. The criteria to divide small and medium companies from large companies are annual sales of $500 million and 300 employees. This research thus adopts the criteria to create two groups based on company size.

Table 6-15: Differences in implementation of risk mitigating practices between the smaller and larger companies subject to annual turnover

Strategy	Practices	Small Turnover (N=102)	Large Turnover (N=72)	F-statistics	p-value
Building a stable logistics network (SL)	SL1	5.10	4.82	1.259	0.263
	SL2	4.79	4.81	.002	0.964
	SL3	4.95	5.47	5.722	*
	SL4	4.91	5.22	1.499	0.222
Leveraging logistics information (LI)	LI1	3.63	4.79	18.231	***
	LI2	3.70	4.64	12.698	***
	LI3	4.04	4.82	9.514	**
	LI4	4.25	4.90	7.600	**
	LI5	4.16	4.89	9.034	**
Leveraging outsourcing contracts (OC)	OC1	4.79	5.44	9.018	**
	OC2	4.43	5.18	8.287	**
	OC3	4.41	5.04	6.998	**
	OC4	4.67	5.26	7.062	**
	OC5	4.79	5.32	5.992	*
Developing logistics collaboration (LC)	LC1	5.39	5.69	2.517	0.114
	LC2	4.47	4.97	5.229	*
	LC3	4.70	4.92	1.121	0.291
	LC4	4.63	4.96	2.360	0.126
	LC5	4.68	5.18	6.428	*

***: $p<0.001$, **: $p<0.01$, *: $p<0.05$

6.3.2.1. Annual turnover

Table 6-15 shows the mean difference in each risk management practice between the smaller companies (annual sales less than $500 million) and the larger companies (annual sales more than $500 million). The results suggest that larger companies are keener to initiate risk management practices, and that the size of annual sales generates significant differences in LI and OC strategies. There might be several reasons for this finding. The first possible reason is that large companies with higher annual sales have more capability in the area of financial investment, which is linked to the initiatives to leverage logistics information in order to build an integrated system to collect, analyse and distribute the information. The second is that they possess bargaining power over smaller companies, which enables them to influence outsourcing contracts concerning risk management *per se*. On the contrary, both groups showed less significant difference in SL and LC strategies. This suggests that SL and LC strategies are basic elements of risk management in international logistics regardless of the company size assessed by annual sales.

These differences were further clarified by comparing the top 5 risk mitigating measures taken by each group, as can be seen in Table 6-16. The list shows that smaller companies focus more on initiatives for the SL strategy because the Top 5 list includes all four initiatives for the strategy. The only exception was the LC1 (creating partnerships) practice, but it was just the most prevailing practice to all respondents. In contrast, larger companies selected more diverse initiatives in the top 5 list, embracing practices in OC strategy, such as supplier monitoring and auditing (OC1) and supplier certification programmes (OC2). Although LI strategy showed a significant difference between the two groups, the low mean value left the strategy out of this Top 5 list.

Table 6-16: The top 5 risk management practices subject to annual turnover

Rank	Small Turnover Group			Large Turnover Group		
	Practices	**Mean**	**S.D.**	**Practices**	**Mean**	**S.D.**
1	LC1	5.39	1.36	LC1	5.69	1.04
2	SL1	5.10	1.63	SL3	5.47	1.28
3	SL3	4.95	1.50	OC1	5.44	1.27
4	SL4	4.91	1.73	SL4	5.22	1.52
5	SL2	4.79	1.66	OC2	5.18	1.53

Contrary to the groups organised by industry, the differences in logistics robustness and resilience between the groups subject to annual sales were not clear-cut because three elements showed no significant differences while five elements were significantly different at the 5% level. To this end, it can be interpreted that the strategic fit of smaller companies to SL and LC strategies is acceptable to some degree when the risk management outcomes were taken into account.

Table 6-17: Differences in robustness and resilience between the smaller and larger companies subject to annual turnover

Outcome	Scale Items	Small Turnover	Large Turnover	F-statistics	p-value
Robustness	RB1	4.77	5.22	4.708	*
	RB2	4.41	4.94	5.811	*
	RB3	4.77	5.17	4.200	*
	RB4	4.61	4.86	1.342	0.248
Resilience	RS1	4.59	5.10	5.895	*
	RS2	4.84	5.22	3.549	0.061
	RS3	4.70	5.13	4.490	*
	RS4	4.83	5.17	2.724	0.101

***: p<0.001, **: p<0.01, *: p<0.05

6.3.2.2. Number of employees

The next analysis segregated the respondents into two groups given the number of employees. Similar to the previous result, there was no significant difference between the means in most practices in SL strategy between the groups (Table 6-18). The only exception, once again, was the standard procedure to regulate the logistics processes. It can be therefore concluded that risk avoidance, risk hedging and insurance are the measures that can be taken regardless of company size, the standard procedure is considered when the size of a firm saturates a certain point. Contrary to the previous result, however, Table 6-18 shows that there is no significant difference between the means in LC strategy. This could lead to an interesting deduction that companies with small annual sales strive to build up a collaborative relationship, but companies with a small number of staff do not follow this path. This proposition is examined further by the analysis of human resources in the next section.

Similar to the results in the analysis regarding annual sales, companies with a large number of employees appeared to have better robustness and resilience in their logistics networks with a mixture of statistical significance and non-significance. This result also demonstrates the strategic fit of small companies to SL strategy to some extent because 3 out of 8 measurement scales in Table 6-19 showed no significant difference between the means.

Table 6-18: Differences in implementation of risk mitigating practices between the smaller and larger companies subject to the number of employees

Strategy	Practices	Small staff number (N=124)	Large staff number (N=50)	F-statistics	p-value
Building a stable logistics network (SL)	SL1	5.04	4.84	0.547	0.461
	SL2	4.70	5.04	1.560	0.213
	SL3	4.97	5.66	8.661	**
	SL4	4.93	5.32	2.030	0.156
Leveraging logistics information (LI)	LI1	3.65	5.26	31.710	***
	LI2	3.69	5.08	25.017	***
	LI3	4.02	5.20	19.217	***
	LI4	4.27	5.14	11.578	**
	LI5	4.19	5.12	12.447	**
Leveraging outsourcing contracts (OC)	OC1	4.81	5.68	13.844	***
	OC2	4.55	5.22	5.537	*
	OC3	4.45	5.22	8.884	**
	OC4	4.70	5.44	9.223	**
	OC5	4.84	5.44	6.652	*
Developing logistics collaboration (LC)	LC1	5.40	5.80	3.685	0.057
	LC2	4.47	5.20	9.641	**
	LC3	4.62	5.20	6.733	**
	LC4	4.56	5.28	9.943	**
	LC5	4.66	5.44	13.641	***

***: p<0.001, **: p<0.01, *: p<0.05

Table 6-19: Differences in robustness and resilience between the smaller and larger companies subject to the number of employees

Outcome	Scale Items	Small staff number	Large staff number	F-statistics	p-value
Robustness	RB1	4.75	5.46	9.850	**
	RB2	4.42	5.16	9.691	**
	RB3	4.81	5.26	4.758	*
	RB4	4.63	4.92	1.497	0.223
Resilience	RS1	4.67	5.12	3.857	0.051
	RS2	4.86	5.34	4.779	*
	RS3	4.73	5.24	5.478	*
	RS4	4.88	5.20	2.125	0.147

***: p<0.001, **: p<0.01, *: p<0.05

6.3.3. Available resources

In the previous analysis, it was found that there are significant differences in risk management practices between small companies and large companies, but the differences slightly differ subject to the criteria to define the small and large companies (annual turnover and the number of employees). This section specifies the business contexts using available resources for risk management. There are two types of available resources: one is human resources and the other is financial resources. In the case study interviews, participants argued that the deficiency of human and financial resources for international logistics risk management make it difficult for their firms to implement risk management strategies. To validate this idea, two questions were designed in the survey in order to create groups relating to available resources. The questions asked participants to which degree they agree with the following statements. Groups with different levels of available resource were segregated by the respondents' answers to following questions.

We have sufficient human resources to be used for the management of logistics risks.

We have sufficient financial resources to be used for the management of logistics risks.

Table 6-20: Differences in implementation of risk mitigating practices between companies with less human resource and more human resource

Strategy	Practices	Less human resource (N=77)	More human resource (N=97)	F-statistics	p-value
Building a stable logistics network (SL)	SL1	4.90	5.05	0.397	0.530
	SL2	4.45	5.07	6.436	*
	SL3	4.62	5.60	22.2333	***
	SL4	4.56	5.43	12.571	**
Leveraging logistics information (LI)	LI1	3.21	4.82	39.826	***
	LI2	3.29	4.72	33.297	***
	LI3	3.61	4.96	32.569	***
	LI4	3.82	5.07	31.900	***
	LI5	3.64	5.11	44.796	***
Leveraging outsourcing contracts (OC)	OC1	4.44	5.56	30.110	***
	OC2	3.99	5.34	30.954	***
	OC3	4.10	5.13	21.051	***
	OC4	4.36	5.35	21.155	***
	OC5	4.55	5.38	16.330	***
Developing logistics collaboration (LC)	LC1	5.18	5.78	10.611	**
	LC2	4.25	5.02	13.227	***
	LC3	4.27	5.20	22.427	***
	LC4	4.29	5.14	17.575	***
	LC5	4.47	5.22	15.136	***

***: p<0.001, **: p<0.01, *: p<0.05

As shown from Table 6-20 to Table 6-23, available resources for risk management created significant differences both in risk management practices and in robust/resilient logistics networks. Although company size could not make differences in several risk management practices and factors in robustness/resilience, the level of available resources made clear distinctions between the group with less resources and more resources. It cannot completely be excluded that company size is closely associated with available resources, but the important factor that determines the level of risk management is deemed to be the existence of corporate resources, not the amount of annual sales or the number of employees. This result revisits issues like temporal focus, top management support and resource alignment (Manuj and Mentzer 2008a; Skinner and Hanna 2009) because these elements decide the level of available resources within a firm.

Table 6-21: Differences in robustness and resilience between companies with less human resource and more human resource

Outcome	Scale Items	Less human resource (N=77)	More human resource (N=97)	F-statistics	p-value
Robustness	RB1	4.34	5.44	32.331	***
	RB2	3.96	5.16	35.173	***
	RB3	4.34	5.41	38.287	***
	RB4	4.03	5.26	39.373	***
Resilience	RS1	4.17	5.30	34.274	***
	RS2	4.51	5.39	21.723	***
	RS3	4.32	5.31	27.153	***
	RS4	4.53	5.32	16.679	***

***: p<0.001, **: p<0.01, *: p<0.05

Table 6-22: Differences in implementation of risk mitigating practices between companies with less financial resource and more financial resource

Strategy	Practices	Less finance resource (N=78)	More finance resource (N=96)	F-statistics	p-value
Building a stable logistics network (SL)	SL1	4.68	5.23	5.107	*
	SL2	4.44	5.09	7.358	**
	SL3	4.67	5.57	18.949	***
	SL4	4.62	5.39	9.858	**
Leveraging logistics information (LI)	LI1	3.26	4.80	35.789	***
	LI2	3.36	4.68	27.308	***
	LI3	3.71	4.90	24.452	***
	LI4	3.92	5.00	22.500	***
	LI5	3.73	5.05	34.180	***
Leveraging outsourcing contracts (OC)	OC1	4.58	5.46	17.701	***
	OC2	4.05	5.30	25.847	***
	OC3	4.12	5.13	19.625	***
	OC4	4.38	5.34	19.903	***
	OC5	4.60	5.34	12.615	***
Developing logistics collaboration (LC)	LC1	5.22	5.76	8.549	**
	LC2	4.23	5.04	14.674	***
	LC3	4.29	5.19	20.852	***
	LC4	4.22	5.21	24.271	***
	LC5	4.50	5.20	13.028	***

***: $p<0.001$, **: $p<0.01$, *: $p<0.05$

Table 6-23: Differences in robustness and resilience between companies with less financial resource and more financial resource

Outcome	Scale Items	Less finance resource (N=78)	More finance resource (N=96)	F-statistics	p-value
Robustness	RB1	4.41	5.40	24.807	***
	RB2	3.92	5.21	41.396	***
	RB3	4.40	5.38	30.598	***
	RB4	4.03	5.27	40.567	***
Resilience	RS1	4.20	5.28	30.600	***
	RS2	4.47	5.43	25.748	***
	RS3	4.35	5.30	25.438	***
	RS4	4.47	5.38	25.576	***

***: $p<0.001$, **: $p<0.01$, *: $p<0.05$

6.4. Validation of Research Model

This section analyses and validates the measurement and structural models proposed in Chapter 5 with using a Partial Least Square Structural Equation Modelling (PLS-SEM) technique. The analysis was executed mainly by SmartPLS version 2.0 (beta) software package (Ringle *et al.* 2005), but IBM SPSS 20.0 software package was also used as a supplement. The original data from the 174 responses were used for this analysis without data screening and treatment because the collected data had no missing values. In addition, PLS-SEM has fewer restrictions in the normality of data with the distribution-free assumptions, especially compared to CB-SEM (Chin 1998), thus it did not require any data treatment. This research follows a two-step process involving separate evaluation of measurement models and the structural model (Hair *et al.* 2014).

6.4.1. Measurement models

All variables in this research were operationalised by multi-scale reflective measures. To this end validity and reliability tests of the measurement models are required prior to examining the relationships between variables. In PLS-SEM, the measurement model is also called as the outer model which shows to what extent each indicator is related with the latent variable it intends to reflect (Chin 1998). The assessment of outer models consists of content validity, internal consistency reliability, convergent validity and discriminant validity (Hair *et al.* 2014).

Content validity of the nine latent variables representing organisational orientations, risk management strategies and their outcomes was ensured by combining rigorous a literature review with interviews with logistics experts. The measurement model adopted the existing scale items wherever possible. However, the deficiency of SCRM studies that used multi-scale constructs led this research to develop new indicators which reflect findings from th literature review and interviews. The constructs and scale items were reviewed by Q-sorting and pilot study processes in order to achieve high content validity.

Table 6-24: Factor loadings, reliability and validity

Categories	Latent Variables	Items	Factor Loading	Reliability & Validity
Organisational Orientation	**Disruption Orientation (DO)**	DO1	0.761***	α = 0.809 CR = 0.868 AVE = 0.623
		DO2	0.773***	
		DO3	0.782***	
		DO4	0.838***	
	Customer Orientation (CO)	CO1	0.896***	α = 0.882 CR = 0.919 AVE = 0.741
		CO2	0.886***	
		CO3	0.881***	
		CO4	0.773***	
	Quality Orientation (QO)	QO1	0.741***	α = 0.858 CR = 0.903 AVE = 0.701
		QO2	0.884***	
		QO3	0.866***	
		QO4	0.851***	
Risk Management Strategies	**Building a stable logistics network (SL)**	SL1	0.567***	α = 0.755 CR = 0.844 AVE = 0.580
		SL2	0.732***	
		SL3	0.886***	
		SL4	0.824***	
	Leveraging logistics information (LI)	LI1	0.920***	α = 0.956 CR = 0.966 AVE = 0.851
		LI2	0.914***	
		LI3	0.941***	
		LI4	0.923***	
		LI5	0.914***	
	Leveraging outsourcing contracts (OC)	OC1	0.862***	α = 0.925 CR = 0.943 AVE = 0.768
		OC2	0.869***	
		OC3	0.898***	
		OC4	0.905***	
		OC5	0.847***	
	Developing logistics collaboration (LC)	LC1	0.791***	α = 0.915 CR = 0.937 AVE = 0.748
		LC2	0.818***	
		LC3	0.907***	
		LC4	0.898***	
		LC5	0.904***	
Risk Management Outcomes	**Robustness (RB)**	RB1	0.888***	α = 0.921 CR = 0.944 AVE = 0.808
		RB2	0.921***	
		RB3	0.906***	
		RB4	0.881***	
	Resilience (RS)	RS1	0.914***	α = 0.943 CR = 0.959 AVE = 0.855
		RS2	0.950***	
		RS3	0.923***	
		RS4	0.911***	

(Note: *** = p<0.001)

Internal consistent reliability and indicator reliability were examined by Cronbach's alpha (α), composite reliability (CR) and average variance extracted (AVE). If the Cronbach's alpha exceeds 0.7, the level of reliability is considered to be satisfactory. Also, if the values of composite reliability and AVE are more than 0.7 and 0.5 respectively, the internal consistent reliability of the model is at the acceptable level. The results show that all the latent variables had Cronbach's α, CR and AVE values exceeding these thresholds, as demonstrated in Table 6-24. Therefore, it can be concluded that internal consistent reliability of the measurement model is satisfactory.

Convergent validity was assessed by the magnitude and significance of factor loadings. If the factor loading is greater than at least 0.5 or preferably 0.707 with statistical significance (Chin 1998), convergent validity is satisfied. The results in Table 6-24 show that all the factor loadings, except for one, are greater than 0.7 with statistical significance at the 0.1% level. The factor loading of the only exception (SL1) is also an acceptable level of 0.567 when it is considered that scale items in SL strategy were not based on established scales. Therefore, this result demonstrates that each latent variable is appropriately measured by a proposed set of scale items.

Table 6-25: Fornell-Larcker Criterion for discriminant validity

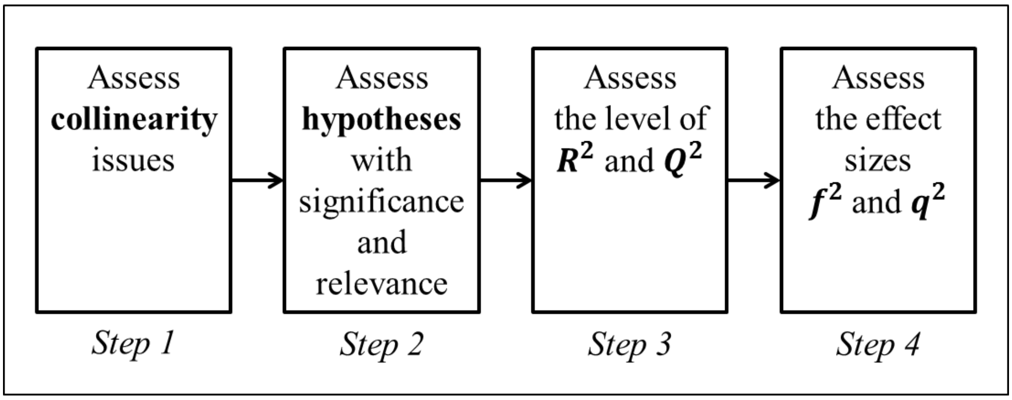
	DO	CO	QO	SL	LI	OC	LC	RB	RS
DO	**0.789**								
CO	0.677	**0.861**							
QO	0.366	0.415	**0.837**						
SL	0.547	0.713	0.381	**0.762**					
LI	0.504	0.630	0.439	0.662	**0.922**				
OC	0.537	0.650	0.359	0.666	0.722	**0.877**			
LC	0.521	0.627	0.414	0.637	0.715	0.718	**0.865**		
RB	0.589	0.657	0.435	0.705	0.704	0.709	0.727	**0.899**	
RS	0.522	0.597	0.306	0.660	0.620	0.564	0.636	0.798	**0.924**

Discriminant validity was also tested by applying the process proposed by Fornell and Larcker (1981). It compares the square root of AVE with inter-correlation coefficients between latent variables. Discriminant validity exists if the square root of AVE of each construct is larger than its correlation with other constructs. In Table 6-25 the square root of AVE is placed on the diagonal in bold for comparison with inter-correlation coefficients, which highlights that discriminant validity assumption is also supported. Alternatively, discriminant validity can be assessed by looking at cross-loading of items to find out whether each item loads the highest on its latent variables (Carmines and Zeller 2008). After all cross-loadings being checked, discriminant validity was confirmed again.

6.4.2. Structural Model

The structural model in this research consists of the hypotheses regarding the relationships between (1) organisational orientation and risk management strategies, (2) inter-firm strategies and intra-firm strategies and (3) risk management strategies and their desired outcomes. The structural model was assessed by adapting the systematic approach suggested by Hair *et al.* (2014). It consists of assessment of (1) collinearity issues, (2) the significance and relevance of the structural model relationships, (3) the level of $R^2$and Q^2 (4) the effect size f^2 and q^2.

Figure 6-2: The analysis process of the structural model



6.4.2.1. Collinearity issues

To assess the collinearity issues, four separate OLS regressions were conducted. More specifically, the following sets of predictor constructs for collinearity were assessed: (1) DO, CO and QO as predictors of OC and LC; (2) DO, CO, QO and OC as predictors of SL; (3) DO, CO, QO and LC as predictors of LI; and (4) SL, LI, OC and LC as predictors of RB and RS. Table 6-26 indicates that all VIF values of the analyses are below the threshold value of 5.

In this regard, it can be concluded that collineartity among predictor variables will not be an issue in this structural model, which allows the further analysis of the structural model.

Table 6-26: Collinearity Assessment

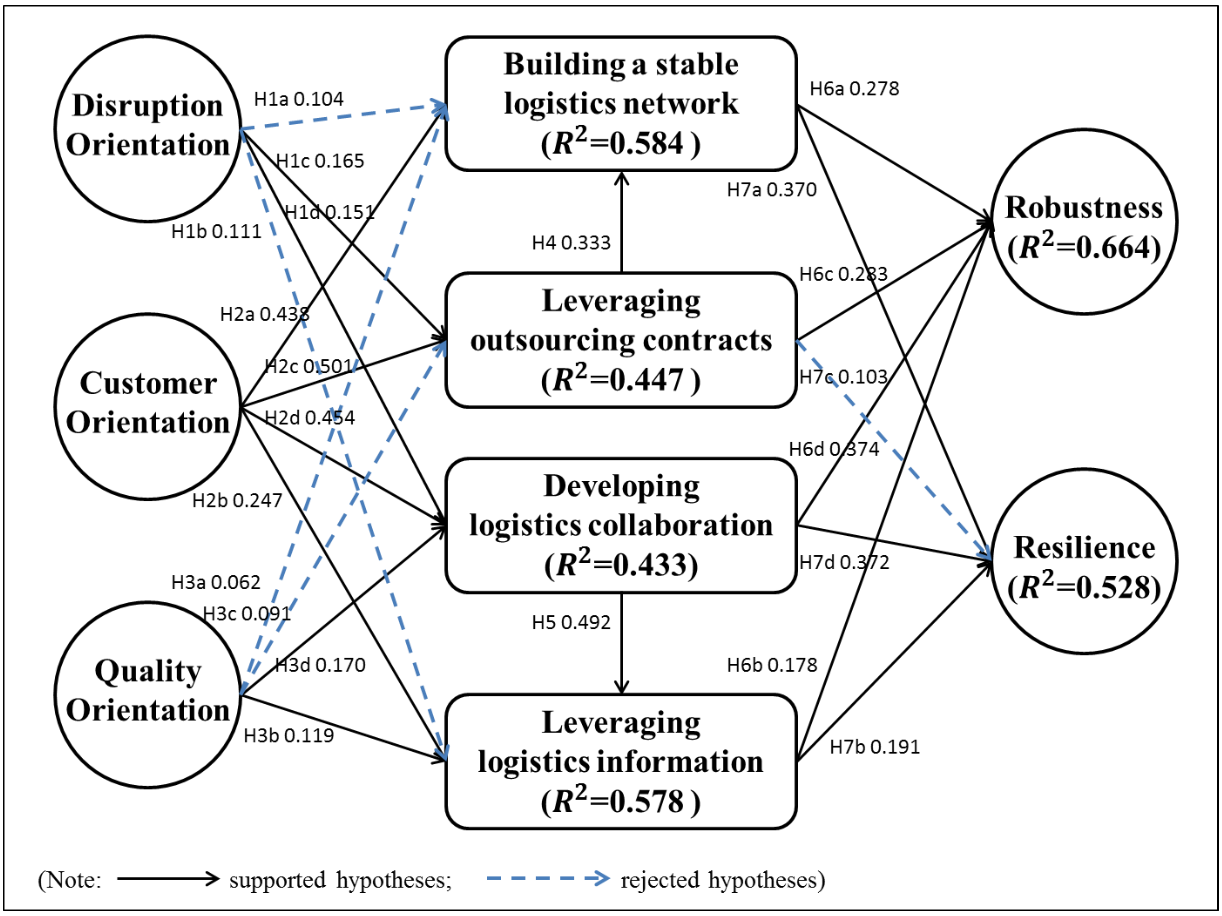
First Set		Second Set		Third Set		Fourth Set	
Constructs	**VIF**	**Constructs**	**VIF**	**Constructs**	**VIF**	**Constructs**	**VIF**
DO	1.873	DO	1.922	DO	1.913	SL	2.505
CO	1.961	CO	2.416	CO	2.326	LI	2.789
QO	1.227	QO	1.242	QO	1.278	OC	2.798
		OC	1.808	LC	1.765	LC	2.565

6.4.2.2. Hypotheses testing

The standardised path coefficients and their statistical significance were examined in order to test the hypotheses proposed in the previous chapter. The hypotheses look at the relationships between organisational orientations and risk management strategies (H1, H2 and H3), the relationship between OC strategy and SL strategy (H4), the relationship between LC strategy and LI strategy (H5) and risk management strategies and robustness/resilience (H6 and H7). PLS-SEM produced the standardised path coefficients, while their statistical significances were established after running the bootstrapping routine of 174 cases and 5,000 samples. As this model is predictive, the hypotheses were tested at the significance level of 10% (T-statistic > 1.64).

The overall results of the structural model, particularly relating to (2) and (3), are graphically illustrated in Figure 6-3 for the overview. In this figure, straight arrows represent the supported 17 hypotheses at the 10% significance level, while dotted arrows mean the rejected 5 hypotheses. Also, R^2 of the endogenous variables are presented below the variable names. The following sections will explain these results in more detail.

Figure 6-3: The brief results of hypotheses testing and R^2



(Source: Author)

(1) The effects of Disruption Orientation

Hypothesis 1:

Disruption Orientation (DO) has a significant positive impact on the implementation of risk management strategies.

H1a: DO has a significant positive impact on the implementation of SL strategy.

H1b: DO has a significant positive impact on the implementation of LI strategy.

H1c: DO has a significant positive impact on the implementation of OC strategy.

H1d: DO has a significant positive impact on the implementation of LC strategy.

H1 assumed the positive influences of disruption orientation (DO) on the four risk management strategies. As the awareness and recognition of disruptions will stimulate the need for implementing risk management strategies (Bode *et al.* 2011; Kern *et al.* 2012), disruption orientation was expected to influence the proposed strategies. According to the PLS-SEM results, however, its impacts on intra-firm strategies (SL and LI strategies) were not statistically significant. On the other hand, disruption orientation exhibited positive relationships with inter-firm strategies (OC and LC strategies). To this end, H1 is partially supported subject to certain strategies.

Table 6-27: Results of the hypothesis testing (H1)

Hypothesis	H1a	H1b	H1c	H1d
Relationship	DO ➔ SL	DO ➔ LI	DO ➔ OC	DO ➔ LC
Path coefficient	0.104	0.111	0.165	0.151
T-statistic	1.369	1.293	2.348	1.961
Significance	NS	NS	**	**

(Note: * p<0.1, ** p<0.05, *** p<0.01)

(2) The effects of Customer Orientation

Hypothesis 2:

Customer Orientation (CO) has a significant positive impact on the implementation of risk management strategies.

H2a: CO has a significant positive impact on the implementation of SL strategy.

H2b: CO has a significant positive impact on the implementation of LI strategy.

H2c: CO has a significant positive impact on the implementation of OC strategy.

H2d: CO has a significant positive impact on the implementation of LC strategy.

Customer orientation is a customer-focused culture which strives to augment the customer value and needs. H2 was set out to test the effects of customer orientation on risk management strategies. The PLS-SEM results, as described in Table 6-28, show that it has positive and strong impacts on all four risk management strategies investigated. In particular, the influences of customer orientation stand out when its path coefficients (0.247-0.454) are co mpared with those of other organisational orientations (0.062-0.170). Thus, it can be stated that H2 is supported.

Table 6-28: Results of the hypothesis testing (H2)

Hypothesis	H2a	H2b	H2c	H2d
Relationship	CO → SL	CO → LI	CO → OC	CO → LC
Path coefficient	0.438	0.247	0.501	0.454
T-statistic	5.328	3.304	6.377	5.169
Significance	***	***	***	***

(Note: * p<0.1, ** p<0.05, *** p<0.01)

(3) The effects of Quality Orientation

Hypothesis 3:

Quality Orientation (QO) has a significant positive impact on the implementation of risk management strategies.

H3a: QO has a significant positive impact on the implementation of SL strategy.
H3b: QO has a significant positive impact on the implementation of LI strategy.
H3c: QO has a significant positive impact on the implementation of OC strategy.
H3d: QO has a significant positive impact on the implementation of LC strategy.

H3 focuses on the path coefficients from quality orientation (QO) to risk management strategies. Quality orientation delineates the corporate traits to prioritise logistics quality, such as performance, reliability and flexibility, to logistics costs. According to the analysis results, quality orientation has a significant positive impact on the strategies to enhance information processing capability (LI and LC strategies), while generating no significant effects on the strategies to reduce information processing needs (SL and OC strategies). Therefore, H3 is partially supported given the focus of the risk management strategies.

Table 6-29: Results of the hypothesis testing (H3)

Hypothesis	H3a	H3b	H3c	H3d
Relationship	QO → SL	QO → LI	QO → OC	QO → LC
Path coefficient	0.062	0.119	0.091	0.170
T-statistic	0.869	1.759	1.225	2.333
Significance	NS	*	NS	**

(Note: * p<0.1, ** p<0.05, *** p<0.01)

(4) The effects between risk management strategies

Hypothesis 4: 'Leveraging outsourcing contract (OC)' strategy has a significant positive impact on 'Building a stable logistics network (SL)' strategy.

Hypothesis 5: 'Developing logistics collaboration (LC)' strategy has a significant positive impact on 'Leveraging logistics information (LI)' strategy.

H4 and H5 explore the relationships between risk management strategies, particularly the influences of inter-firm strategies on intra-firm strategies. H4 is associated with the strategies to reduce information processing needs, thereby assuming the positive impact of inter-firm OC strategy on intra-firm SL strategy. In a similar vein, H5 supposes that inter-firm LC strategy positively influences intra-firm LI strategy by augmenting the level of information processing capability. The analysis results indicate that both hypotheses are supported with high relevance and significance.

Table 6-30: Results of the hypothesis testing (H4 & H5)

Hypothesis	H4	H5
Relationship	OC → SL	LC → LI
Path coefficient	0.333	0.492
T-statistic	4.524	7.563
Significance	***	***

(Note: * p<0.1, ** p<0.05, *** p<0.01)

(5) The effects of risk management strategies on robustness

Hypothesis 6:

Risk management strategies have a significant positive impact on logistics robustness.

H6a: SL strategy has a significant positive impact on robustness.

H6b: LI strategy has a significant positive impact on robustness.

H6c: OC strategy has a significant positive impact on robustness.

H6d: LC strategy has a significant positive impact on robustness.

H6 investigates as to whether risk management strategies can generate positive outcomes in international logistics operations by heightening the level of logistics robustness. Robustness means the preparedness of logistics to minimise the risk occurrence and to absorb negative impacts. PLS-SEM produced both direct and total effects of the strategies in consideration of mediating effects of SL strategy and LI strategy on OC strategy and LC strategy. As seen in Table 6-31, all four strategies have direct and positive effects on logistics robustness. When total effects are taken into account (see Table 6-32), the standardised path coefficients of OC and LC strategies are significantly increased due to mediating effects through SL and LI strategies. Therefore, it can be concluded that the H6 is supported, showing that proposed strategies create logistics robustness.

Table 6-31: Direct effects and hypothesis testing (H6)

Hypothesis	H6a	H6b	H6c	H6d
Relationship	SL ➔ RB	LI ➔ RB	OC ➔ RB	LC ➔ RB
Path coefficient	0.278	0.178	0.190	0.286
T-statistic	3.855	2.311	1.919	3.147
Significance	***	**	*	***

(Note: * p<0.1, ** p<0.05, *** p<0.01)

Table 6-32: Total effects and hypothesis testing (H6)

Hypothesis	H6a	H6b	H6c	H6d
Relationship	SL ➔ RB	LI ➔ RB	OC ➔ RB	LC ➔ RB
Path coefficient	0.278	0.178	0.283	0.374
T-statistic	3.855	2.311	2.816	4.246
Significance	***	**	***	***

(Note: * p<0.1, ** p<0.05, *** p<0.01)

(6) The effects of risk management strategies on resilience

Hypothesis 7:

Risk management strategies have a significant positive impact on logistics resilience.

H7a: SL strategy has a significant positive impact on resilience.

H7b: LI strategy has a significant positive impact on resilience.

H7c: OC strategy has a significant positive impact on resilience.

H7d: LC strategy has a significant positive impact on resilience.

H7 also focuses on the outcomes of risk management strategies, but rather on logistics resilience. As outlined in Chapter 5, resilience is related to the capability to respond to and recover from logistics disruptions so that the logistics network bounces back to the normal process. Through H7, the positive impacts of risk management strategies on logistics resilience can be tested. The analysis results comprise of the direct effects and total effects due to mediating effects. The direct effects in Table 6-33 indicate that SL, LI and LC strategies have positive and strong impacts on logistics resilience. On the contrary, OC strategy has no significant effect on resilience. In the total effects (see Table 6-34), OC showed no significant relationship with resilience, whereas both SL and LC strategies have strong path coefficients over 0.37.

Table 6-33: Direct effects and hypothesis testing (H7)

Hypothesis	H7a	H7b	H7c	H7d
Relationship	SL → RS	LI → RS	OC → RS	LC → RS
Path coefficient	0.370	0.191	-0.020	0.278
T-statistic	4.282	2.445	0.185	2.636
Significance	***	**	NS	***

(Note: * p<0.1, ** p<0.05, *** p<0.01)

Table 6-34: Total effects and hypothesis testing (H7)

Hypothesis	H7a	H7b	H7c	H7d
Relationship	SL → RS	LI → RS	OC → RS	LC → RS
Path coefficient	0.370	0.191	0.103	0.372
T-statistic	4.282	2.445	0.993	3.845
Significance	***	**	NS	***

(Note: * p<0.1, ** p<0.05, *** p<0.01)

6.4.2.3. R^2 and Q^2 values

PLS-SEM produces results to maximise the R^2 value which is measured by the squared correlation coefficients between the predicted value and the actual value of an endogenous construct. The R^2 value is thus often used as a primary coefficient of determination of structural models because it suggests to what degree the variance of an endogenous variable was explained by the model. When it comes to outcome variables, 66.4 percent of robustness and 52.8 percent of resilience were explained by this model. As for risk management strategies, more than 50 percent of intra-firm strategy constructs can be explained by the model, whereas the R^2 values of inter-firm strategies were marginally below 0.5. These relatively low values are mainly due to the deficient number of variables that intend to explain the inter-firm strategies compared to those for intra-firm strategies and outcomes. As far as the parsimonious is concerned, these R^2 values are also acceptable.

Stone-Geisser's Q^2 value is an indicator which illustrates the model's predictive relevance as to whether the model accurately predicts the data points of scale items within endogenous variables (Geisser 1974; Stone 1974). Q^2 values above 0 indicate that the structural model has predictive relevance to the endogenous variables. Q^2 value was calculated by using the 'cross-validated redundancy approach'. Blindfolding with the omission distance 7 was applied to finding out the Q^2 value for each endogenous variable. The results show that Q2 values of all endogenous variables well exceeded the threshold of 0, which proves that the model has predictive relevance.

Table 6-35: R^2 and Q^2 values of endogenous variables

	Risk Management Strategies				Outcomes	
	SL	**LI**	**OC**	**LC**	**Robustness**	**Resilience**
R^2	0.584	0.578	0.447	0.433	0.664	0.528
Q^2	0.321	0.487	0.340	0.315	0.532	0.450

6.4.2.4. Effect Sizes (f^2 and q^2)

Based on the R^2 and Q^2 values, the scale of the effect sizes can be also calculated by f^2 and q^2. These two effect sizes commonly evaluate the contribution of an exogenous variable to the R^2/Q^2 value of an endogenous variable. Along with the standardised path coefficients, these values can describe the effects of exogenous variables on an endogenous variable, thus Table 6-39 summarised the path coefficient, the f^2 value and the q^2 value of each exogenous variable in relations to an endogenous variable. As a rule of thumb, the f^2 and q^2 values of 0.02, 0.15 and 0.35 indicate the small, medium and large effects respectively.

Firstly, building a stable logistics network (SL) strategy was largely influenced by customer orientation (CO) and leveraging outsourcing contracts (OC) strategy whose standardised coefficients are 0.604 and 0.333 respectively with the medium f^2 and small q^2 effect sizes. Secondly, leveraging logistics information (LI) strategy was primarily affected by developing logistics collaboration (LC) strategy (β = 0.492, f^2 = 0.325, q^2 = 0.224), but also significantly determined by customer orientation (CO) and quality orientation (QO). The significant effects of LC strategy on LI strategy are evident because the quality and timeliness of logistics information largely depend on the level of logistics collaboration with the partners which are proximate to the information sources.

Table 6-36: f^2 and q^2 effect sizes for endogenous variables

Endogenous construct	Exogenous constructs	Path coefficients	f^2 effect size	q^2 effect size
SL	DO	0.104	0.003	-0.017
	CO	0.604	0.190	0.048
	QO	0.092	0.007	-0.014
	OC	0.333	0.146	0.037
LI	DO	0.111	0.002	-0.005
	CO	0.470	0.062	0.038
	QO	0.203	0.027	0.017
	LC	0.492	0.325	0.224
OC	DO	0.165	0.026	0.024
	CO	0.501	0.231	0.154
	QO	0.091	0.012	0.008
LC	DO	0.151	0.022	0.012
	CO	0.454	0.185	0.112
	QO	0.170	0.041	0.024
RB	SL	0.278	0.107	0.061
	LI	0.178	0.035	0.026
	OC	0.283	0.041	0.027
	LC	0.374	0.093	0.063
RS	SL	0.370	0.136	0.103
	LI	0.191	0.028	0.022
	OC	0.103	0.000	0.000
	LC	0.372	0.064	0.045

Thirdly, leveraging outsourcing contracts (OC) strategy has customer orientation (CO: $\beta = 0.501$, $f^2 = 0.231$, $q^2 = 0.154$) as the main driver, while disruption orientation (DO) has a moderate effect on the strategy.

Fourthly, developing logistics collaboration (LC) strategy was influenced by all three organisational orientations suggested although customer orientation (CO) showed outstanding effects ($\beta = 0.454$, $f^2 = 0.185$, $q^2 = 0.112$) among them.

Fifthly, robustness (RB) and resilience (RS) of logistics networks are determined by the level of implementing risk management strategies. Among those strategies, the path coefficients, f^2 values and q^2 values of LC strategy and SL strategy are notable, whereas OC strategy has no effect on resilience when f^2 and q^2 values are taken into account. This can explain the reason why the degrees of implementation of SL and LC strategies were higher than the level of implementation of other strategies as shown in Table 6-5.

6.5. Discussion

The descriptive statistics, ANOVA and PLS-SEM results in the previous sections point towards several topics for discussion with respect to risk mitigation strategies for international logistics. The strategies were generated to mitigate the self-enhancing risks within international logistics operations, particularly relating to information and relationship risks. To this end, the strategic framework adopted information processing theory including the consideration of both intra- and inter-firm strategies. A literature review of SCRM studies combined with 11 interviews about 8 case companies conceptualised and populated the strategies with industry practices. The research model of this thesis incorporated organisational orientations as enablers of the strategic implementation as well as logistics robustness and resilience as desired outcomes of the strategic implementation. It was analysed in a predictive manner by PLS-SEM along with producing descriptive statistics and ANOVA results. This section will discuss the findings more comprehensively to derive several implications.

6.5.1. The selective effects of organisational orientations

This thesis has designed a research model to investigate the relationships between organisational orientations and risk management strategies. Three organisational orientations, therefore, were selected as the antecedents that stimulate the implementation of risk mitigating strategies. Although the hypotheses assumed that the three kinds of corporate culture could motivate four proposed strategies, it is important to note that the hypotheses were created not by the confirmatory purpose, but by the predictive purpose. Thus, H1 to H3 were designed to look at which organisational orientations have an impact on which risk management strategies. The findings showed that some orientations had no effects on certain strategies. For instance, disruption orientation (DO) had no relationships with intra-firm strategies (H1a and H1b) while quality orientation (QO) could not affect the strategies to reduce information processing needs (H3a and H3c). Contrarily, customer orientation (CO) appeared to make a positive influence on all risk management strategies.

Customer orientation is built upon the understanding of and response to customer needs (Chen and Paulraj 2004; Braunscheidel and Suresh 2009), which can ensure customer satisfaction with logistics performance and quality. The customer-driven culture enables firms to implement proactive and reactive initiatives to provide reliable and responsive logistics operations. Thus, firms first devise a disciplined but flexible logistics network which can meet the customer needs even in case of disruptions (SL Strategy). To achieve a stable network, the roles of supply chain partners who take part in logistics functions are also very important. The outsourcing contracts (OC strategy), therefore, should be very delicately written to maintain the disciplines while providing flexibility to international logistics operations. Customers often require precise logistics information in order to manage inventory and manufacturing. Firms with customer focus respond to this requirement by timely updating logistics information using platforms to collect, process and disseminate information (LI strategy). As the majority of logistics information originates external organisations such as trade and logistics partners, logistics collaboration is a necessity for these firms. Moreover, since the customer is also the subject of logistics collaboration, firms with customer orientation strive to create a strong relationship with the customer (LC strategy). In consideration of path coefficients, f^2 and q^2 effect sizes, customer orientation is the most prominent stimuli which have great impacts on risk management strategies.

The analysis result of disruption orientation showed the limitations of this orientation's effects to inter-firm strategies (OC and LC strategies). In fact, the result that there are no relationships between disruption orientation and intra-firm strategies (SL and LI strategies) is not quite consistent with the previous research. Since disruption orientation is closely related to the awareness of risks which alerts firms to be prepared for probable risks, it is known to draw internal reactions and responses from a firm (Bode *et al.* 2011; Kern *et al.* 2012). Nonetheless, it needs to be highlighted that intra-firm strategies require expensive initiatives with managerial decisions on the investment of corporate resources. On the contrary, inter-firm strategies consist of relatively inexpensive practices whose costs can be included in the outsourcing contracts (OC strategy) or can be shared with partners (LC strategy). The cost of implementing risk management measures have been argued as a critical issue because the benefit is materialised only after disruption occurs. In particular, the low-frequency characteristics of international logistics risks may deter firms from investing financial and human resources into risk management initiatives at the intra-firm level. This posits that disruption orientation may not draw the need for the necessary investment for risk management. Rather, the organisational culture emanating from pressures on revenue and profit, such as customer orientation, can motivate firms to execute the investment for risk management.

Quality orientation emphasises the culture where firms prioritise logistics quality to logistics price. In the analysis, quality orientation showed positive relationships with the strategies to enhance information processing capability (LI and LC strategies), but no significant relationships with the strategies to reduce information processing needs (SL and OC strategies). From this result, it can be inferred that the pursuit of logistics quality will lead to the pursuit of capability in risk management. Indeed, having an integrated information system and knowledge management based on logistics information was regarded as the key evidence of logistics quality in the case study interviews. In addition, this capability can be transferrable to other supply chain areas beyond international logistics operations. The collaboration with partners can secure the quality performance, reliability and flexibility from partners, which eventually enhance the focal company's capability to meet the logistics quality.

6.5.2. The effects of risk management strategies on desired logistics networks

The research model and hypotheses also tested the relationships between risk management strategies and their desired outcomes represented by robust and resilient logistics networks. As the associations of these two aspects are straight-forward, this part of the research model was designed to confirm the hypotheses.

The hypothesis testing revealed that risk management strategies have positive impacts on robustness and resilience except for OC strategy whose impact is not valid on the resilient logistics networks. To understand this conclusion, the characteristics of OC strategy and resilience should be evaluated first. OC strategy reduces the need for information processing by regulating the outcomes and behaviours of a firm's suppliers in order to minimise the occurrence of risks from the suppliers, thereby reducing the firm's overall risk level. This is a pre-defined and proactive strategy which should be implemented from the commencement of outsourcing contracts. The auditing and monitoring is also conducted according to the agreed level of operations and performance. This strategy, in essence, focuses on controlling the initial risk impact to the minimum level, whose effects on robustness is well presented in Table 6-32.

However, this strategy is not closely related to the capability to respond to or recover from disruptions at which resilience primarily aims because risk events never allow such time for the amendment of existing contracts to enhance capability. OC strategy often encompasses a practice to force suppliers to get involved in disruptions at the early stage and to transfer the risks to suppliers, but their scope of activities and responsibilities have definite limitations because they often play just a small portion of functions within the entire international logistics operations. In this regard, focal company takes the responsibility of ultimate outcomes from subsequent risks centred on distorted information through the logistics network and damaged relationships with its partners. Both SL and OC strategies aim for a disciplined process in international logistics to enhance logistics robustness; however, SL strategy also targets solution flexibility with many alternatives at hand, whereas OC strategy is only valid to control an individual alternative.

This finding provided another important insight regarding relationship management. Relationship management can have a spectrum from arm’s length relationship via collaboration to vertical integration (Kampstra *et al.* 2006). OC strategy is, in its nature to control the suppliers, based more on transactional relationships than on collaborative relationships. The comparison of OC strategy and LC strategy sheds light on the effects of these two strategies on risk management because, whereas OC strategy only affects robustness, LC strategy has positive impacts both on robustness and resilience. It means that any type of relationship, if the partners clearly aim at risk management, can be effective to manage the initial impact from a disruption by reducing risk chance or impact, but subsequent risk impact can be mitigated only by the relationships based on collaboration. Thus, it is not surprising that collaborative measures, such as Collaborative Planning Forecasting and Replenishment (CPFR), Efficient Consumer Response (ECR), Vendor Managed Inventory (VMI), Collaborative Transportation Management (CTM) and Continuous Replenishment (CR) (Esper and Williams 2003; Holweg *et al*, 2005), have the features of both proactive and reactive risk management that can enhance resilience as well as robustness within the supply chain.

Chapter 7

Conclusions

The primary objective of this thesis was to investigate the risk management strategies for international logistics that can break a self-enhancing risk spiral and achieve a desirable logistics network. To achieve this purpose, this study (1) identified and analysed various risks in international logistics operations, and then (2) examined the strategies for managing these risks (3) in relations with organisational orientations and robustness/resilience. This research, in nature, is a multi-phase mixed method study which consists of three interconnected research phases. The first phase of this research was the combination of exploratory and analytic study, mainly aiming at the profiles of international logistics risks, risk clusters and the risk structure concerning interactions between risk clusters (Chapter 4). The second phase was another exploratory study using case study interviews and a literature review to develop a framework for risk management strategies to mitigate international logistics risks and to propose hypotheses regarding the relationships between organisational orientations, risk management strategies and their desired outcomes represented by robustness and resilience (Chapter 5). The last phase aimed not just to test suggested measurement and structural models by the PLS-SEM technique, but also to demonstrate the level of strategic implementation subject to corporate contingencies (Chapter 6).

7.1. Research Findings

From the literature review in Chapter 2, several research gaps were identified. The primary research gap was in the area of the application of supply chain risks to international logistics risk, where networks and processes are more complex than domestic supply chains may have.

The second research gap was the need for holistic and systematic risk analysis because existing risk identification and analysis has tended to provide independent risk concepts without considering interconnectedness and interconnections of risk factors. The third was the risk management at a strategic level in consideration of empirical evidence and generalisability based on established theories. The fourth gap was related to the business contexts affecting the implementation of risk management strategies while the last was about the consequences of risk management strategies.

The research questions of this study were developed to address these research gaps, which are as follows:

RQ1: What are the risk areas to be managed in international logistics?

RQ1a: What are the risks in international logistics operations?

RQ1b: How are these risks understood by using clustering?

RQ1c: How are these risk clusters interacting with each other?

RQ2. How can a firm effectively manage risks in international logistics?

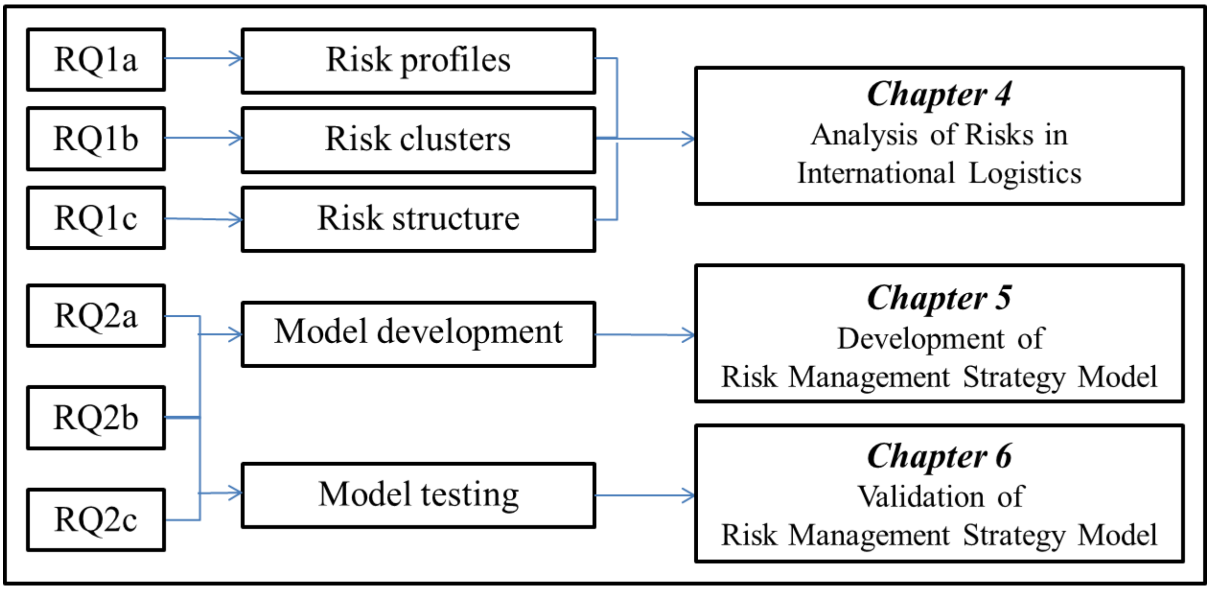
RQ2a. What are the main risk management strategies to be considered?

RQ2b. Which factors can facilitate implementation of these risk management strategies?

RQ2c. Can these strategies generate positive outcomes for the logistics network?

When it is considered that the risk management process consists of risk identification, risk analysis and risk mitigation, RQ1 was concerned with identification and analysis of international logistics risks, whereas RQ2 focused more on risk mitigation. Figure 8.1 illustrates how the research questions were addressed in each chapter.

Figure 7-1: The flows of research questions



7.1.1. Risk identification (RQ1a and RQ1b)

RQ1a: What are the risks in international logistics operations?

Focus group discussions of 30 practitioners and 6 academics revealed that international logistics operations have risk factors in common with supply chain risks, but also have unique risk factors that can be differentiated from supply chain risks. In particular, the liner shipping market and operational practices appeared to generate unique threats to international logistics. In addition, long lead-time and the distance between trade partners created distortion to information which is necessary for smooth logistics operations. Moreover, various entities involved in international logistics can generate fresh risks areas in inter-organisational relationships. In total, 88 different risks were found to reside in international logistics operations (see Table 4-1).

RQ1b: How are these risks understood by using clustering?

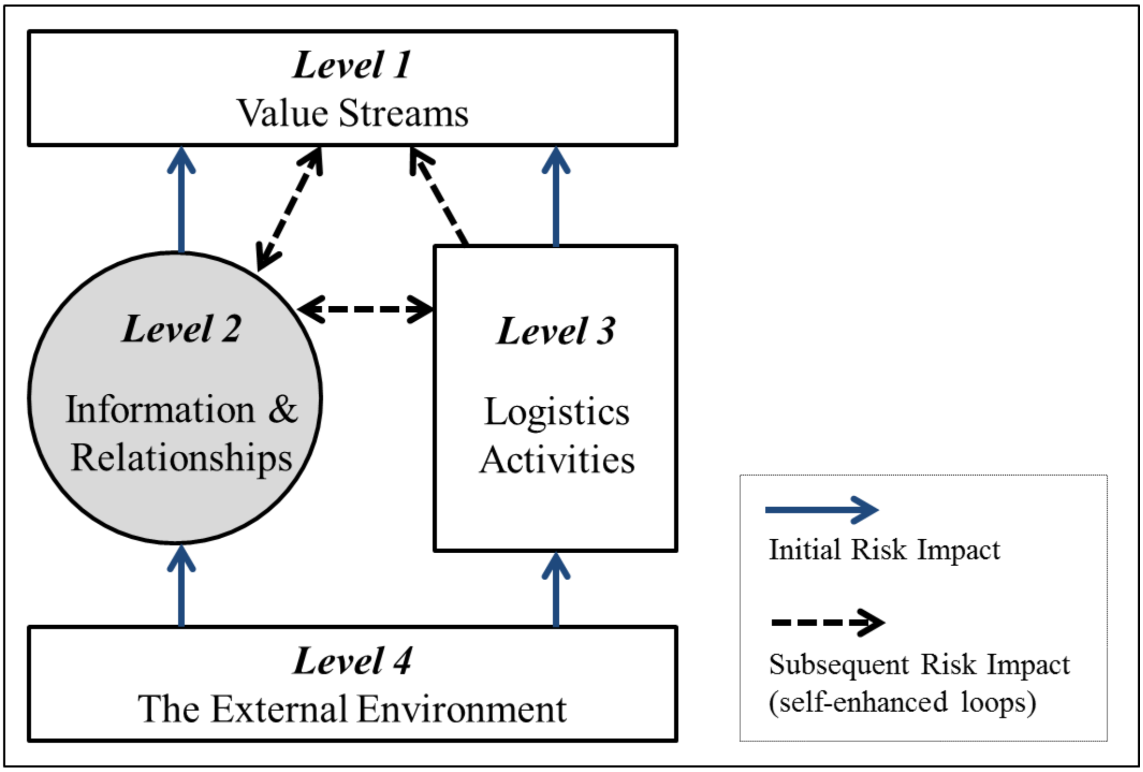
The focus group discussions showed that there were two patterns in clustering international logistics risks: the first was risk sources and the second was loss types. The features of international logistics risks can be clearly understood by these two clustering patterns. Risk sources comprised of external environment, trade partners, logistics service providers and control systems, which delineate the areas from which risk events can arise. Loss types, on the other hand, were specified into time loss, cost loss and product loss. 20 risk clusters were generated with intertwining these two risk dimensions, thereby suggesting a framework to understand the risks in international logistics. The complete list of the 88 risks and 20 risk clusters can be seen in Table 4-4.

7.1.2. Risk analysis (RQ1c)

RQ1c: How are these risk clusters interacting with each other?

Although risk clusters provide decent understandings of the risks, this kind of taxonomy, in its nature, depends on the differences between elements rather than their interactions and interconnectedness. As the previous research showed the same limitation as the taxonomy approach has, this study sought the interactions between the risk clusters. To this end, interpretive structured modelling was adopted to look at the interactions between 20 risk clusters that were found in the focus group research. A total of 8 logistics experts were invited to decide the relationships between risk elements, which was analysed by the interpretive structured modelling technique. The initial model was developed upon 16 risk clusters except four risk clusters relating to information and relationship because these four clusters created excessive transitivity. The final model topped up these risk clusters on the initial model, as shown in Figure 4-12. The initial 16 risk clusters had one-way interactions from external environments risks via risks relating to trade partners or logistics service provider risks to time/cost/product losses. On the contrary, the latter 4 clusters fostered dynamic interactions between risk clusters with generating self-enhancing loops of risks.

Figure 7-2: Interactions of the four levels in international logistics risks



(Source: Author)

RQ1: What are the risk areas to be managed in international logistics?

Now the research question has returned to the overarching and primary objective of risk identification and analysis: how international logistics risks can be understood and what risks must be managed as the main priority? Based on Peck's (2005) model and the ISM-based model, this study proposed four levels in international logistics risks: (1) Level 1 – value streams; (2) Level 2 – information and relationships; (3) Level 3 – logistics activities; and (4) Level 4 – the external environment. As Sheffi and Rice (2005) argued, once a disruption occurs, several waves of risks influences logistics operations. The impact of initial risks can be minimal, but the subsequent impacts can be immense. This research points out that the risks relating to information and relationships (Level 2) is the main cause of self-enhancing loops of risks that facilitates the second and third waves of risk impacts, as shown in Figure 7-2. Therefore, it was concluded that managing information and relationships in international logistics operations is necessary to break the risk spiral from subsequent risk impact as well as to alleviating the initial risk impact. It was also important for Level 3 risks because the formulation of appropriate relationships can regulate the logistics activities of external organisations, such as trade partners and logistics service providers.

7.1.3. Risk management strategies (RQ2a)

RQ2a. What are the main risk management strategies to be considered?

This research adopted information processing theory to develop risk management strategies which can adequately respond to risks relating to information and relationships. Although information processing theory consists of two main strategies in relation to narrowing the gap between information processing needs and information processing capability, this study added one more dimension, intra-/inter-organisational strategies, to the existing theory. Given the 2X2 matrix, four types of risk management strategies were conceptualised. In order to understand the strategies and practices to manage risks in international logistics, the framework was further conceptualised and populated by a literature review as well as case study interviews with 11 logistics practitioners from 8 companies. As a result, it revealed that firms involved in international logistics operations can selectively implement four basic strategies, which are (1) building a stable logistics network, (2) leveraging logistics information, (3) leveraging outsourcing contracts and (4) developing logistics collaboration. It also suggested risk mitigating practices to serve these strategies. The descriptive analysis of the survey data from 174 companies showed that the building a stable logistics network strategy was implemented most frequently, which was closely followed by the developing logistics collaboration strategy and the leveraging outsourcing contracts strategy. On the contrary, the leveraging logistics information strategy fell behind other strategies due to its requirements for heavy investment in the form of financial and human resources.

7.1.4. Antecedents and outcomes of risk management strategies (RQ2b and RQ2c)

RQ2b. Which factors can facilitate implementation of these risk management strategies?

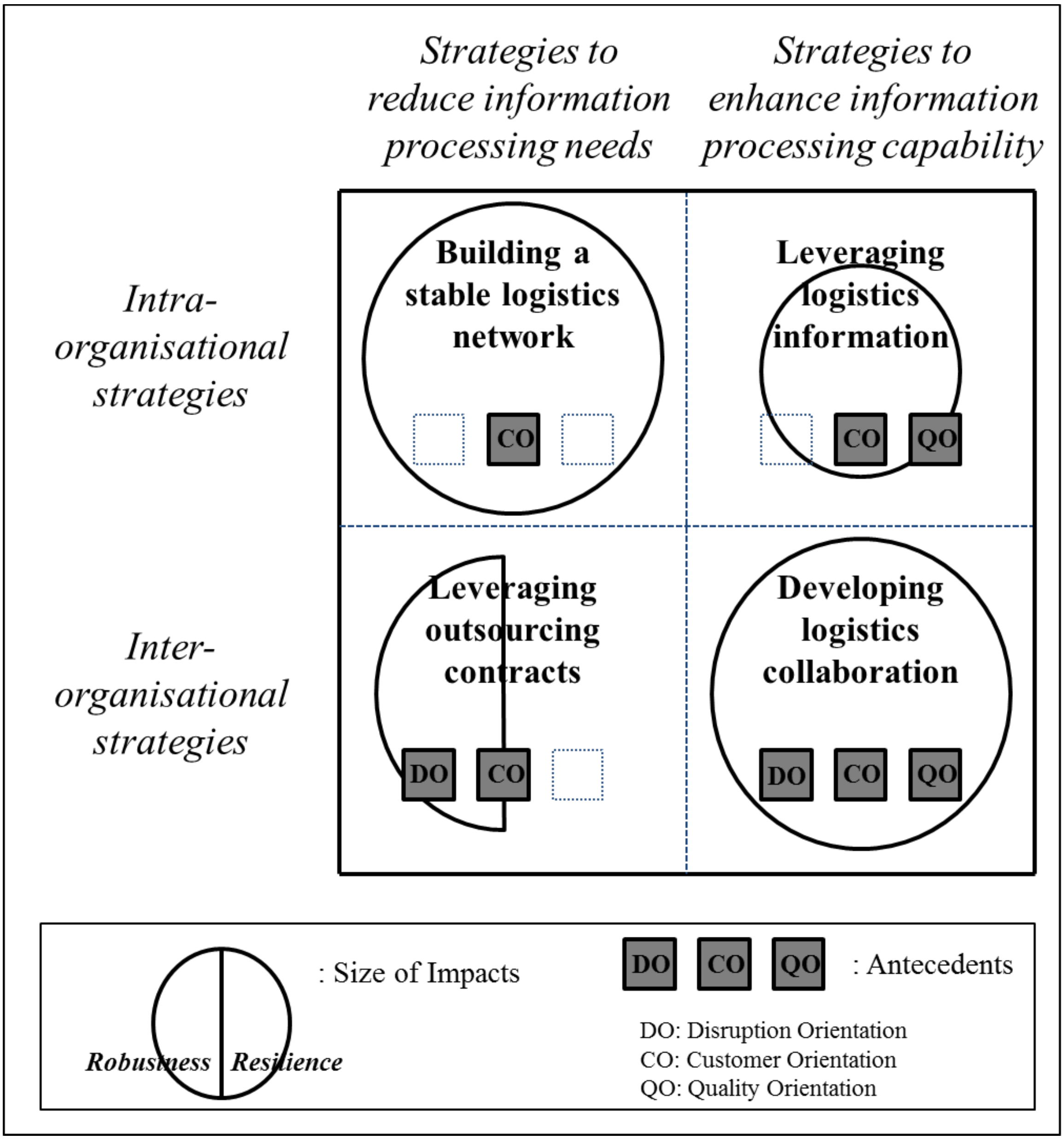
RQ2c. Can these strategies generate positive outcomes for the logistics network?

As the antecedents of risk management strategies, this study focused on organisational orientations which can facilitate the implementation of risk management strategies. As a result, disruption orientation, customer orientation and quality orientation were derived from the literature review and interviews. In addition, several contextual contingencies, such as industry, firm size and available resources. The desired outcomes of risk management strategies comprised of robustness and resilience in the logistics networks, whose conceptual differences and operational definitions were also delineated in this study. In particular, it is argued that robustness is associated with the initial impact of risks with resilience being related to the subsequent risk impacts.

To find out the positive relationships between organisational orientations, risk management strategies and robustness/resilience, a structural model with seven hypotheses was developed and tested by the partial least square structural equation modelling (PLS-SEM) technique. The analysis of the survey data from 174 companies demonstrated that organisational orientations stimulate the implementation of different risk management strategies because disruption orientation had a positive impact on intra-organisational strategies with quality orientation influencing capability-enhancing strategies. On the other hand, customer orientation positively affected all four risk management strategies. When it comes to the influence of contingencies, analysis of variance (ANOVA) was applied. Although three contingencies used in this study proved to create differences between groups, the effect of available resources generated the most significant differences.

As for the relationships among risk management strategies, inter-organisational strategies appeared to have an impact on intra-organisational strategies given the way it deals with the information processing gap. Lastly, implementation of risk management strategies had positive effects on robust and resilient logistics networks, except the leveraging outsourcing contract strategy which had no impact on resilience. Figure 7-3 describes these research findings in a graphical manner. In this figure, the size of a circle shows a strategy's size of impact on robustness and resilience: robustness is represented by the left hemisphere while resilience is represented by the right hemisphere. For instance, it can be interpreted that leveraging outsourcing contracts has a medium effect size for robustness, but no effect on resilience. Likewise, the active squares in each strategy indicate the organisational orientations that affect risk management strategies.

Figure 7-3: Findings from PLS-SEM analysis



(Source: Author)

RQ2. How can a firm effectively manage risks in international logistics?

The effectiveness of risk management strategies on creating robust and resilient logistics networks was evaluated in this study by path coefficients with t-statistic, f^2 effect size and q^2 effect size. As can be seen in Figure 7-3, the strategies to build a stable logistics network and to develop logistics collaboration appeared to be the most effective in augmenting both robustness and resilience in the logistics network. The strategy to leverage logistics information also had positive impacts on both robustness and resilience, but its impact was relatively small compared to the previous two strategies. On the contrary, the strategy to leverage outsourcing contracts can make a significant influence only on robustness. These results demonstrate the strategic priority in implementing risk management strategies if a firm's resources are constrained. In particular, the dependence solely on the strategy to leverage outsourcing contracts needs to be avoided. From the f^2 and q^2 sizes, however, it can be also inferred that factors other than risk management strategies, such as operational excellence or capabilities, may influence the level of robustness or resilience.

Fostering certain types of organisational orientations appeared to be effective in stimulating the implementation of risk management strategies. In particular, customer orientation had positive impacts on all four strategies, which is because this orientation makes firms strive to reduce customers' complaints arising from disturbances or disruptions to their operations or to follow customers' requirements to create more desirable logistics networks including risk management. On the other hand, disruption orientation had effects on inter-organisational strategies while quality orientation had effects on the strategies to enhance information processing capability. Therefore, firms intending to strengthen their level of risk management are advised to primarily cultivate customer orientation.

7.2. Research Implications

Application of three phases of risk management to international logistics operations provided abundant insights into how risks in international logistics can be understood and how firms involved in international logistics can effectively mitigate these risks. As a consequence, this research has produced quite a number of theoretical, methodological and managerial implications.

7.2.1. Theoretical implications

The first theoretical implication is that this research is the first study which has applied three risk management processes to international logistics. Although there have been studies on logistics or maritime transport, their research scope was constrained to a specific mode or a certain phase of risk management, thus lacking a holistic view of risk management (Tang and Musa 2011; Ghadge *et al.* 2012). This research assumed the multimodal transport centred on liner shipping and various entities involved in international logistics, thereby highlighting risks amplified by information and relationship issues as well as illuminating the importance of inter-organisational risk mitigating measures. In addition, a number of unique risks specific to international logistics were explored by this research.

Secondly, it suggested four levels of risks that differentiated ILRM from SCM. The levels of risks, derived from the interpretive structured modelling, are a stand-alone important finding which can enrich the understanding on the international risks. However, it also unpacks how the consideration of risk management can reshape supply chain management. As supply chain management, by definition, concerns the flows of material, finance and information simultaneously (Tang 2006), some SCRM studies have taken the same stance that placed the threats to material, finance and information at the same risk level as types of losses (Peck 2005). Although this could be an intuitive deduction from SCM knowledge, empirical findings of this study suggested that the information flow must be treated differently from the material and finance flows. Indeed, risks related to information flows are not the consequence of other risk events, but rather the facilitator of subsequent risk impacts by creating multiple self-enhancing risk loops. In addition, this research revealed that relationships with external organisations have similar effects on the risk structure, therefore managing information and relationships should take priority in risk management particularly when a multitude of entities is involved in the operations.

Thirdly, a framework for risk management strategies was suggested based on information processing theory (Galbraith 1973), a rigorous literature review as well as empirical findings from case study interviews. This framework comprises of two dimensions, namely the treatment of information processing gap and intra-/inter-organisational strategies, which can effectively respond to risks arising from the failure in information and relationships. In addition, it explored the practices for each strategy fostering a set of comprehensive knowledge on risk management strategies. The set of strategies and practices was empirically validated by the test of measurement models similar to confirmatory factor analysis. This process overcame the research gap in the previous research by developing an empirical and theory-based strategy framework which can embrace various operational/tactical risk management initiatives in a systematic manner. The framework was created in the context of international logistics risk management, but can be also applicable to supply chain risk management. In these circumstances, risk management strategies in this research expanded discussions on supply chain risk management strategies (i.e., Bode *et al.* 2011) and on global supply chain risk management strategies (i.e, Manuj and Mentzer 2008a; 2008b).

Fourthly, several mechanisms behind the implementation of risk management strategies were examined in this research. Specifically, this study used three organisational orientations (Chen and Paulraj 2004; Braunsheidel and Suresh 2009; Bode *et al.* 2011) and several business contexts to investigate how they are related to risk management strategies. Although they are just a small number of factors compared to the possible factors that are expected to affect the strategic implementation, their effects on each risk management strategy are now empirically validated by a large-scale survey. The findings can be a stepping stone for further research because they suggest corporate features and cultures that a firm needs to possess for risk management.

Fifthly, this research revisited the definitions and operationalisation of robustness and resilience, and then conceptualised those capabilities highlighting their distinctive features. Although the two concepts are often used interchangeably in SCRM research, their differences have been also acknowledged by some researchers (Ponomarov and Holcomb 2009; Klibi *et al.* 2011; Spiegler *et al.* 2012). This study further developed the conceptualisations based on Rice and Sheffi's (2005) risk impact model, in consideration of the factors like risk impact, time, risk speed and risk tolerance. Therefore, the distinctions between these robustness and resilience were highlighted and also tested by the measurement model tests. The scale items for these two risk management outcomes can also be easily applied to future quantitative research on SCRM.

Lastly, the results can be applicable to better understanding of SCM and SCRM. Many SCM literature emphasised the importance of information and relationships in supply chains, but didn't have empirical grounds to support the idea in risk management views. This study revealed the crucial roles of information and relationships in risk management, thus will provide theoretical reinforcement for SCRM, supply chain collaboration, supply chain integration and supply chain ICT studies. In addition, the relationships between organisational orientations and risk management strategies may become the grounds for future research on organisational orientation investigating multi-faceted outcomes of these orientations. The constructs used in this research can be easily transformed into SCRM, which can foster empirical research based on large-scale survey.

7.2.2. Methodological implications

The first methodological implication is that this work combined empirical and analytical research techniques to capture the real shape of international logistics risks. The creative combination of focus group and interpretive structured modelling methods maximised the explanation power of the proposed risk structure because it analysed the empirically-driven elements in a systematic manner. It is a big difference from previous research which used elements from literature review. Also, this study invited a group of experts to decide contextual relationships, which is also a unique point because those relationships were decided by researchers in the previous studies. The result has graphically and systematically demonstrated the interactions of international logistics risks, which can provide empirical evidence to the concept of the risk spiral or the vicious circle of risks. Therefore, findings from focus group discussions were closely interconnected while the interpretive structured modelling was able to have empirical grounds. There have been a handful of studies using focus group and a few studies using ISM, but this study is the first attempt to mix these two methods to investigate the risk structure.

The second is that PLS-SEM was adopted to examine the relationships centred on risk management strategies. PLS-SEM has not been used very often in SCRM research which was mainly led by qualitative studies. As delineated in the comparisons between two SEM techniques, PLS-SEM has advantages when some predictions of the effects are required in a research model, such as the effects stemming from corporate contingencies and contexts on risk management strategies. This research can provide guidance for future research which will use this technique in the context of risk management.

Last but not least, this research covered all risk management phases using a multi-phase research method. It showed the applications of both qualitative and quantitative research methods within positivism paradigm by amalgamating advantages that each method possesses. In particular, the linkages between different methods were clearly suggested to figure out a holistic risk management approach. Companies can follow the series of research methods proposed in this research to find out critical risks in their organisations' logistics operations, the current status of their risk management practices and the future directions for mitigating critical risks.

7.2.3. Managerial implications

Managerial implications can be also drawn from this study. Firstly, the profile of international logistics risks will enable managers to anticipate and proactively deal with potential risks. The risks mentioned in this research are not completely exhaustive but still very meaningful because they are explored by practitioners from different industries involved in international logistics. Although inbound and outbound international logistics process might be a small portion of the entire supply chain, its importance cannot be underestimated because international logistics operations are often the weakest link of the supply chain due to lack of information and control.

Secondly, four risk sources (trade partners, logistics service providers, control systems and external environment), three loss types (time, cost and product) and twenty risk clusters can provide a guideline to managers in investigating risks of their daily logistics operations. With individual or collective efforts, they can explore risk factors residing in each category. In this way, they can reach the root causes of their current and future disruptions, which can be the foundation of their risk management.

Thirdly, this study highlighted the importance of the relationships with trade partners and logistics service providers because they play a great role not just in amplifying international logistics risks but also in mitigating the risks. In particular, measures to maintain the logistics reliability of the partners and to develop collaboration are highlighted as the primary risk management strategies. Firms can investigate their definition of relationships reflecting the risk management practices proposed in this study, and thus achieve positive risk management performance.

Fourthly, firms involved in international logistics can evaluate the current status of their risk management efforts with the risk management strategies and practices suggested in this study, and then benchmark some of them. Four strategies (Building a stable logistics network, Leveraging logistics information, Leveraging outsourcing contracts and Developing logistics collaboration) and 19 practices were explained with practical examples from case companies, which provide practical ideas as to how the firms can reduce risks. It will also be important for firms to reach a consensus on their direction of risk management with their trade and logistics partners in reflection of this list of practices.

Fifthly, the research suggests that firms should carefully consider risk management strategies because their effects on risk management vary slightly. In general, the strategies to build a stable logistics network and to develop logistics collaboration are effective to fulfil both robustness and resilience. Companies with short business history or resources, therefore, may focus on these two strategies first, and then incorporate the other two strategies. Heavy investment into contract management systems and integrated information systems needs to be done carefully if they mainly aim at risk management because their effects on risk management are limited compared to the previous two strategies.

Lastly, organisational orientations were emphasised in this research to enhance risk management strategies leading to risk management capabilities. Customer focus and awareness is a good starting point for a firm to consider possible risk areas and their consequences in the logistics process. From the customer's point of view, companies can easily detect risks undermining their operations and have strong rationale to rectify the issues despite the needs for financial investment and top management's supports. Disruption awareness within an organisation also provides a chance to review the international logistics network and enables firms to develop robust inter-firm relationships. Quality orientation does not just augment the operational performance of a firm's logistics, but also increases information processing capacity by initiating necessary investment in the logistics quality. Firms striving for risk management culture can implant these orientations first to achieve effective international logistics both in operational performance and in risk management performance.

7.3. Limitations and Future Research

The limitations of this study will open avenues for future research relating to risk management.

Firstly, the process of risk identification and analysis can be replicated in other supply chain functions, such as warehousing and procurement. Since this study focused only on international logistics out of a variety of functions in supply chain management, the findings may be very specific to the international logistics contexts. The application of the same research process to other areas will broaden the knowledge on supply chain risk management. In addition, the comparisons of ISM-based models between the functions will enhance the understanding of conflicting goals within supply chain operations, thus making it possible to implement an overarching strategy that can mitigate the risks across various functions in the supply chain.

Secondly, the variation to the construction of focus groups may result in more abundant knowledge. This study used industry groups without mixing up the participants. Mixed group, however, may facilitate further discussions about risk factors which the same group of people may overlook because they just take them for granted. Moreover, although this study invited participants from exporters, importers, international freight forwarders, liner companies, 3PL service providers and academics, other sectors in international logistics, such as inland transport service providers, terminal operators and customs may also be invited to future research to provide a more comprehensive picture of international logistics risks.

Thirdly, cross-validation of the structural model can be possible by widening the geographical scope of the research. This study investigated risk management by firms in South Korea. Even though South Korean firms are a good sample to test the model when their volume of international trade and logistics is taken into account, cross-validation of the model by other geographical areas will ascertain the general application of the research model and findings. In particular, a comparative analysis between countries with small and large international trade volume will provide fresh insight into the development of risk management initiatives.

Fourthly, the extension of the research model with incorporation of various antecedents of risk management strategies is highly recommended. In this research, three organisational orientations and three business contexts were used to explain the mechanisms behind implementing risk management strategies. However, the SCRM literature suggested a number of factors, though conceptually, that can affect the strategic decisions relating to risk management. To this end, verification of these factors based on the current research model will be a great potential area for the future research.

Lastly, risk performance measured by risk occurrence or risk impact can be incorporated into the future research model. This research used robust and resilience logistics networks as the outcomes of risk management because they can represent the desired outcomes from risk management. However, to precisely evaluate the effectiveness of risk management strategies, it will be necessary to investigate whether the strategies have actually reduced the risk level. In fact, this thesis made use of two questionnaire surveys, the first of which incorporated the risk level as the consequence of risk management. The problem was that the risk level was not just dependent on the degree of risk management, but also relied on the complexities that a firm's logistics network inherently possesses, which generated a poor model-fit of the initial research model. Future research may consider the relationships among logistics complexities, risk management strategies and risk level in order to confirm the positive effects of risk management on risk management performance.

References

Adhitya, A., Srinivasan, R. and Karimi, I.A. (2009). Supply chain risk identification using a HAZOP-based approach. *AlChE Journal* 55(6), pp. 1447-1463.

Armstrong, J.S. and Overton, T.S. (1977). Estimating nonresponse bias in mail surveys. Journal of Marketing Research 14(3), pp. 396-402.

Asbjørnslett, B.E. (2008). Assessing the vulnerability of supply chains. In: Zsidisin, G.A. and Ritchie, R. (eds.), *Supply Chain Risk: A Handbook of Assessment, Management and Performance*. New York: Springer.

Bagozzi, R.P. and Fornell, C. (1982). Theoretical concepts, measurement, and meaning. In: Fornell, C. (Ed.), *A Second Generation of Multivariate Analysis*. New York: Praeger

Baird, I.S. and Thomas, H. (1990). What is risk anyway? In: Bettis, R.A. and Thomas H. (eds.), *Risk, Strategy, and Management*. JAI Press: Greenwich, CT.

Bakshi, N. and Kleindorfer, P. (2009). Co-opetition and investment for supply-chain resilience. *Production and Operations Management* 18(6), pp. 583-603

Banomyong, R. and Beresford, A.K.C. (2001). Multimodal transport: the case of Laotian garment exporters. *International Journal of Physical Distribution and Logistics Management* 31(9), pp. 663-685.

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

Barratt, M. and Oke, A. (2007). Antecedents of supply chain visibility in retail supply chains: a resource-based theory perspective. *Journal of Operations Management* 25(6), pp. 1217-1233.

Barratt, M.A. and Oliveira, A. (2001). Exploring the experiences of collaborative planning: the enablers and inhibitors. *International Journal of Physical Distribution and Logistics Management* 31(2), pp. 266-289.

Barry, J. (2004). Supply chain risk in an uncertain global supply chain environment. *International Journal of Physical Distribution and Logistics Management* 34(9), pp. 695-697.

Bask, A.H. (2001). Relationships among TPL providers and members of supply chains – a strategic perspective. *Journal of Business & Industrial Marketing* 16(6), pp. 470-486.

Beamon, B.M. (1998). Supply chain design and analysis: models and methods. *International Journal of Production Economics* 55(3), pp. 281-294.

Benton, T. and Craib, I. (2001). *Philosophy of Social Science: The Philosophical Foundations of Social Thought*. Basingstoke: Palgrave.

Beresford, A.K.C. (1999). Modelling freight transport costs: a case study of the UK-Greece corridor. *International Journal of Logistics Research and Applications* 2(3), pp. 229-246.

Berle, O., Rice Jr, J.B. and Asbjørnslett, B.E. (2011). Failure modes in the maritime transportation system. *Maritime Policy & Management* 38(6), pp. 605-632.

Bhaskar, R. (1975). *A Realist Theory of Science*. Leeds: Leeds Books.

Bichou, K. (2004). The ISPS Code and the cost of port compliance: an initial logistics and supply chain framework for port security assessment. *Maritime Economics and Logistics* 6, pp. 322-348.

Birkinshaw, J., Toulan, O. and Arnold, D. (2001). Global account management in multinational corporations: theory and evidence. *Journal of International Business Studies* 32, pp. 231-248.

Blackburn, R. and Stokes, D. (2000). Breaking down the barriers: using focus groups to research small and medium-sized enterprises. *International Small Business Journal* 19(1), pp. 44-67.

Blackhurst, J., Craighead, C.W., Elkins, D. and Handfield, R.B. (2005). An empirically derived agenda of critical research issues for managing supply-chain disruptions. *International Journal of Production Research* 43(19), pp. 4067-4081.

Blackhurst, J.V., Scheibe, J.P. and Johnson, D.J. (2008). Supplier risk assessment and monitoring for the automotive industry. *International Journal of Physical Distribution and Logistics Management* 38(2), pp. 143-165.

Blackhurst, J., Dunn, K.S. and Craighead, C.W. (2011). An Empirically Derived Framework of Global Supply Resiliency. *Journal of Business Logistics* 32(4), pp. 374-391.

Blos, M.F., Quaddus, M., Wee, H.M. and Watanabe, K. (2009). Supply chain risk management (SCRM): a case study on the automotive and electronic industries in Brazil. *Supply Chain Management: An International Journal* 14(4), pp. 247-252.

Bode, C., Wagner, S.M., Petersen, K.J. and Ellram, L.M. (2011). Understanding responses to supply chain disruptions- insights from information processing and resource dependence perspectives. *Academy of Management Journal* 54(4), pp. 833-856.

Braunscheidel, M.J. and Suresh, N.C. (2009). The organizational antecedents of a firm's supply chain agility for risk mitigation and response. *Journal of Operations Management* 27(2), pp. 119-140.

Brindley, C.S. (2004). *Supply Chain Risk*. Aldershot: Ashgate Publishing.

Bryman, A. (2012). *Social Research Methods*, 4th edition. Oxford: Oxford University Press.

Bryman, A. and Bell, E. (2011). *Business Research Methods*. 3rd edition. Oxford: Oxford University Press.

Bowersox, D.J. (1990). The strategic benefits of logistics alliances, *Harvard Business Review* 68(4), pp. 36-43.

Byrne, B.M. (2001). *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*. Mahwah, N.J: Lawrence Erlbaum Associates.

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

Caridi, M., Moretto, A., Perego, A. and Tumino, A. (2014). The benefits of supply chain visibility: a value assessment model. *International Journal of Production Economics* 151(1), pp. 1-19.

Carmines, E.G. and Zeller, R.A. (2008). *Reliability and Validity Assessment*. Newbury Park, CA: Sage.

Cavinato, J.L. (2004). Supply chain logistics risks: From the back room to the board room. *International Journal of Physical Distribution and Logistics Management* 34(5), pp. 383-387.

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

Cheng, T.C.E., Yip, F.K. and Yeung, A.C.L. (2012). Supply risk management via guanxi in the Chinese business context: The buyer's perspective. *International Journal of Production Economics* 139(1), pp. 3-13.

Childerhouse, P. and Towill, D.R. (2004). Reducing uncertainty in European supply chains. *Journal of Manufacturing Technology Management* 15(7), pp. 585-598.

Chiles, T.H. and McMackin, J.F. (1996). Integrating variable risk preferences, trust, and transaction cost economics. *Academy of Management Review* 21(1), pp. 73-99.

Chin, W.W. (1998). Issues and opinion on Structural Equation Modeling. *MIS Quarterly*, March, pp. 7-16.

Chin, (2010). How to write up and report PLS analyses. In: Vinzi, V.E., Chin, W.W., Henseler, J. and Wang, H. (Eds.) Handbook of Partial Least Squares. London: Springer.

Choi, T.Y. and Liker, J.K. (1995). Bringing Japanese continuous improvement approaches to U.S. manufacturing: the roles of process orientation and communications. *Decision Sciences* 26(5), pp. 589-620.

Chopra, S. and Meindl, P. (2007). *Supply Chain Management: Strategy, Planning and Operation*, 2nd edition. Boston: Pearson.

Chopra, S. and Sodhi, (2004). Managing risk to avoid supply-chain breakdown. *MIT Sloan Management Review*, Fall, pp. 53-61.

Christopher, M. (2005). *Logistics and Supply Chain Management: Creating Value-adding Networks*, 3rd edition. Harlow: Pearson Education Limited.

Christopher, M. and Lee, H. (2004). Mitigating supply chain risk through improved confidence. *International Journal of Physical Distribution and Logistics Management* 34(5), pp. 388-396.

Christopher, M. and Peck, H. (2004). Building the resilient supply chain. *International Journal of Logistics Management* 15(2), pp. 1-14.

Christopher, M., Mena, C., Khan, O. and Yurt, O. (2011). Approaches to managing global sourcing risk. *Supply Chain Management: An International Journal* 16(2), pp. 67-81.

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

Colicchia, C. and Strozzi, F. (2012). Supply chain risk management: a new methodology for a systematic literature review. *Supply Chain Management: An International Journal* 17(4), pp. 403-418.

Corbett, C. and van Wassenhove, L. (1993). Trade-offs? What trade-offs? Competence and competitiveness in manufacturing strategy. *California Management Review*, Summer, pp. 107-122.

Craighead, C.W., Blackhurst, R.C. and Bowen, F. (2007). The severity of supply chain disruptions: design characteristics and mitigation capabilities. *Decision Sciences* 38(1), pp. 131-156.

Creswell, J.W. and Clark, V.P. (2011). *Designing and Conducting Mixed Methods Research*, 2nd edition. London: Sage.

Cucciella, F. and Gastaldi, M. (2006). Risk management in supply chain: a real option approach. *Journal of Manufacturing Technology Management* 17(6), pp. 700-720.

Daft, R.L. and Weick, K.E. (1984). Towards a model of organizations as interpretation systems. *Academy of Management Review* 9(2), pp. 284-295.

Damian, B. (2013). Maersk to up November rates increase to $950 per teu. *Lloyd's List*, 9 October 2013, p. 1.

Das, T.K. and Teng, B.-S. (2001). A risk perception model of alliance structuring. *Journal of International Management* 7(1), pp. 1-29.

Davis, T. (1993). Effective supply chain management. *Sloan Management Review*, Summer, pp. 35-46.

Deane, J.K., Craighead, C.W. and Ragsdale, C.T. (2009). Mitigating environmental and density risk in global sourcing. *International Journal of Physical Distribution and Logistics Management* 39(10), pp. 861-883.

Denison, D.R. (1990). *Corporate Culture and Organizational Effectiveness*. Oxford: John Wiley & Sons.

Denyer, D. and Tranfield, D. (2009). Producing a systematic review. In: Buchanan, D.A. and Bryman, A. (Eds.), *The Sage Handbook of Organizational Research Methods*. Thousand Oaks, CA: Sage Publications.

de Waart, D. (2006). Getting SMART about risk management. Supply Chain Management Review, November, pp. 27-33.

Diabat, A., Govindan, K. and Panicker, V.V. (2012). Supply chain risk management and its mitigation in a food industry. *International Journal of Physical Distribution and Logistics Management* 50(11), pp. 3039-3050.

Draaijer, D.J. (1992). Market orientedness of improvement programmes in manufacturing: results from field study research. *International Journal of Operations and Production Management* 12(7), pp. 24-40.

Dubios, A. and Gadde, L.E. (2002). Systematic combining: an abductive approach to case research. *Journal of Business Research* 55(7), pp. 553-560.

Duggleby, W. (2005). What about focus group interaction data? *Qualitative Health Research* 15(6), pp. 832-840.

Easterby-Smith, M., Thorpe, R. and Lowe, A. (2002). Management Research: An Introduction, 2nd edition. London: Sage.

Eisenhardt, K.M. (1989). Agency theory: an assessment and review. *Academy of Management Review*, 14(1), pp. 57-74.

Ellram, L.M. and Siferd, S.P. (1998). Total cost of ownership: a key concept in strategic cost management decisions. *Journal of Business Logistics* 19(1), pp. 55-84.

Ellegaard, C. (2008). Supply risk management in a small company perspective. *Supply Chain Management: An International Journal* 13(6), pp. 425-434.

Ellie, S.C., Shockley, J. and Henry, R.M. (2011). Making sense of supply disruption risk research- a conceptual framework grounded in enactment theory. *Journal of Supply Chain Management* 47(2), pp. 65-96.

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

Faisal, M.N., Banwet, D.K. and Shankar, R. (2006). Supply chain risk mitigation: modeling the enablers. *Business Process Management Journal* 12(4), pp. 535-552.

Faisal, M.N., Banwet, D.K. and Shankar, R. (2007). Quantification of risk mitigation environment of supply chains using graph theory and matrix methods. *European Journal of Industrial Engineering* 1(1), pp. 22-39.

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

Fawcett, S.E., Calatone, R.J. and Roath, A. (1996). An investigation of the impact of flexibility on global reach and firm performance. *Journal of Business Logistics* 17(2), pp. 167-196.

Flint, P. (2004). Supply chain risk management. *Supply Chain Management: An International Journal* 9(2), pp. 183-196.

Fornell, C. and Larcker, D.F. (1981). Structural equation models with unobservable variables and measurement error: algebra and statistics. *Journal of Marketing Research* 18(3), pp. 382-388.

Forza, C. (2002). Survey research in operations management: a process-based perspective. *International Journal of Operations and Production Management* 22(2), pp. 152-194.

Freeman, H.E. (1984). *Strategic Management: A Stakeholder Approach*. Boston: Pitman Publishing.

Galbraith, J.R. (1973). *Designing Complex Organizations*. Boston: Addison-Wesley Longman.

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

Gaudenzi, B. and Borghesi, A. (2006). Managing risks in the supply chain using the AHP method. *International Journal of Logistics Management* 17(1), pp. 114-136.

Gefen, D., Straub, D.W. and Boudreau, M.-C. (2000). Structural equation modelling and regression: guidelines for research practice. *Communication of AIS* 4(7), pp. 1-77.

Geisser, S. (1974). A predictive approach to the random effect model. *Biometrika* 61(1), pp. 101-107.

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

Ghadge, A., Dani, S. and Kalawsky, R. (2012). Supply chain risk management: present and future scope. *The International Journal of Logistics Management* 23(3), pp. 313-339.

Ghauri, P.N. and Gronhaug, K. (2002). *Research Methods in Business Studies: A Practical Guide*. Harlow: Financial Times and Prentice Hall.

Gibbons, M.R. (1982). Multivariate tests of financial models: a new approach. *Journal of Financial Economics* 10, pp. 3-27.

Gilbert, N. (2008). *Researching Social Life*. 3rd edition. London: Sage Publication.

Giunipero, L.C. and Eltantawy, R.A. (2004). Securing the upstream supply chain: a risk management approach. *International Journal of Physical Distribution & Logistics Management* 34(9), pp. 698-713.

Giunipero, L.C., Hooker, R.E. Joseph-Matthews, S., Yoon, T.E. and Brudvig, S. (2008). A decade of SCM literature: past, present and future implications. *Journal of Supply Chain Management* 44(4), pp. 66-86.

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

Govindan, K., Palaniappan, M., Zhu, Q. and Kannan, D. (2012). Analysis of third party reverse logistics provider using interpretive structural modelling. *International Journal of Production Economics* 140, pp. 204-211.

Hair, J.F., Black, W.C., Babin, B.J. and Anderson, R.E. (2010). *Multivariate Data Analysis: A Global Perspective,* 7th edition. New Jersey: Prentice Hall.

Hair, J.F., Ringle, C.M. and Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice* 19(2), pp. 139-151.

Hair, J.F., Hult, G.T.M., Ringle, C.M. and Sarstedt, M. (2014). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. Thousand Oaks, CA: Sage Publication.

Hallikas, J., Virolainen, V.-M. and Tuominen, M. (2002). Risk analysis and assessment in network environments: A dyadic case study. *International Journal of Production Economics* 78(1), pp. 45-55.

Hallikas, J., Karvonen, I., Pulkkinen, U., Virolainen, V.-M. and Tuominen, M. (2004). Risk management processes in supplier networks. *International Journal of Production Economics* 90(1), pp. 47-58.

Harland, C., Brenchley, R. and Walker, H. (2003). Risk in supply networks. *Journal of Purchasing & Supply Management* 9(2), pp. 51-62.

Hauser, L.M. (2003). Risk-adjusted Supply Chain Management. *Supply Chain Management Review* 7(6), pp. 64-71.

Hendricks, K.B. and Singhal, V.R. (2003). The effect of supply chain glitches on shareholder wealth. *Journal of Operations Management* 21, pp. 501-522.

Hendricks, K.B. and Singhal, V.R. (2005). Association between supply chain glitches and operating performance. *Management Science* 51(5), pp. 695-711.

Hendricks, K.B., Singhal, V.R. and Zhang, R. (2009). The effect of operational slack, diversification, and vertical relatedness on the stock market reaction to supply chain disruptions. *Journal of Operations Management* 27(3), pp. 233-246.

Hensley, R.L. (1999). A review of operations management studies using scale development techniques. *Journal of Operations Management* 17(3), pp. 343-358.

Hinkin, T.R. (1995). A review of scale development practices in the study of organizations. *Journal of Management* 21(5), pp. 967-988.

Hofer, A.R. and Knemeyer, A.M. (2009). Controlling for logistics complexity: scale development and validation. *International Journal of Logistics Management* 20(2), pp. 187-200.

Holweg, M., Disney, S., Holmstrom, J. and Smaros, J. (2005). Supply chain collaboration: making sense of the strategy continuum. *European Management Journal* 23(2), pp. 170-181.

Hult, G.T.M., Ketchen Jr., D.J. and Slater, S.F. (2004). Information processing knowledge development, and strategic supply chain performance. *Academy of Management Journal* 47(2), pp. 241-253.

Johansson, H.J., McHugh, P., Pendlebury, A.J. and Wheeler, W.A. (1993) *Business Process Reengineering: Breakpoint Strategies for Market Dominance*. Chichester: Wiley.

Jüttner, U. (2005). Supply chain risk management: Understanding the business requirements from a practitioner perspective. *International Journal of Logistics Management* 16(1), pp. 120-141.

Jüttner, U. and Maklan, S. (2011). Supply chain resilience in the global financial crisis: an empirical study. *Supply Chain Management: An International Journal* 16(4), pp. 246-259.

Jüttner, U., Peck, H. and Christopher, M. (2003). Supply chain risk management- outlining an agenda for future research. *International Journal of Logistics Research and Applications* 6(4), pp. 197-210.

Kahneman, D. and Tversky, A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica* 47(2), pp. 263-292.

Kam, B.H., Chen, L. and Wilding, R. (2011). Managing production outsourcing risks in China's apparel industry: a case study of two apparel retailers. *Supply Chain Management: An International Journal* 16(6), pp. 428-445.

Kampstra, R.P., Ashayeri, J. and Gattorna, J.L. (2006). Realities of supply chain collaboration. *The International Journal of Logistics Management* 17(3), pp. 312-330.

Kern, T. and Willcocks, L.P. (2001). *The Relationship Advantage: Information Technologies, Sourcing, and Management*. Oxford: Oxford University Press.

Kern, D., Moser, R., Hartmann, E. and Moder, M. (2012). Supply risk management: model development and empirical analysis. *International Journal of Physical Distribution and Logistics Management* 42(1), pp. 60-82.

Ketokivi M. and Choi T. (2014). Renaissance of case research as a scientific method. *Journal of Operations Management* 32(5), pp. 232-240.

Khan, O. and Burnes, B. (2007). Risk and supply chain management: creating a research agenda. *International Journal of Logistics Management* 18(2), pp. 197-216.

Khan, O., Christopher, M. and Burnes, B. (2008). The impact of product design on supply chain risk: a case study. *International Journal of Physical Distribution and Logistics Management* 38(5), pp. 412-432.

Kleindorfer, P.R. and Saad, G.H. (2005). Managing disruption risks in supply chains. *Production and Operations Management* 14(1), pp. 53-68.

Klibi, W., Martel, A. and Guitouni, A. (2010). The design of robust value-creating supply chain networks: a critical review. *European Journal of Operational Research* 203(2), pp. 283-293.

Kouvelis, P., Chambers, C. and Wang, H. (2006). Supply chain management research and *Production and Operations Management*: review, trends, and opportunities. *Production and Operations Management* 15(3), pp. 449-469.

Kovacs, G. and Spens, K.M. (2005). Abductive reasoning in logistics research. *International Journal of Physical Distribution and Logistics Management* 35(2), pp. 132-144.

Kraljic, P. (1983). Purchasing must become supply management. *Harvard Business Review*, Sep/Oct, pp. 109-117.

Krause, D.R. (1999). The antecedents of buying firms' efforts to improve suppliers. *Journal of Operations Management* 17(2), pp. 205-224.

Krueger, R.A. (1998). *Analyzing & Reporting Focus Group Results*. London: Sage Publications.

Kull, T.J. and Talluri, S. (2008). A supply risk reduction model using integrated multicriteria decision making. *IEEE Transactions on Engineering Management* 55(3), pp. 409-419.

Kumar, R. (2011). *Research Methodology*, 3rd edition. London: Sage Publications.

Lambert, D., Emmelhainz, M. and Gardner, J. (1999). Building successful logistics partnerships. Journal of Business Logistics 20(1), pp. 165-181.

Larson, P.D. and Halldórsson, A. (2004). Logistics versus supply chain management: an international survey. *International Journal of Logistics Research and Applications* 7(1), pp. 17-31.

Lassar, W.M. and Kerr, J.R. (1996). Strategy and control in supplier-distributor relationships: an agency perspective. *Strategic Management Journal* 17(8), 613-632.

Latour, A. (2001). Trial by fire: a blaze in Albuquerque sets off major crisis for cell-phone giants. *The Wall Street Journal*, 29 January 2001.

Lavastre, O., Gunasekaran, A. and Spalanzani, A. (2012). Supply chain risk management in French companies. *Decision Support Systems* 52(4), pp. 828-838.

Lawrance, W.W. (1980). The nature of risk. In: Schwing R.C. and Albers, W.A. (Eds.) *Societal Risk Assessment*. New York: Springer Science + Business Media.

Lee, H.L. (2002). Aligning supply chain strategies with product uncertainties. *California Management Review* 44(3), pp. 105-119.

Lee, H.L. and Whang, S. (2000). Information sharing in a supply chain. *International Journal of Manufacturing Technology and Management* 1(1), pp. 79-93.

Lee, H.L. and Whang, S. (2001). E-fulfilment: winning the last mile of e-commerce. *MIT Sloan Management Review* 42(4), pp. 54-62.

Levary, R.R. (2007). Ranking foreign suppliers based on supply risk. *Supply Chain Management: An International Journal* 12(6), pp. 392-394.

Lieb, R.C. (1992). The use of third-party logistics services by large American manufacturers. *Journal of Business Logistics* 13(2), pp. 29-42.

Lin, Y. and Zhou, L. (2011). The impacts of product design changes on supply chain risk: a case study. *International Journal of Physical Distribution and Logistics Management* 41(2), pp. 162-186.

Lumpkin, G.T. and Dess, G.G. (1996). Clarifying the enterpreneurial orientation construct and linking it to performance. *Academy of Management Review* 21(1), pp. 135-172.

MacCrimmon, K.R. and Wehrung, D.A. (1986). *Taking Risks: The Management of Uncertainty*. New York: Free Press.

Malone, D.W. (1975). An introduction to the application of interpretive structural modelling. Proceedings of the IEEE 63(3), pp. 397-404.

Manuj, I. and Mentzer, J.T. (2008a). Global supply chain risk management. *Journal of Business Logistics* 38(3), pp. 192-223.

Manuj, I. and Mentzer, J.T. (2008b). Global supply chain risk management strategies. *International Journal of Physical Distribution and Logistics Management* 38(3), pp. 192-223.

March, J.G. and Shapira, Z. (1987). Managerial perspectives on risk and risk taking. *Management Science* 33(11), pp. 1404-1418.

Markowitz, H. (1952). Mean-Variance analysis in portfolio choice and capital markets. *Journal of Finance* 7, pp. 77-91.

Mason-Jones, R. and Towill, D.R. (1999). Shrinking the supply chain uncertainty circle. *Control*, Sep, pp. 17-22.

May (2001). *Social Research: Issues, Methods and Process*, 3rd edition. Philadelphia: Open University.

McCrea, B. (2005). EMS completes the visibility picture. *Logistics Management* 44(6), pp. 57-61.

McDaniel, C. and Gates, R (1999). *Contemporary Marketing Research*. Cincinnati, OH: South West College.

McGinnis, M.A. (1989). A comparative evaluation of freight transportation choice models. *Transportation Journal* 29(2), pp. 36-46.

McNamara, C. (2010). *Basics of conducting focus groups*. [Online] Available at: http://www.managementhelp.org/evaluatn/focusgrp.htm [Accessed: 24 May 2013]

Meixell, M.J. and Gargeya, V.B. (2005). Global supply chain design: a literature review and critique. *Transportation Research Part E: Logistics and Transportation Review* 41(6), pp. 531-550.

Mentzer, J.T. and Kahn, K.B. (1995). A framework for logistics research. *Journal of Business Logistics* 16(1), pp. 231-250.

Milgate, M. (2001). Supply chain complexity and delivery performance: an international exploratory study. *Supply Chain Management: An International Journal* 6(3), pp. 106-118.

Miller, K. (1992). A framework for integrated risk management in international business. *Journal of International Business Studies*, Second Quarter, pp. 311-331.

Miller, J.G. and Roth, A.V. (1994). A taxonomy of manufacturing strategies. *Management Science* 40(3), pp. 285-304.

Milliken, F.J. (1987). Three types of perceived uncertainty about the environment: state, effect, and response uncertainty. *Academy of Management Review* 12(1), pp. 133-143.

Min, S., Roath, A.S., Daugherty, P.J., Genchev, S.E., Chen, H., Arndt, A.D. and Richey, R.G. (2005). Supply chain collaboration: what's happening? The International Journal of Logistics Management 16(2), pp. 237-256.

Mitchell, V.W. (1995). Organizational risk perception and reduction: a literature review. *British Journal of Management* 6(2), pp. 115-133.

Mitchell, V.W. (1999). Consumer perceived risk: conceptualisations and models. *European Journal of Marketing* 33(1/2), pp.163-195.

Mohr, J. and Nevin, J.R. (1990). Communication strategies in marketing channels: a theoretical perspective, *Journal of Marketing* 54(4), pp. 36-51.

Morgan, D.L. (1998). *Planning Focus Groups*. Thousand Oaks: Sage Publications.

Moore, G.C. and Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research* 2(3), pp. 192-222.

Narver, J.C. and Slater, S.F. (1990). The effect of a market orientation on business profitability, *Journal of Marketing* 54, pp. 20-35.

Naslund, D. (2002). Logistics needs qualitative research – especially action research. *International Journal of Physical Distribution and Logistics Management* 32(5), pp. 321-338.

Natarajarathinam, M., Capar, I. and Narayanan, A. (2009). Managing supply chains in times of crisis: a review of literature and insights. *International Journal of Physical Distribution and Logistics Management* 39(7), pp. 535-573.

Newall, J. (1977). Industrial buyer behaviour. *European Journal of Marketing* 11(3), pp. 166-211.

Nilsson, F. (2006). Logistics management in practice – towards theories of complex logistics. *International Journal of Logistics Management* 17(1), pp. 38-54.

Norrman, A. and Jansson, U. (2004). Ericsson's proactive supply chain risk management approach after a serious sub-supplier accident. *International Journal of Physical Distribution and Logistics Management* 34(5), pp. 434-456.

Nyaga, G.N., Whipple, J.M. and Lynch, D.F. (2010). Examining supply chain relationships: do buyer and supplier perspectives on collaborative relationships differ? *Journal of Operations Management* 28(2), pp. 101-114.

Ojala, M. and Hallikas, J.M. (2006). Investment decision-making in supplier networks: Management of risk. *International Journal of Production Economics* 104(1), pp. 201-213.

Oke, A. and Gopalakrishnan, A. (2009). Managing disruptions in supply chains: A case study of a retail supply chain. *International Journal of Production Economics* 118(1), pp. 168-174.

Olson, D.L. and Wu, D. (2011). Risk management models for supply chain: a scenario analysis of outsourcing to China. *Supply Chain Management: An International Journal* 16(6), pp. 401-408.

Pan, F. and Nagi, R. (2010). Robust supply chain design under uncertain demand in agile manufacturing. *Computers and Operations Research* 37(4), pp. 668-683.

Park, B.I. and Ghauri, P.N. (2015). Determinants influencing CSR practices in small and medium sized MNE subsidiaries: A stakeholder perspective. *Journal of World Business* 50, pp. 192-204.

Patton, M.Q. (2002). *Qualitative research and evaluation methods*. 3rd edition. Thousand Oaks, CA: Sage Publications.

Paulsson, U. (2004). Supply chain risk management. In: Brindley, C. (Ed.) *Supply Chain Risk: A Reader*. Aldershot: Ashgate.

Pawson, (2002). Evidence-based policy: the promise of “realist synthesis.” *Evaluation* 8(3), pp. 340-358.

Peck, H. (2005). Drivers of supply chain vulnerability: an integrated framework. International *Journal of Physical Distribution and Logistics Management* 35(4), pp. 210-232.

Pettit, T.J., Fiksel, J. and Croxton, K.L. (2010). Ensuring Supply chain Resilience: Development of a Conceptual Framework. *Journal of Business Logistics* 31(1), pp. 1-21.

Pfohl, H.-C., Gallus, P. and Thomas, D. (2011). Interpretive structural modeling of supply chain risks. *International Journal of Physical Distribution and Logistics Management* 41(9), pp. 839-859.

Piboonrungroj, P. (2013). *Supply Chain Collaboration: Impacts and Mediation on Firm Performance*. Unpublished PhD Thesis, Cardiff University.

Piercy, J.E. and Ballou, R.H. (1978). A performance evaluation of freight transport modes. *Logistics and Transportation Review* 14(2), pp. 99-116.

Ponomarov, S.Y. and Holcomb, M.C. (2009). Understanding the concept of supply chain resilience. *International Journal of Logistics Management* 20(1), pp. 124-143.

Porter, M.E. (1990). Competitive advantage, agglomeration economies, and regional policy. *International Regional Science Review* 19(1), pp. 85-94.

Prater, E. (2005). A framework for understanding the interaction of uncertainty and information systems on supply chains. *International Journal of Physical Distribution and Logistics Management* 35(7), pp. 524-539.

Pujawan, I.N. and Geraldin, L.H. (2009). House of risk: a model for proactive supply chain risk management. *Business Process Management Journal* 15(6), pp. 953-967.

Puto, C.P., Patton, W.E. and King, R.H. (1995). Risk handling strategies in industrial vendor selection decisions, *Journal of Marketing* 49, Winter, pp. 89-98.

Ramanathan, U. and Gunasekaran, A. (2014). Supply chain collaboration: impact of success in long-term partnerships. *International Journal of Production Economics* 147, pp. 252-259.

Rao, S. and Goldsby, T.J. (2009). Supply chain risks: a review and typology. *International Journal of Logistics Management* 20(1), pp. 97-123.

Rao, K. and Young, R.R. (1994). Global supply chains: factors influencing outsourcing of logistics functions. *International Journal of Physical Distribution and Logistics Management* 24(6), pp. 11-19.

Rice, J.B. and Caniato, F. (2003). Building a secure and resilient supply network. *Supply Chain Management Review* 7(5), pp. 22-30.

Ringle, C.M., Wende, S. and Will, A. (2005). SmartPLS 2.0 (Beta), SmartPLS, Hamburg [Available at www.smartpls.de].

Ritchie, B. and Brindley, C. (2007a). An emergent framework for supply chain risk management and performance measurement. *Journal of Operational Research Society* 58(11), pp. 1398-1411.

Ritchie, B. and Brindley, C. (2007b). Supply chain risk management and performance- A guiding framework for future development. *International Journal of Operations & Production Management* 27(3), pp. 303-322.

Robson, C. (2002). Real World Research, 2nd edition. Oxford: Blackwell.

Ross, J.W. and Westerman, G. (2004). Preparing for utility computing: the role of IT architecture and relationship management. *IBM Systems Journal* 43(1), pp. 5-19.

Rowe, W.D. (1980). Risk assessment: approaches and methods. In Conrad, J. (ed.) *Society, Technology and Risk Assessment*. London: Academic Press.

Rueda-Manzanares, A., Aragon-Correa, J.A. and Sharma, S. (2008). The influence of stakeholders on the environmental strategy of service firms: the moderating effects of complexity, uncertainty and munificence. *British Journal of Management* 19(2), pp. 185-203.

Saaty, T.L. (1990). How to make a decision: the analytic hierarchy process. *European Journal of Operations Research* 48(1), pp. 9-26.

Sabherwal, R. (1999). The role of trust in outsourced IS development projects. *Communications of the ACM* 42(2), pp. 80-86.

Sachan, A. and Datta, S. (2005). Review of supply chain management and logistics research. *International Journal of Physical Distribution and Logistics Management* 35(9), pp. 664-705.

Sage, A.P. (1977). *Interpretive Structural Modeling: Methodology for Large-scale Systems*. New York: McGraw-Hill.

Sanchez-Rodrigues, V., Stantchev, D., Potter, A., Naim, M. and Whiteing, A. (2008). Establishing a transport operation focused uncertainty model for the supply chain. *International Journal of Physical Distribution and Logistics Management* 38(5), pp. 388-411.

Sanchez-Rodrigues, V., Potter, A. and Naim, M. (2010). Evaluating the causes of uncertainty in logistics operations. *International Journal of Logistics Management* 21(1), pp.45-64.

Sarantakos, S. (2005). *Social Research*, 3rd edition. Melbourne: Macmillan Education.

Saunders, M., Lewis, P. and Thornhill, A. (2012). *Research Methods for Business Students*, 6th edition. Harlow: Pearson Education Limited.

Schoenthaler, R. (2003). Creating real-time supply chain visibility. Electronic Business 29(8), pp. 12-13.

Schoenherr, T., Tummala, V.M.R. and Harrison, T.P. (2008). Assessing supply chain risks with the AHP: providing decision support for the offshoring decision by a US manufacturing company. *Journal of Purchasing & Supply Management* 14(2), pp. 100-111.

Serangi, S. and Srivatsan, S. (2009). Interrelationship between Operations and Marketing in Reducing Demand Risk. *Journal of Marketing Channels* 16(3), pp. 227-243.

Shapira, Z. (1986). *Risk in Managerial Decision Making*. Unpublished Dissertation, Hebrew University.

Sheffi, Y. (2001). Supply chain management under the threat of international terrorism. *International Journal of Logistics Management* 12(2), pp. 1-11.

Sheffi, Y. and Rice, J. (2005). A supply chain view of the resilient enterprise. *Sloan Management Review* 47(1), pp. 41-48.

Skipper, J.B. and Hanna, J.B. (2009). Minimizing supply chain disruption risk through enhanced flexibility. *International Journal of Physical Distribution and Logistics Management* 39(5), pp. 404-427.

Slovic, P. (2000). *Perception of Risk*. Ebbw Vale: Earthscan Publications.

Smeltzer, L.R. and Siferd, S.P. (1998). Proactive supply management: the management of risk. *Journal of Supply Chain Management* 34(4), pp. 38-45.

Sodhi, M.S. (2005). Managing demand risk in tactical supply chain planning for a global consumer electronics company. *Production and Operations Management* 14(1), pp. 69-79.

Sodhi, M.S. and Lee, S. (2007). An analysis of sources of risk in the consumer electronics industry. *Journal of Operational Research Society* 58(11), pp. 1430-1439.

Sodhi, M.S. and Tang, C.S. (2009). Modeling supply-chain planning under demand uncertainty using stochastic programming: A survey motivated by asset–liability management. *International Journal of Production Economics* 121(2), pp. 728-738.

Sodhi, M.S., Son, B.-G. and Tang, C.S. (2012). Researchers' perspectives on supply chain risk management. *Production and Operations Management* 21(1), pp. 1-13.

Spekman, R.E. and Davis, E.W. (2004). Risky business: expanding the discussion on risk and the extended enterprise. *International Journal of Physical Distribution and Logistics Management* 34(5), pp. 414-433.

Spens, K.M. and Kovacs, G. (2006). A content analysis of research approaches in logistics research. *International Journal of Physical Distribution and Logistics Management* 36(5), pp. 374-390.

Spiegler, V.L.M., Naim, M.M. and Wikner, J. (2012). A control engineering approach to the assessment of supply chain resilience. *International Journal of Production Research* 50(21), pp. 6162-6187.

Steele, P.T. and Court, B.H. (1996). *Profitable Purchasing Strategies: A Manager's Guide for Improving Organizational Competitiveness through the Skills of Purchasing*. London: McGraw-Hill.

Stefansson, G. and Russell, D.M. (2008). Supply chain interfaces: defining attributes and attribute values for collaborative logistics management. *Journal of Business Logistics* 29(1), pp. 347-359.

Stone, M. (1974). Cross-valedictory choice and assessment of statistical predictions. *Journal of Royal Statistical Society* 2(36), pp. 111-147.

Svensson, G. (2000). A conceptual framework for the analysis of vulnerability in supply chains. *International Journal of Physical Distribution and Logistics Management* 30(9), pp.731-750.

Svensson, G. (2002). A typology of vulnerability scenarios towards suppliers and customers in supply chains based upon perceived time and relationship dependencies. *International Journal of Physical Distribution and Logistics Management* 32(3), pp. 168-187.

Svensson, G. (2003). A generic conceptual framework of interactive service quality. *Managing Service Quality* 13(4), pp. 267-275.

Svensson, G. (2004). Key areas, causes and contingency planning of corporate vulnerability in supply chains: A qualitative approach. *International Journal of Physical Distribution and Logistics Management* 34(9), pp. 728-748.

Tang, C.S. (2006a). Perspectives in supply chain risk management. *International Journal of Production Economics* 103, pp. 451-488.

Tang, C.S. (2006b). Robust strategies for mitigating supply chain disruptions. *International Journal of Logistics Research and Applications* 9(1), pp. 33-45.

Tang, C.S. and Musa, S.N. (2011). Identifying risk issues and research advancements in supply chain risk management. *International Journal of Production Economics* 133(1), pp. 25-34.

Tashakkori, A. and Teddlie, C. (2003). *Handbook of Mixed Methods in Social and Behavioral Research*. Thousand Oaks, CA: Sage.

Thomas, A.B. (2004). *Research Skills for Management Studies*. London: Routledge.

Thun, J.H. and Hoenig, D. (2011). An empirical analysis of supply chain risk management in the German automotive industry. *International Journal of Production Economics* (), pp.

Tohamy, N. (2003). *Supply Chain Visibility Defined*. Research Report, Forrester Research, Cambridge, MA.

Trkman, P. and McCormack, K. (2009). Supply chain risk in turbulent environments—A conceptual model for managing supply chain network risk. *International Journal of Production Economics* 119(2), pp. 247-258.

Tsai, M.-C., Liao, C.-H. and Han, C.-S. (2008). Risk perception on logistics outsourcing of retail chains: model development and empirical verification in Taiwan. *Supply Chain Management: An International Journal* 13(6), pp. 415-424.

Tummala, R. and Schoenherr, T. (2011). Assessing and managing risks using the Supply Chain Risk Management Process (SCRMP). *Supply Chain Management: An International Journal* 16(6), pp. 474-483.

Tushman, M.L. and Nadler, D.A. (1978). Information processing as an integrating concept in organizational design. *Academy of Management Review* 3(3), pp. 613-624.

van der Vorst, J.G.A.J. and Beulens, A.J.M. (2002). Identifying sources of uncertainty to generate supply chain redesign strategies. *International Journal of Physical Distribution and Logistics Management* 32(6), pp. 409-430.

Vilko, J.P.P. and Hallikas, J.M. (2012). Risk assessment in multimodal supply chains. *International Journal of Production Economics* 140(2), pp. 586-595.

Wagner, S.M. and Bode, C. (2006). An empirical investigation into supply chain vulnerability. *Journal of Purchasing & Supply Management* 12(6), pp. 301-312.

Wagner, S.M. and Bode, C. (2008). An empirical examination of supply chain performance along several dimensions of risk. *Journal of Business Logistics* 29(1), pp. 307-325.

Wagner, S.M. and Bode, C. (2009). Dominant risks and risk management practices in supply chains. In: Zsidisin, G.A. (Ed.) *Supply Chain Risk: A Handbook of Assessment, Management and Performance*. New York: Springer.

Wallace, S.W. and Choi, T.-M. (2011). Flexibility, information structure, options, and market power in robust supply chains. *International Journal of Production Economics* 134(2), pp. 284-288.

Waters, D. (2007). *Supply Chain Risk Management: Vulnerability and Resilience in Logistics*. London: Kogan Page.

Watfield, J.N. (1994). A Science of Generic Design: Managing Complexity through Systems Design, 2nd edition. Ames, IA: Iowa State University Press.

Watson, R.H. (1978). "Interpretive structural modelling" – a useful tool for technology assessment? *Technological Forecasting and Social Change* 11(2), pp. 165-185.

Wiklund, J. and Shepherd, D. (2003). Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium-sized businesses. *Strategic Management Journal* 24(13), pp. 1307-1314.

Williamson, O.E. (1975). *Markets and Hierarchies: Analysis and Antitrust Implications*. New York: Free Press.

World Economic Forum (2013). *Building Resilience in Supply Chains*. [Online] Available at: http://www.accenture.com/SiteCollectionDocuments/PDF/Accenture-Building-Resilience-Supply-Chains.pdf [Accessed: 25 May 2014].

World Shipping Council (2011). *Trade Statistics* [Online]. Available at: http://www.worldshipping.org/about-the-industry/global-trade/trade-statistics [Accessed: 25 May 2013].

World Shipping Council (2013). *Top 50 World Container Ports* [Online]. Available at: http://www.worldshipping.org/about-the-industry/global-trade/top-50-world-container-ports [Accessed on 15 January 2014].

WTO (2013). International Trade Statistics 2013 [Online]. Available at: http://www.wto.org/english/res_e/statis_e/its2013_e/its13_toc_e.htm [Accessed on 15 January 2014].

Woo, S.-H., Pettit, S.J., Kwak, D.-W., Beresford, A.K.C. (2011). Seaport research: a structured literature review on methodological issues since the 1980s. *Transportation Research Part A: Policy and Practice* 45(7), pp. 667-685.

Wu, T., Blackhurst, J. and Chidambaram, V. (2006). A model for inbound supply risk analysis. *Computers in Industry* 57(4), pp. 350-365.

Yates, J.F. and Stone, E.R. (1992). The risk construct. In: Yates, J.F. (Ed.) *Risk-taking Behavior*. Oxford: John Wiley & Sons.

Yin, R.K. (2009). *Case Study Research: Design and Methods*, 4th edition. London: Sage.

Zsidisin, G.A. (2003). A grounded definition of supply risk. *Journal of Purchasing & Supply Management* 9(5), pp. 217-224.

Zsidisin, G.A. and Ellram, L.M. (2003). An Agency Theory Investigation of Supply Risk Management. *Journal of Supply Chain Management* 39(2), pp. 15-27.

Zsidisin, G.A. and Wagner, S.M. (2010). Do Perceptions Become Reality? The Moderating Role of Supply Chain Resiliency on Disruption Occurrence. *Journal of Business Logistics* 31(2), pp. 1-20.

Zsidisin, G.A., Panelli, A. and Upton, R. (2000). Purchasing organization involvement in risk assessments, contingency plans, and risk management: an exploratory study. *Supply Chain Management: An International Journal* 5(4), pp. 187-198.

Zsidisin, G.A., Ellram, L.M., Carter, J.R. and Cavinato, J.L. (2004). An analysis of supply risk assessment techniques, *International Journal of Physical Distribution and Logistics Management* 34(5), pp. 397-413.

Zsidisin, G.A., Melnyk, S.A. and Ragatz, G.L. (2005). An institutional theory perspective of business continuity planning for purchasing and supply management. *International Journal of Production Research* 43(16), pp. 3401-3420.

Appendix A – Ethical Approval 1

ETHICS 2

Cardiff Business School Cardiff University | Ysgol Fusnes Caerdydd Prifysgol Caerdydd

FULL ETHICAL APPROVAL FORM (STAFF/PhD STUDENTS) or students referring their form for a full ethical review

(For guidance on how to complete this form, please see Learning Central – CARBS RESEARCH ETHICS)

If your research will involve patients or patient data in the NHS then you should secure approval from the NHS National Research Ethics Service. Online applications are available on http://www.nres.npsa.nhs.uk/applicants/

Name of Lead Researcher : Dong-Wook Kwak

School: Cardiff Business School

Email: kwakd@cf.ac.uk

Names of other Researchers: None

APPLICATION APPROVED RESEARCH ETHICS COMMITTEE CARDIFF BUSINESS SCHOOL CARDIFF UNIVERSITY

Email addresses of other Researchers : N/A

Title of Project:

Identification and evaluation of risks in international logistics and the impacts of risk management on logistics performance perception

Start and Estimated End Date of Project: 01/Jan/2012 – 30/Apr/2013

Aims and Objectives of the Research Project:

The objective of this research is three-fold:
(1) Identification and evaluation of risks in international logistics
(2) The effects of risk management measures on risk prevention/mitigation
(3) The impacts of risk management on perceived logistics performance

Please indicate any sources of funding for this project:

None

1. Describe the methodology to be applied in the project

This research is an exploratory study using individual and focus group interviews, which is a part of my PhD thesis Prior to applying main analytic methodologies, it is pre-requisite to identify and evaluate risk features and sources in international logistics as well as to understand the behaviours of each entity involved in the business, specifically related to outsourcing behaviour and organisational learning. In this regard, qualitative interview methods would be necessary to grasp the basic ideas in order to use main quantitative methods. Semi-structured interviews and focus group, thus, would be the methods for this purpose.

Semi-structured interviews have the name because of the role of the list of interview questions: researchers prepare a list of questions as a guideline, but they can be flexible regarding the range of topics and how to lead the questions. In this research, this method addresses the research questions regarding identification of risks and evaluation of risks in terms of criticality as well as the general question on the global logistics domain of the participant company. The aim of this interview is to

ETHICS 2 (version August 2011)

Ethical Approval 1 (continued)

explore the risk sources and notions on the risks in global logistics. As it is an exploratory study to provide sufficient insights to following focus groups, general questions will be asked with lots of flexibility in deciding the process and intensity during the interview.

Focus Group is a frequently-used qualitative method to gather data and information from a group of participants. The main advantage of focus group over other qualitative methods, such as interviews, is that the participants can generate their ideas and discuss the ideas in detail. As the participants are made up of the people from diversified (career) backgrounds, they can consider the issue from various dimensions, which can be beneficial both to the researchers and the participants. The conclusions derived from the discussions are generally agreed by all participants, which provide more reliability. In this research, focus group studies will be divided into two parts. The first part will start from asking several questions about the potential risks in global logistics and the customer's perceptions on those risks. Their discussion is expected to facilitate valuable ideas and generate the discourses on this issue. The second part aims at the creation of the list of risk sources in global logistics and their specifications. Each participant will be asked to write down all the potential risks and the proposed risks will be categorised into more broad concepts of risks.

PLEASE ATTACH COPIES OF QUESTIONNAIRES OR INTERVIEW TOPIC GUIDES TO THIS APPLICATION

2. Describe the participant sample who will be contacted for this Research Project. You need to consider the number of participants, their age, gender, recruitment methods and exclusion/inclusion criteria

There will be four groups of participants in this research given the possible diversified perspectives: shippers, carriers, intermediaries and academics. The semi-structured interviews will be conducted to approximately 2 to 3 participants from each group so that diversified perspectives can be combined together. As the participants need to be experts in managing and executing the entire processes in global logistics, their positions in their firms would be at the managerial level or beyond. The age and gender may be various because the conditions to select participants would be rather dependent on their positions in their firms. Shipper firms will be selected from the top exporters in Korea listed in the annual export awards. Carriers will be two Korean liner companies and one non-Korean liner companies among the world top 10 carriers while intermediaries firms will be chosen from third-party logistics companies and freight forwarding companies. The participants will be recruited by direct contacts of the researcher and some of them have already agreed to engage in this research. To maximise the roles of global logistics in their activities, the firms dedicated to short-haul transits would be excluded. As for the focus group, six participants will be involved in each group research. As a series of focus group discussions should continue until new ideas are depleted (theoretical saturation), several groups will be organised according to their geographical proximity or meeting availability. The conditions for the participants in the focus groups are the same as those for semi-structured interviews.

3. Describe the method by which you intend to gain consent from participants.

The consent from participants will be obtained by written consent forms attached to this approval form. The form will be sent to the participants prior to conducting interviews or focus group discussions so that signed forms can be collected before starting interviews/discussions. The consent forms include statements that the participants fully understand the research purpose, required time, their rights of voluntary participation and withdrawal and the ethical commitment of anonymity and confidentiality.

Apart from the consent forms, the research will explain the purpose of the research and how their participation will be treated in detail before starting the interviews and focus group discussions. Also the agenda will be sent in advance so that the participants can fully prepared and

ETHICS 2 (version August 2011)

Ethical Approval 1 (continued)

precisely answer the questions proposed in the research.

PLEASE ATTACH A COPY OF ALL INFORMATION WHICH WILL BE GIVEN TO PROSPECTIVE PARTICIPANTS (including invitation letter, briefing documents and, if appropriate, the consent form you will be using).

4. Please make a clear and concise statement of the ethical and health and safety considerations - http://www.cf.ac.uk/osheu/index.html ***- raised by the project and how you intend to deal with them (please use additional sheets where necessary)***

Anonymity and confidentiality will be the main ethical considerations because the research is closely related to the opinions of the participating companies on the risks in global logistics. As for focus groups, the issue is more delicate because anonymity and confidentiality should be kept by each participant. Therefore, minimum obligations will be imposed on participants with their rights guaranteed. The recording files and notes will be destroyed within 2 years, more precisely 1 month after finishing this project. The result of the research will be provided to the participants who want it.

The health and safety guidelines will be duly complied if there are necessary situations.

STUDENTS SHOULD BIND THE SIGNED AND APPROVED FORM INTO THEIR REPORT, DISSERTATION OR THESIS

ETHICS 2 (version August 2011)

Ethical Approval 1 (continued)

Please complete the following in relation to your research project:

		Yes	No	n/a
(a)	Will you describe the main details of the research process to participants in advance, so that they are informed about what to expect?	☒	☐	☐
(b)	Will you tell participants that their participation is voluntary?	☒	☐	☐
(c)	Will you obtain written consent for participation?	☒	☐	☐
(d)	Will you tell participants that they may withdraw from the research at any time and for any reason?	☒	☐	☐
(e)	If you are using a questionnaire, will you give participants the option of omitting questions they do not want to answer?	☐	☐	☒
(f)	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐	☐
(g)	Will you offer to send participants findings from the research (e.g. copies of publications arising from the research)?	☒	☐	☐
(h)	If working with children and young people please confirm that you have given due consideration to University guidance available at: http://www.cardiff.ac.uk/govrn/cocom/resources/2010%20November%20Safeguarding%20Children%20&%20VA's.doc	☒		

PLEASE NOTE:
If you have ticked **No** to any of 5(a) to 5(g), please give an explanation on a separate sheet.
(Note: N/A = not applicable)
There is an obligation on the principal researcher/student to bring to the attention of Cardiff Business School Ethics Committee any issues with ethical implications not clearly covered by the above checklist.

Signed:
(Principal Researcher/Student) D. W. Kwak

Print Name: DONG-WOOK KWAK

Date: 9/ NOV / 2011

SUPERVISOR'S DECLARATION (Student researchers only): As the supervisor for this student project I confirm that I believe that all research ethical issues have been dealt with in accordance with University policy and the research ethics guidelines of the relevant professional organisation.

Signed:

Print Name: DR. A.K.C. BERESFORD

Date: 10/11/11

TWO copies of this form (and attachments) MUST BE OFFICIALLY STAMPED by Ms Lainey Clayton, Room F43, Cardiff Business School

STATEMENT OF ETHICAL APPROVAL

This project has been considered using agreed School procedures and is now approved.

Official stamp of approval of the School Research Ethics Committee:

Date: 16/11/2011

APPLICATION APPROVED
RESEARCH ETHICS COMMITTEE
CARDIFF BUSINESS SCHOOL
CARDIFF UNIVERSITY

ETHICS 2 (version August 2011)

Appendix B – Ethical Approval 2

ETHICS 2

Cardiff Business School
Cardiff University

Ysgol Fusnes Caerdydd
Prifysgol Caerdydd

FULL ETHICAL APPROVAL FORM (STAFF/PhD STUDENTS) or students referring their form for a full ethical review

(For guidance on how to complete this form, please see Learning Central – CARBS RESEARCH ETHICS)

If your research will involve patients or patient data in the NHS then you should secure approval from the NHS National Research Ethics Service. Online applications are available on http://www.nres.npsa.nhs.uk/applicants/

Name of Lead Researcher : Dong-Wook Kwak

School: CARBS

Email: kwakd@cf.ac.uk

Names of other Researchers: None

Email addresses of other Researchers : N/A

APPLICATION APPROVED
RESEARCH ETHICS COMMITTEE
CARDIFF BUSINESS SCHOOL
CARDIFF UNIVERSITY

Title of Project: Risk perception in international logistics and the mechanisms in selecting mitigation strategies

Start and Estimated End Date of Project: Oct/2010 - Jan/2014

Aims and Objectives of the Research Project:

- To clarify causal relationships among risk events identified in the focus group research by using interpretive structural modelling

Please indicate any sources of funding for this project:

N/A

1. Describe the methodology to be applied in the project

The purpose of this project is to enhance the findings of focus group research, the first phase of my PhD thesis. This project will use interpretive structural modelling (ISM) as the main analytic methodology. ISM is a qualitative and interpretive method to create a structural mapping of complex interconnections of elements. As the selection of risk events was conducted in focus group research, this project starts with establishing the contextual relation type. It also constructs a structural self-interaction matrix by pairwise comparisons of the risk events, and then develops a reachability matrix and draws a digraph to show the relationships of the risk events.

The implementation of ISM takes a lot of time especially when the number of elements is large. As the total number of risk events in this project is 32, the participants should conduct pairwise comparisons of the elements approximately 500 times. Therefore, it is estimated that the completion of these pairwise comparisons takes at least 3 hours. This disadvantage confines this research to hiring only two groups of participants. Each group consists of one practitioner and one academician so that their knowledge can cover both general and specialised knowledge in

ETHICS 2 (version August 2011)

Ethical Approval 2 (continued)

international logistics. Delphi method will be complementarily used to resolve any different results from the two groups. The rounds of Delphi research will cease when there are no disagreements to the results of pairwise comparisons. Based on these results from pairwise comparisons, reachability matrix, driving power & dependence diagram and the digraph will be produced.

PLEASE ATTACH COPIES OF QUESTIONNAIRES OR INTERVIEW TOPIC GUIDES TO THIS APPLICATION

2. Describe the participant sample who will be contacted for this Research Project. You need to consider the number of participants, their age, gender, recruitment methods and exclusion/inclusion criteria

At the pairwise comparison stage, two practitioners and two academicians will be invited. One practitioner is a manager of a shipper firm and the other is a manager in a logistics provider firm. Two academicians are skilled researchers who have experiences in operations of international logistics. At the Delphi stage, panels of four practitioners will be invited. All the participants are also selected among the 36 participants in the previous focus group research regardless of age and gender.

3. Describe the method by which you intend to gain consent from participants.

"Informed Consent Document" will be sent together with the cover letter to the participants. This document, hereto attached, clearly states the objective and process of the research and also mentions the right of participants to withdraw from the research. This document will help participants easily understand the research.

PLEASE ATTACH A COPY OF ALL INFORMATION WHICH WILL BE GIVEN TO PROSPECTIVE PARTICIPANTS (including invitation letter, briefing documents and, if appropriate, the consent form you will be using).

4. Please make a clear and concise statement of the ethical and health and safety considerations - http://www.cf.ac.uk/osheu/index.html - raised by the project and how you intend to deal with them (please use additional sheets where necessary)

There might be some issues on the confidentiality of participating firms although the chance is very slight. To prevent these issues, the names or other indicating mentions about a specific company will not appear in the research project. All data will be anonymised and, once the research project is completed, the data will be destroyed within a year. No issues relating to health and safety are expected to be raised in this project.

STUDENTS SHOULD BIND THE SIGNED AND APPROVED FORM INTO THEIR REPORT, DISSERTATION OR THESIS

ETHICS 2 (version August 2011)

Ethical Approval 2 (continued)

Please complete the following in relation to your research project:

		Yes	No	n/a
(a)	Will you describe the main details of the research process to participants in advance, so that they are informed about what to expect?	☒	☐	☐
(b)	Will you tell participants that their participation is voluntary?	☒	☐	☐
(c)	Will you obtain written consent for participation?	☒	☐	☐
(d)	Will you tell participants that they may withdraw from the research at any time and for any reason?	☒	☐	☐
(e)	If you are using a questionnaire, will you give participants the option of omitting questions they do not want to answer?	☒	☐	☐
(f)	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐	☐
(g)	Will you offer to send participants findings from the research (e.g. copies of publications arising from the research)?	☒	☐	☐
(h)	If working with children and young people please confirm that you have given due consideration to University guidance available at: http://www.cardiff.ac.uk/govrn/cocom/resources/2010%20November%20Safeguarding%20Children%20&%20VA's.doc	☒		

PLEASE NOTE:
If you have ticked **No** to any of 5(a) to 5(g), please give an explanation on a separate sheet.
(Note: N/A = not applicable)
There is an obligation on the principal researcher/student to bring to the attention of Cardiff Business School Ethics Committee any issues with ethical implications not clearly covered by the above checklist.

Signed:
(Principal Researcher/Student) D. W. Kwak

Print Name: Dong-Wook Kwak

Date: 18 / Apr / 2013

SUPERVISOR'S DECLARATION (Student researchers only): As the supervisor for this student project I confirm that I believe that all research ethical issues have been dealt with in accordance with University policy and the research ethics guidelines of the relevant professional organisation.

Signed: aKC Beresford

Print Name: A. K. C. BERESFORD

Date: 18 / 4 / 13

TWO copies of this form (and attachments) MUST BE OFFICIALLY STAMPED by Ms Lainey Clayton, Room F43, Cardiff Business School

STATEMENT OF ETHICAL APPROVAL

This project has been considered using agreed School procedures and is now approved.

Official stamp of approval of the School
Research Ethics Committee:

Date:

ETHICS 2 (version August 2011)

Appendix C - Ethical Approval 3

ETHICS 2

Cardiff Business School
Cardiff University

Ysgol Fusnes Caerdydd
Prifysgol Caerdydd

FULL ETHICAL APPROVAL FORM (STAFF/PhD STUDENTS) or students referring their form for a full ethical review

(For guidance on how to complete this form, please see Learning Central – CARBS RESEARCH ETHICS)

If your research will involve patients or patient data in the NHS then you should secure approval from the NHS National Research Ethics Service. Online applications are available on http://www.nres.npsa.nhs.uk/applicants/

Name of Lead Researcher : **Dong-Wook Kwak**

School: Cardiff Business School

Email: kwakd@cf.ac.uk

Names of other Researchers:

Email addresses of other Researchers :

APPLICATION APPROVED
RESEARCH ETHICS COMMITTEE
CARDIFF BUSINESS SCHOOL
CARDIFF UNIVERSITY

Title of Project:

Managing risks in international maritime logistics: risk perception and the mechanisms in selecting mitigation strategies (3rd Phase)

Start and Estimated End Date of Project: Oct/2010 - Apr/2014

Aims and Objectives of the Research Project:

To investigate risk management strategies in international logistics operartions and motives/factors that affect the selection of strategies

Please indicate any sources of funding for this project:

None

1. Describe the methodology to be applied in the project

Semi-structured interviews will be applied as the primary method of data collection in this research project. Firstly, the participants will be asked several questions in respect to the major uncertainties/risks in their logistics operations and their organisational responses in order to avoid or mitigate the risk events. Secondly, the factors or motives that affect selection of the organisational strategies will be sought. Lastly, the interview will seek the opinions of participants as to whether implementation of the strategies is sufficiently effective to lower their levels of risk exposure, in consideration of costs and benefits from the implementation. The detailed research agenda is attached at the end of this form.

The interview will be conducted mainly via telephone and will be tape-recorded for transcription. Each interview is expected to take 60 minutes to complete.

PLEASE ATTACH COPIES OF QUESTIONNAIRES OR INTERVIEW TOPIC GUIDES TO THIS APPLICATION

ETHICS 2 (version August 2011)

Ethical Approval 3 (continued)

2. Describe the participant sample who will be contacted for this Research Project. You need to consider the number of participants, their age, gender, recruitment methods and exclusion/inclusion criteria

The population of this research is the companies who operate international logistics from/to South Korea. As this research considers 'strategic fit' of different strategies, two criteria will be employed in selecting samples among the population. The first criterion is the size of companies: the sample will consist of the same number of people from large- and small-sized companies respectively. The second criterion is the industry they belong to. The sample will be a mixture of exporting/importing companies and international logistics intermediaries. As each company group (i.e. the group of small-sized freight forwarding companies) will have 2 participants, the number of participating firms for this research will be 8 in total. Selective convenience sampling will be applied due to these criteria. The age and gender of participants are not important, but their working experience and job positions will matter. This research is planning to recruit participants in managerial/directorial positions and/or with at least 10-year experience in international logistics.

3. Describe the method by which you intend to gain consent from participants.

A "Consent Form" will be sent to the participants together with the invitation letter and interview agenda. These documents, hereto attached, will clearly state the objective and process of the research and also mentions the right of participants to withdraw from the research. This document will help participants easily understand the research and consent to their participation. The signed consent form will be collected as an electronic format because the majority of interviews will be conducted via phone.

PLEASE ATTACH A COPY OF ALL INFORMATION WHICH WILL BE GIVEN TO PROSPECTIVE PARTICIPANTS (including invitation letter, briefing documents and, if appropriate, the consent form you will be using).

4. Please make a clear and concise statement of the ethical and health and safety considerations - http://www.cf.ac.uk/osheu/index.html ***- raised by the project and how you intend to deal with them (please use additional sheets where necessary)***

There might be some issues on the confidentiality of participating firms although the chance is very slight. To prevent these issues, the names or other mentions indicative of a specific company will not appear in the research project. All data will be anonymised and, once the research project is completed, the data will be destroyed within a year. No issues relating to health and safety are expected to be raised in this project.

STUDENTS SHOULD BIND THE SIGNED AND APPROVED FORM INTO THEIR REPORT, DISSERTATION OR THESIS

APPLICATION APPROVED
RESEARCH ETHICS COMMITTEE
CARDIFF BUSINESS SCHOOL
CARDIFF UNIVERSITY

ETHICS 2 (version August 2011)

Ethical Approval 3 (continued)

Please complete the following in relation to your research project:

		Yes	No	n/a
(a)	Will you describe the main details of the research process to participants in advance, so that they are informed about what to expect?	☒	☐	☐
(b)	Will you tell participants that their participation is voluntary?	☒	☐	☐
(c)	Will you obtain written consent for participation?	☒	☐	☐
(d)	Will you tell participants that they may withdraw from the research at any time and for any reason?	☒	☐	☐
(e)	If you are using a questionnaire, will you give participants the option of omitting questions they do not want to answer?	☒	☐	☐
(f)	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐	☐
(g)	Will you offer to send participants findings from the research (e.g. copies of publications arising from the research)?	☒	☐	☐
(h)	If working with children and young people please confirm that you have given due consideration to University guidance available at: http://www.cardiff.ac.uk/govrn/cocom/resources/2010%20November%20Safeguarding%20Children%20&%20VA's.doc	☐		

PLEASE NOTE:
If you have ticked **No** to any of 5(a) to 5(g), please give an explanation on a separate sheet.
(Note: N/A = not applicable)
There is an obligation on the principal researcher/student to bring to the attention of Cardiff Business School Ethics Committee any issues with ethical implications not clearly covered by the above checklist.

Signed:
(Principal Researcher/Student) D. W. Kwak

Print Name: DONG-WOOK KWAK

Date: 13 Jan 2014

APPLICATION APPROVED
RESEARCH ETHICS COMMITTEE
CARDIFF BUSINESS SCHOOL
CARDIFF UNIVERSITY

SUPERVISOR'S DECLARATION (Student researchers only): As the supervisor for this student project I confirm that I believe that all research ethical issues have been dealt with in accordance with University policy and the research ethics guidelines of the relevant professional organisation.

Signed:

Print Name: PROF. ANTHONY K. C. BERESFORD

Date: 13 – 01 – 14

APPLICATION APPROVED
RESEARCH ETHICS COMMITTEE
CARDIFF BUSINESS SCHOOL
CARDIFF UNIVERSITY

TWO copies of this form (and attachments) MUST BE OFFICIALLY STAMPED by Ms Lainey Clayton, Room F43, Cardiff Business School

STATEMENT OF ETHICAL APPROVAL

This project has been considered using agreed School procedures and is now approved.

Official stamp of approval of the School Research Ethics Committee: D Foster / Chair

Date: 7/2/2014

ETHICS 2 (version August 2011)

Appendix D - Ethical Approval 4

ETHICS 2

Cardiff Business School
Cardiff University

Ysgol Fusnes Caerdydd
Prifysgol Caerdydd

FULL ETHICAL APPROVAL FORM
(STAFF/PhD STUDENTS) or students referring their form for a full ethical review

(For guidance on how to complete this form, please see Learning Central – CARBS RESEARCH ETHICS)

If your research will involve patients or patient data in the NHS then you should secure approval from the NHS National Research Ethics Service. Online applications are available on http://www.nres.npsa.nhs.uk/applicants/

Name of Lead Researcher : Dong-Wook Kwak

School: CARBS

Email: kwakd@cf.ac.uk

Names of other Researchers: None

APPLICATION APPROVED
RESEARCH ETHICS COMMITTEE
CARDIFF BUSINESS SCHOOL
CARDIFF UNIVERSITY

Email addresses of other Researchers : N/A

Title of Project: Risk perception in international logistics and the mechanisms in selecting mitigation strategies

Start and Estimated End Date of Project: Oct/2010 - Apr/2014

Aims and Objectives of the Research Project:

- To assess risk perception of shipper firms with regard to disruptions/disturbances in international logistics
- To investigate the mechanisms in selecting a risk mitigation strategy

Please indicate any sources of funding for this project:

N/A

1. Describe the methodology to be applied in the project

This project is the second and third phase of my PhD thesis with using questionnaire survey as the data collection method. The questionnaire comprises of four distinctive parts. The first part is the personal and corporate information of participants which will be analysed to be used for multi-group analysis. It consists of a dozen of multiple choice questions to collect categorical data. The second part is aimed to assess disruptions/disturbances in international logistics by asking likelihood and various facets of impacts of each individual risk event. It uses 5-point scale questions. The third part is devised to evaluate risk perceptions with using analytic hierarchy process. It comprises of pair-wise comparisons questions which directly compare two risk events. The last part aims to investigate the contexts and mechanisms in selecting risk mitigating strategies in international logistics and to examine the effectiveness of the appropriate mitigation strategies. It also uses 7-point scale so that the results can be used for structural equation modelling.

Several analysis techniques will be used to analyse the collected data: matrices analysis and analytical hierarchy process (AHP) for the second phase, and structural equation modelling for the

ETHICS 2 (version August 2011)

Ethical Approval 4 (continued)

third phase of my PhD thesis.

APPLICATION APPROVED
RESEARCH ETHICS COMMITTEE
CARDIFF BUSINESS SCHOOL
CARDIFF UNIVERSITY

PLEASE ATTACH COPIES OF QUESTIONNAIRES OR INTERVIEW TOPIC GUIDES TO THIS APPLICATION

2. Describe the participant sample who will be contacted for this Research Project. You need to consider the number of participants, their age, gender, recruitment methods and exclusion/inclusion criteria

The target participants of this research are shippers (both exporters and importers) involved in international multimodal logistics whose main transport mode is container shipping. The sample group will be short-listed to approximately 1,000 Korean international trade companies registered to the Korea International Trade Association. This project prefers two participants per each company, but the response from one participant will be also accepted. The questionnaire will be distributed via e-mail to CEO, COO, Directors of Logistics, Directors of Supply Chain, Managers in Logistics Departments, or other similar positions in the companies. Their ages will vary and gender will not be concerned.

3. Describe the method by which you intend to gain consent from participants.

"Informed Consent Document" will be sent together with cover letter and the questionnaire via e-mail to the participants. The document, hereto attached, clearly states the objective and process of the research and also mentions the right of participants to withdraw from the research. This document will help participants to easily understand the research and to reach the consent to fill out questionnaires.

PLEASE ATTACH A COPY OF ALL INFORMATION WHICH WILL BE GIVEN TO PROSPECTIVE PARTICIPANTS (including invitation letter, briefing documents and, if appropriate, the consent form you will be using).

4. Please make a clear and concise statement of the ethical and health and safety considerations - http://www.cf.ac.uk/osheu/index.html - raised by the project and how you intend to deal with them (please use additional sheets where necessary)

There might be some issues on the confidentiality of participating firms although the chance is very slight. To prevent these issues, the names or other indicating mentions about a specific company will not appear in the research project. All data will be anonymised and, once the research project is completed, the data will be destroyed within a year.

No issues relating to health and safety will be raised in this project because this is questionnaire survey via e-mail without any face-to-face contacts.

STUDENTS SHOULD BIND THE SIGNED AND APPROVED FORM INTO THEIR REPORT, DISSERTATION OR THESIS

ETHICS 2 (version August 2011)

Ethical Approval 4 (continued)

Please complete the following in relation to your research project:

		Yes	No	n/a
(a)	Will you describe the main details of the research process to participants in advance, so that they are informed about what to expect?	☒	☐	☐
(b)	Will you tell participants that their participation is voluntary?	☒	☐	☐
(c)	Will you obtain written consent for participation?	☒	☐	☐
(d)	Will you tell participants that they may withdraw from the research at any time and for any reason?	☒	☐	☐
(e)	If you are using a questionnaire, will you give participants the option of omitting questions they do not want to answer?	☒	☐	☐
(f)	Will you tell participants that their data will be treated with full confidentiality and that, if published, it will not be identifiable as theirs?	☒	☐	☐
(g)	Will you offer to send participants findings from the research (e.g. copies of publications arising from the research)?	☒	☐	☐
(h)	If working with children and young people please confirm that you have given due consideration to University guidance available at: http://www.cardiff.ac.uk/govrn/cocom/resources/2010%20November%20Safeguarding%20Children%20&%20VA's.doc	☒		

PLEASE NOTE:
If you have ticked **No** to any of 5(a) to 5(g), please give an explanation on a separate sheet.
(Note: N/A = not applicable)
There is an obligation on the principal researcher/student to bring to the attention of Cardiff Business School Ethics Committee any issues with ethical implications not clearly covered by the above checklist.

Signed:
(Principal Researcher/Student) D. W. Kwak

Print Name: DONG-WOOK KWAK

Date: 14 / May / 2013

SUPERVISOR'S DECLARATION (Student researchers only): As the supervisor for this student project I confirm that I believe that all research ethical issues have been dealt with in accordance with University policy and the research ethics guidelines of the relevant professional organisation.

Signed:

Print Name: PROF. ANTHONY K.C. BERESFORD

Date: 14 MAY 2013

TWO copies of this form (and attachments) MUST BE OFFICIALLY STAMPED by Ms Lainey Clayton, Room F43, Cardiff Business School

STATEMENT OF ETHICAL APPROVAL

This project has been considered using agreed School procedures ~~and is~~ now approved.

Official stamp of approval of the School Research Ethics Committee:

APPLICATION APPROVED
RESEARCH ETHICS COMMITTEE
CARDIFF BUSINESS SCHOOL
CARDIFF UNIVERSITY

T. W. Entwistle
21 May 2013.

Date: 21/5/2013

ETHICS 2 (version August 2011)

Appendix E – Questionnaire in English

Survey on the Risk Management Strategies in the international logistics operations

Thank you very much for your participation in this survey. I am Dong-Wook Kwak, a PhD student at Cardiff Business School in the UK.

This questionnaire is designed to understand the risk management strategies in international logistics operations as well as the contexts, motives and outcomes in selecting specific strategies. The responses will be analysed statistically by partial least square structural equation modelling.

The target participants of this survey are logistics professionals who are working for manufacturers, trading companies, 3PL providers and international freight forwarders. It is estimated to take 20 minutes to complete this questionnaire.

The data collected from this survey will be treated with full confidentiality. As your response will be analysed statistically, your identity will not appear in the research paper. While you are completing the questionnaire, you may omit some questions if you do not want to answer. In addition, you may withdraw from this research any time and for any reason by sending a written request to me. If you would like to receive the result of this research, I would be happy to provide it to you once it is published.

It would be appreciated if you could send the completed questionnaire to **kwakd@cf.ac.uk**. If you have any queries regarding the survey, please do not hesitate to contact me.

Thank you very much.

Yours Sincerely,

Dong-Wook Kwak
(under supervision of Professor Anthony Beresford)
Cardiff Business School, United Kingdom

1. Please indicate your opinions on the following statements regarding the contexts of your logistics operations.
(1: "Strongly Disagree"- No middle point - 6: "Strongly Agree")

Available Resources	Disagree <-----> Agree					
We have sufficient human resources to be used for the management of logistics risks.	1	2	3	4	5	6
We have sufficient financial resources to be used for the management of logistics risks.	1	2	3	4	5	6

Corporate Culture	Disagree <-----> Agree					
We have corporate culture to proactively identify and remove any possible risks.	1	2	3	4	5	6

Risk Characteristics	Disagree <-----> Agree					
The logistics risks that we concern most are neither recurrent nor easily anticipated.	1	2	3	4	5	6

Relationships	Disagree <-----> Agree					
We think that our supply chain partners provide reliable and dependable logistics operations.	1	2	3	4	5	6
We think that our supply chain partners are always sincere and trustworthy to us.	1	2	3	4	5	6

Influence	Disagree <-----> Agree					
We have influential power that can change the processes or behaviours of our supply chain partners.	1	2	3	4	5	6

Innovation Initiatives	Disagree <-----> Agree					
Our company provides time and resources for employees to generate, exchange and experiment with innovative logistics ideas/solutions.	1	2	3	4	5	6
Our supply chain partners try to apply innovative logistics ideas/solutions to our logistics operations.	1	2	3	4	5	6

2. Please indicate your opinions on the following statements regarding the motives of risk management strategies.
(1: "Strongly Disagree"- 4: "Neutral" - 7: "Strongly Agree")

Logistics Complexity	Disagree <-----------> Agree						
Our logistics network is complex due to a number of nodes and flows.	1	2	3	4	5	6	7
The timeliness of the cargo movement is crucial to our logistics.	1	2	3	4	5	6	7
We often have difficulties in meeting the logistics process required by specific regions or customers.	1	2	3	4	5	6	7
Our products require high security or specialised handling.	1	2	3	4	5	6	7

Logistics Disruption Orientation	Disagree <-----------> Agree						
We feel the need to be alert for possible logistics disruptions at all times.	1	2	3	4	5	6	7
Logistics disruptions show us where we can improve.	1	2	3	4	5	6	7
We recognise that logistics disruptions are always looming.	1	2	3	4	5	6	7
After a logistics disruption has occurred, it is analysed thoroughly.	1	2	3	4	5	6	7

Customer Orientation	Disagree <-----------> Agree						
We anticipate, understand and respond to customers' needs and wants in logistics operations.	1	2	3	4	5	6	7
We evaluate and follow-up customer complaints and feedback in our logistics operations.	1	2	3	4	5	6	7
We interact with customers to create greater values in our logistics standards.	1	2	3	4	5	6	7
Satisfying customer needs is the main objective of our logistics operations.	1	2	3	4	5	6	7

Quality Orientation	Disagree <-----------> Agree						
Our logistics strategy cannot be described as the one to transport products with the lowest price.	1	2	3	4	5	6	7
Our logistics strategy is based on quality performance rather than price.	1	2	3	4	5	6	7
Our logistics strategy places greater emphasis on reliability than price.	1	2	3	4	5	6	7
Our logistics strategy places greater emphasis on flexibility than price.	1	2	3	4	5	6	7

Innovation	Disagree <-----------> Agree						
We pursue a cutting-edge system that can integrate information across global supply chain.	1	2	3	4	5	6	7
We pursue the technology for the real-time tracking in global supply chain, such as RFID, QR Code or PDA.	1	2	3	4	5	6	7
We pursue innovative vehicles, packages or other physical assets across global supply chain.	1	2	3	4	5	6	7
We pursue continuous innovation in core global supply chain processes.	1	2	3	4	5	6	7
We pursue agile and responsive processes against changes across global supply chain.	1	2	3	4	5	6	7
We pursue creative methods and/or service in global supply chain operations.	1	2	3	4	5	6	7

3. Please indicate to what extent you pursue the following logistics risk management strategies.
(1: "Not at all"; 4: "Moderately" - 7: "Very much")

Designing a stable logistics system	Not at all <------> Very much						
We strive to avoid any risky geo-political areas, transport modes or transport routes.	1	2	3	4	5	6	7
We strive to have multiple transport modes/routes or supply chain partners as back-ups in case of disruption.	1	2	3	4	5	6	7
We strive to devise and abide by a standard procedure and process for logistics.	1	2	3	4	5	6	7
We strive to purchase an insurance that can entirely cover the losses from international logistics.	1	2	3	4	5	6	7

Managing and utilising logistics information	Not at all <------> Very much						
We strive to improve visibility by investing into an integrated information system that can transparently monitor the entire logistics processes.	1	2	3	4	5	6	7
We strive to foster the internal capability to pursue real time evaluation on causes and effects of risks by integrated information management.	1	2	3	4	5	6	7
We strive to foster the internal capability to make an appropriate decision on the responses to disruptions based on the logistics information.	1	2	3	4	5	6	7
We strive to have an information system that can collect and disseminate the variety of data needed along the logistics process in real-time.	1	2	3	4	5	6	7
We strive to foster the internal risk management capability by accumulating and distributing the knowledge/experience/skills based on the integrated information management.	1	2	3	4	5	6	7

Exploiting a strict outsourcing contract	Not at all <------> Very much						
We strive to consistently monitor and audit supply chain partners' processes and performance as stated in the contract.	1	2	3	4	5	6	7
We strive to use approved supply chain partners that consistently meet the quality level by operating a certification programme.	1	2	3	4	5	6	7
We strive to incorporate performance guarantees and associated penalty clauses into the outsourcing contracts.	1	2	3	4	5	6	7
We strive to use multiple criteria in contracting with supply chain partners in order to allocate specific tasks to the most appropriate partner.	1	2	3	4	5	6	7
We strive to make supply chain partners responsible to develop risk mitigation plans and to involve at the initial stage of risk occurrence.	1	2	3	4	5	6	7

Developing logistics collaboration	Not at all <------> Very much						
We strive to create a long-term, exclusive and closer partnership with key supply chain partners based on trust.	1	2	3	4	5	6	7
We strive to share critical, complete and even confidential information with our supply chain partners for risk management.	1	2	3	4	5	6	7
We strive to set up various communication channels with our supply chain partners in order to enhance the frequency and quality of communication.	1	2	3	4	5	6	7
We strive to jointly create risk management knowledge and plan risk management strategies with our supply chain partners.	1	2	3	4	5	6	7
We strive to align logistics objectives and performance level with our supply chain partners and support them to meet the objectives.	1	2	3	4	5	6	7

4. Please indicate your opinion on the following statements regarding the outcomes of logistics risk management.
(1: "Strongly Disagree"- 4: "Neutral" - 7: "Strongly Agree")

Robustness Capability	Disagree <-----------> Agree						
We are able to remain effective and sustain logistics operations even when internal/external disruptions occur.	1	2	3	4	5	6	7
We are able to avoid or minimise risk occurrence by anticipating and preparing for them.	1	2	3	4	5	6	7
We are able to absorb a significant level of negative impacts from recurrent risks.	1	2	3	4	5	6	7
We are able to have sufficient time in considering the most effective reactions even when disruption occurs.	1	2	3	4	5	6	7

Resilience Capability	Disagree <-----------> Agree						
We are able to adapt to the disruptive situations by quickly re-engineering logistics processes.	1	2	3	4	5	6	7
We are able to promptly and adequately respond to logistics disruptions.	1	2	3	4	5	6	7
We are able to quickly recover from disruptions to the previous performance level or to a more desirable level.	1	2	3	4	5	6	7
We are able to reduce the extent of negative impacts from disruptions by minimising the sustaining time of the disruptions with quick responses.	1	2	3	4	5	6	7

Competitive Advantage	Disagree <-----------> Agree						
We have competitive advantage in the efficient logistics operations.	1	2	3	4	5	6	7
We have a competitive advantage in the effective logistics operations.	1	2	3	4	5	6	7
We have a competitive advantage in differentiating our logistics operations.	1	2	3	4	5	6	7
We have a competitive advantage in the reputation of our excellent logistics operations.	1	2	3	4	5	6	7

5. Please indicate the most appropriate answers to the following questions regarding you and your company.

Industry: How would you describe the industry your company is placed?		
(1) Finished Goods Manufacturer	(2) Half-finished Goods Manufacturer	
(3) Raw Material Exporter/Importer	(4) Trading Company	
(5) 3PL Provider	(6) International Freight Forwarder	(7) Others

Annual Sales: What is the annual sales of your company in 2013?		
(1) Less than $1M	(2) $1M - $99M	(3) $100M - $499M
(4) $500M - $999M	(5) $1b - $4.99b	(6) Over $5b

No of Employees: How many employees does your company have?		
(1) Less than 25	(2) 25 - 100	(3) 101 - 300
(4) 301 - 1000	(5) 1001 - 5000	(6) Over 5000

Cargo Volume: How many containers does your company export/import per a month?		
(1) Less than 5 TEU/FEU	(2) 5 - 20	(3) 21 – 50
(4) 51 - 100	(5) 101 - 400	(6) Over 400 TEU/FEU

Position: What is your position in the company?		
(1) CEO	(2) Directors	(3) General Manager
(4) Manager	(5) Associate	

Career: How many years have you worked in the logistics-related industry?		
(1) Less than 4 years	(2) 4 - 7 years	(3) 8 - 11 years
(4) 12 - 15 years	(5) 16 - 19 years	(6) Over 20 years

Thank you

Appendix F – Questionnaire in Korean

국제 물류 위험 관리 전략에 관한 설문조사

안녕하십니까? 먼저 설문조사에 참여하여 주신 것에 대하여 깊은 감사를 드립니다. 저는 영국 카디프 대학에서 국제 물류에서의 리스크 관리에 대해 연구하고 있는 박사 과정생 곽동욱이라고 합니다.

본 설문지는 국제 물류를 수행함에 있어서 활용할 수 있는 위험 관리 전략에는 어떤 것들이 있는지, 그리고 그러한 전략은 어떤 요인에 의해 영향을 받으며 어떠한 결과를 가져오는지에 대해 알아보기 위해 설계 되었습니다.

본 설문은 **제조업체, 무역업체, 3PL 업체, 포워더 업체의 대표이사 또는 수출입 물류 담당 임직원**을 대상으로 하고 있습니다. 본 설문지를 다 작성하시는데 **약 20 분**의 시간이 소요될 것으로 예상됩니다.

완성하여 송부하여 주신 설문지는 본 연구를 위해서만 사용될 예정입니다. 응답하신 내용은 통계적으로 처리되기 때문에, 익명성과 비밀은 철저히 보장됨을 밝혀 드립니다. 설문지는 연구가 종료되는 시점부터 약 1 년간 보관되었다가 폐기될 예정입니다. 연구 참여는 철회하실 수 있으며, 연구의 결과를 원하시는 경우에는 연구 결과가 발표되는 대로 송부 드리도록 하겠습니다.

설문을 작성하시는 동안 질문이 있으시면 언제든 dongwook.kwak@gmail.com 또는 kwakd@cf.ac.uk 으로 질문을 보내 주시면 감사하겠습니다.

다시 한 번 참여에 감사 드립니다.

카디프 대학 박사과정생
(지도교수: Prof Anthony Beresford)
곽동욱 배상

<table>
<tr><td rowspan="2">연락처</td><td>전화</td><td>+44 (0)75 7839 7421 / +82 (0)70 8238 8578</td></tr>
<tr><td>이메일</td><td>kwakd@cf.ac.uk / dongwook.kwak@gmail.com</td></tr>
<tr><td>지도교수 연락처</td><td>이메일</td><td>Beresford@cf.ac.uk</td></tr>
</table>

1. 귀사의 국제물류 위험관리의 결정요인들에 대한 질문입니다. 아래 항목들에 대한 귀하의 의견을 표시하여 주시기 바랍니다.

(1: "전혀 동의하지 않음" – 6: "매우 동의함)

가용 자원	동의 않음 <------> 동의함					
우리 회사에는 물류의 위험을 관리하는데 사용할 수 있는 충분한 인적 자원이 있는 편이다.	1	2	3	4	5	6
우리 회사에는 물류의 위험을 관리하는데 사용할 수 있는 충분한 물적 자원이 있는 편이다.	1	2	3	4	5	6

기업 문화	동의 않음 <------> 동의함					
우리는 발생할 수 있는 위험을 사전에 파악하고 예방하는 기업 문화를 가지고 있는 편이다.	1	2	3	4	5	6

위험의 성격	동의 않음 <------> 동의함					
우리가 물류에 있어서 가장 신경 쓰는 위험은 반복적으로 발생하지 않고 쉽게 예측 되지도 않는 편이다.	1	2	3	4	5	6

관계	동의 않음 <------> 동의함					
우리는 우리의 무역/물류 파트너의 물류 운영이 안정적이며 믿고 맡길 수 있다고 생각한다.	1	2	3	4	5	6
우리는 우리의 무역/물류 파트너가 언제나 우리에게 진실하고 신뢰를 보여 준다고 생각한다.	1	2	3	4	5	6

영향력	동의 않음 <------> 동의함					
우리는 우리의 무역/물류 파트너의 물류 방식이나 행동을 바꿀 수 있는 영향력을 가지고 있는 편이다.	1	2	3	4	5	6

혁신 지향성	동의 않음 <------> 동의함					
우리 회사는 직원들이 혁신적인 물류 아이디어나 솔루션을 발견하고 공유하며 실험해 볼 수 있는 충분한 시간과 자원을 제공하는 편이다.	1	2	3	4	5	6
우리의 무역/물류 파트너는 물류를 운영하는 데 혁신적인 물류 아이디어나 솔루션을 적용해 보려고 노력하는 편이다.	1	2	3	4	5	6

2. 귀사의 국제물류 위험관리의 동기들에 관한 질문입니다. 아래 항목들에 대한 귀하의 의견을 표시하여 주시기 바랍니다.

(1: "전혀 동의하지 않음" – 4: "중립적" – 7: "매우 동의함)

물류 복잡성	동의 않음 <-----------> 동의함						
우리의 물류 네트워크는 다양한 운송방식, 운송지역, 운송업체 등으로 인해 복잡한 편이다.	1	2	3	4	5	6	7
화물 운송의 정시성은 우리의 물류 운영에서 정말 중요하다고 생각한다.	1	2	3	4	5	6	7
우리는 특정 지역이나 특정 고객이 요구하는 물류 프로세스를 맞추는데 어려움을 느낄 때가 종종 있는 편이다.	1	2	3	4	5	6	7
우리가 운송하는 화물은 고도의 보안과 특수한 취급을 요하는 편이다.	1	2	3	4	5	6	7

물류 차질 인식	동의 않음 <-----------> 동의함						
우리는 발생할 수 있는 물류의 차질에 대해 항상 경계심을 가질 필요성을 느끼는 편이다.	1	2	3	4	5	6	7
우리는 물류의 차질을 통해 개선의 여지가 있는 부분을 알 수 있다고 생각한다.	1	2	3	4	5	6	7
우리는 물류의 차질이 언제든 발생할 수 있다고 인식하는 편이다.	1	2	3	4	5	6	7
물류에 차질이 발생한 이후에는 우리는 그것에 대해서 철저히 분석하려는 편이다.	1	2	3	4	5	6	7

고객 지향성	동의 않음 <-----------> 동의함						
우리는 물류 운영에 있어서 고객의 필요나 요구를 예측하고 이해하며 반응하는 편이다.	1	2	3	4	5	6	7
우리는 물류 운영에 관한 고객의 불만이나 피드백을 평가하고 해결해 나가는 편이다.	1	2	3	4	5	6	7
우리는 더 나은 가치를 제공할 수 있도록 고객과의 소통을 통해 물류 표준을 설정하는 편이다.	1	2	3	4	5	6	7
고객의 필요를 만족시키는 것이 우리 물류 운영의 가장 큰 목적이라고 생각한다.	1	2	3	4	5	6	7

품질 지향성	동의 않음 <-----------> 동의함						
우리의 물류 전략은 제품을 가장 저렴한 가격에 운송한다는 한 가지로 국한되지 않는다고 생각한다.	1	2	3	4	5	6	7
우리의 물류 전략은 가격 보다는 양질의 성과에 기반을 두고 있는 편이다.	1	2	3	4	5	6	7
우리의 물류 전략은 가격 보다 확실성을 더 강조하는 편이다.	1	2	3	4	5	6	7
우리의 물류 전략은 가격 보다 유연성을 더 강조하는 편이다.	1	2	3	4	5	6	7

혁신	동의 않음 <-----------> 동의함						
우리는 국제 물류 전과정의 정보를 통합할 수 있는 최신 시스템의 도입을 추구하는 편이다.	1	2	3	4	5	6	7
우리는 RFID, QR Code, PDA 같은 국제 물류의 실시간 인터페이스를 위한 기술의 도입을 추구하는 편이다.	1	2	3	4	5	6	7
우리는 국제 물류에서 혁신적인 기술을 적용한 차량, 포장, 창고 등의 유형자산 도입을 추구하는 편이다.	1	2	3	4	5	6	7
우리는 핵심적인 국제 물류 프로세스에 있어서 지속적인 혁신을 추구하는 편이다.	1	2	3	4	5	6	7
우리는 국제 물류 전과정에 있어서 변화에 기민하게 대응할 수 있는 프로세스를 추구하는 편이다.	1	2	3	4	5	6	7
우리는 국제 물류 운영에 있어서 창의적인 방식이나 서비스를 추구하는 편이다.	1	2	3	4	5	6	7

3. 귀사의 국제물류 위험관리 전략들에 관한 질문입니다. 귀사에서 아래 방안들을 어느 정도 실행하고 계시는지에 대한 의견을 표시하여 주시기 바랍니다.

(1: "전혀 아니다" – 4: "보통임" – 7: "매우 그렇다")

안정적인 물류 방식의 구축	전혀 아니다 <---> 매우 그렇다						
우리 회사는 위험이 큰 지정학적 지역이나 운송 방식 혹은 운송 루트는 피하려고 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 물류 차질에 대비해 복수의 물류 방식/루트 및 무역/물류 파트너를 구비하려고 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 물류의 표준절차와 프로세스를 만들고 이를 준수하려고 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 국제 물류 과정에서의 손실을 100% 커버할 수 있는 보험을 구입하려고 노력하는 편이다.	1	2	3	4	5	6	7

물류 정보의 관리 및 활용	전혀 아니다 <---> 매우 그렇다						
우리 회사는 물류 가시성을 높이기 위한 노력으로 물류 전과정을 투명하게 볼 수 있는 통합 정보 관리 시스템에 투자를 하는 편이다.	1	2	3	4	5	6	7
우리 회사는 물류 과정에서 요구되는 다양한 데이터들을 실시간으로 수집하고 전달하는 시스템을 갖추고자 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 통합 물류 관리를 통해서 위험의 원인과 영향을 실시간으로 평가할 수 있는 내부 역량을 키우고자 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 물류 정보를 기반으로 위험에 대한 올바른 대응 방안을 결정 할 수 있는 내부 역량을 키우고자 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 통합 정보 관리를 기반으로 지식/경험/기술을 사내에 축적하고 보급함으로써 위험관리를 위한 내부 역량을 키우고자 노력하는 편이다.	1	2	3	4	5	6	7

엄격한 아웃소싱 계약의 이용	전혀 아니다 <---> 매우 그렇다

우리 회사는 무역/물류 파트너가 계약에 명시된 대로 행동하고 성과를 내는지 지속적으로 모니터링 하고자 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 자체 인증 제도 등을 통해서 지속적으로 우리의 품질 기준을 만족시킨 무역/물류 파트너만을 사용하고자 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 성과에 대한 약속과 그에 대한 벌칙 조항을 무역/물류 계약에 삽입(하여 파트너들의 자발적인 위험 관리를 유도)하려고 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 특정 업무에 가장 적합한 업체와 계약하기 위해 무역/물류 파트너 선정 시 다수의 평가 기준을 사용하려고 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 무역/물류 파트너에게 위험 대처 계획을 수립하고 위험 발생시 일차적으로 대응할 책임을 부과하려고 노력하는 편이다.	1	2	3	4	5	6	7

물류 협력 관계 구축	전혀 아니다 <---> 매우 그렇다						
우리 회사는 신뢰를 바탕으로 하여 주요한 무역/물류 파트너들과 장기적이고 긴밀한 파트너쉽을 형성하려고 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 위험 관리를 위해 기밀을 포함한 중요하고 완전한 모든 정보를 무역/물류 파트너들과 공유하려고 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 무역/물류 파트너들과의 커뮤니케이션 빈도와 질을 높이기 위해서 다양한 커뮤니케이션 채널을 만들려고 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 무역/물류 파트너들과 공동으로 위험 관리 관련 지식을 구축하고 위험 관리 대응 방안을 함께 계획하고자 노력하는 편이다.	1	2	3	4	5	6	7
우리 회사는 무역/물류 파트너들과 물류에서의 목표와 성과 수준을 사전에 조율해 나가며, 그들이 목표에 도달할 수 있도록 협조하고자 하는 편이다.	1	2	3	4	5	6	7

4. 귀사의 위험관리 역량과 경쟁우위에 관한 질문입니다. 아래 항목들에 대한 귀하의 의견을 표시하여 주시기 바랍니다.

(1: “전혀 동의하지 않음” – 4: “중립적” – 7: “매우 동의함)

내외부 충격에도 흔들림 없는 역량	동의 않음 <-----------> 동의함						
우리 회사는 내/외부적인 물류 차질이 발생하더라도 지속적이고 효과적으로 물류를 운영해 나갈 수 있는 편이다.	1	2	3	4	5	6	7
우리 회사는 위험을 예측하고 대비함으로써 위험의 발생을 미연에 방지하거나 줄일 수 있는 편이다.	1	2	3	4	5	6	7
우리 회사는 재발되는 위험의 부정적인 영향은 상당부분 완충할 수 있는 역량이 있는 편이다.	1	2	3	4	5	6	7
우리 회사는 물류 차질이 발생하더라도 충분한 시간을 가지고 가장 효과적인 대응책을 강구할 수 있는 편이다.	1	2	3	4	5	6	7

신속히 대응하고 회복하는 역량	동의 않음 <-----------> 동의함						
우리 회사는 신속하게 물류 과정을 재설계 함으로써 긴급 상황에 적응해 나갈 수 있는 편이다.	1	2	3	4	5	6	7
우리 회사는 물류 차질 발생 시 신속하고 적절하게 대처할 수 있는 편이다.	1	2	3	4	5	6	7
우리 회사는 물류 차질이 발생하더라도 기존의 성과 수준이나 그 이상의 수준으로 빠르게 회복할 수 있는 편이다.	1	2	3	4	5	6	7
우리 회사는 신속한 대응으로 물류 차질이 지속되는 시간을 최소화 함으로써 위험의 부정적인 영향을 어느 정도 줄일 수 있는 편이다.	1	2	3	4	5	6	7

경쟁 우위	동의 않음 <-----------> 동의함						
우리는 효율적인 물류 운영에 있어서 경쟁 우위를 가지는 편이다.	1	2	3	4	5	6	7
우리는 효과적인 물류 운영에 있어서 경쟁 우위를 가지는 편이다.	1	2	3	4	5	6	7
우리는 물류 운영의 차별화 있어서 경쟁 우위를 가지는 편이다.	1	2	3	4	5	6	7
우리는 탁월한 물류 운영에 대한 평판에 있어서 경쟁 우위를 가지는 편이다.	1	2	3	4	5	6	7

5. 귀하와 귀사에 대한 일반적인 질문입니다. 가장 알맞은 항목에 표시해 주시기 바랍니다.

업종: 귀사는 어떠한 업종에 종사하고 계십니까?			
(1) 완제품 제조업체	(2) 반제품 제조업체	(3) 원재료 수출입 가공업체	
(4) 무역회사/에이전트	(5) 3PL 업체	(6) 프레이트 포워더	(7) 기타

연간 매출액: 2013 년도 귀사의 매출액은 어느 정도였습니까?		
(1) 10 억원 미만	(2) 10 억 이상 100 억 미만	(3) 100 억 이상 500 억 미만
(4) 500 억 이상 1 조원 미만	(5) 1 조 이상 5 조 미만	(6) 5 조원 이상

직원 수: 귀사의 직원 수는 어느 정도입니까?		
(1) 25 인 미만	(2) 25 명 - 100 명	(3) 101 명 - 300 명
(4) 301 명 - 1000 명	(5) 1001 명 - 5000 명	(6) 5000 명 이상

화물량: 귀사는 한 달에 얼마나 많은 화물을 수출입 하십니까?		
(1) 5 TEU/FEU 미만	(2) 5 - 20	(3) 21 - 50
(4) 51 - 100	(5) 101 - 400	(6) 400 TEU/FEU 초과

직위: 귀하의 직위는 무엇입니까?		
(1) 대표이사급	(2) 임원급	(3) 부장/팀장급
(4) 과장/대리급	(5) 사원급	

경력: 귀하께서는 국제 물류 관련 업무에 몇 년간 종사하셨습니까?		
(1) 4 년 미만	(2) 4 년 - 7 년	(3) 8 년 - 11 년
(4) 12 년 - 15 년	(5) 16 년 - 19 년	(6) 20 년 이상

설문에 참여해 주셔서 감사합니다.

Appendix G – Publications related to this Thesis

<Conference Papers>

Kwak, D.-W., Beresford, A., Pettit, S., Mason, R. and Sanchez-Rodrigues, V. (2012). Risks in international multimodal logistics: focus group research. *In Proceedings of the International Association of Maritime Economists (IAME) Conference 2012*. Taipei, Taiwan.

Kwak, D.-W., Beresford, A., Pettit, S., Mason, R. and Lee, H.-Y. (2014). Risk management strategies for international logistics: conceptualisation and validation. *In Proceedings of the Logistics Research Network Annual Conference 2014*, Huddersfield, UK.

<Journal Papers>

Kwak, D.-W., Beresford, A., Pettit, S., Mason, R. and Sanchez-Rodrigues, V. (in preparation). Interactions of global supply chain risks: risk profile, clusters and structure.

Kwak, D.-W., Beresford, A., Pettit, S., Mason, R. and Sanchez-Rodrigues, V. (in preparation). Four dimensions of risk management strategies for global supply chains