

Copenhagen Business School

Risk Management in Multi-tier Supply Chains: A Systematic Literature Review

Master Thesis
MSc. Supply Chain Management
Department of Operations Management

Supervisor: Dr. Andreas Wieland
STU Count: 168.180
Number of Pages: 74
CPR No.: XXXXXX-XXXX
Hand in date: 15th of September 2016

Student: Christian Jae Hales

TABLE OF CONTENTS

1	List of acronyms.....	3
2	Abstract	4
3	Introduction.....	5
4	Research motivation.....	6
4.1	Literature Review	7
4.2	(A) Overview of Literature Reviews on Risk Management in Supply Chains	7
4.3	(B): Overview of Research on Risk Management and Multi-Tier Risk Management in Supply Chain Perspective	11
4.4	Research Question.....	15
4.5	Definitions of Keywords	15
4.5.1	Supply Chain Management.....	15
4.5.2	Risk.....	19
4.5.3	Supply Chain Risk.....	20
4.5.4	Supply Chain Risk Management (SCRM)	21
4.5.5	Multi-Tier Supply Chain (MSC).....	22
4.5.6	Further Clarifications of Concepts and Keywords	22
5	Methodology	24
5.1	Research Design	24
5.2	Systematic Literature Review (SLR)	25
6	Data Collection	32
6.1	Preparing For Literature Search	32
6.2	Search For Literature	33
6.3	Selection of Pertinent Literature	37
6.3.1	Using Mendeley When Applying The Inclusion and Exclusion Criteria	37
6.3.2	Inclusion and Exclusion of Articles	38
6.3.3	Journal and Impact Factor Concerns	40
7	Analysis.....	41
7.1	Research Findings	42
7.2	MSCRM Activity Map and Research Propositions	49
8	Discussion	57
8.1	Results	57

8.2	Further Improvements	59
8.3	Limitations	61
9	Conclusion	62
10	Implications	62
11	References	64

Figure 1: overview of SCRM literature reviews	10
Figure 2: Definition of supply chain and supply chain management	17
Figure 3: Definition of risk and risk management	20
Figure 4: Supply Chain Risk	20
Figure 5: Overview of research design	24
Figure 6: Five-step guide for SLR (Durach, C. F., Wieland, A. and Kembro 2014)	26
Figure 7: Inclusion and Exclusion Criteria	32
Figure 8: EBSCO BSC Search Strings	34
Figure 9: Screenshot of Mendeley Desktop	38
Figure 10: Impact factor	40
Figure 11: Overview of published MSCRM articles	42
Figure 12: Full list of articles	42
Figure 13: Journal publications	45
Figure 14: Journal Impact Factor	46
Figure 15: Overview of methodology	49
Figure 16: MSCRM activity map	51
Figure 17: MSCM activity map with trends	52

1 LIST OF ACRONYMS

EBSCO BSC	EBSCO Business Source Complete
CSR	Corporate Social Responsibility
IF	Thomson Reuters' Journal Citation Report Impact Factor
MSC	Multi-tier Supply Chain
MSCRM	Multi-tier Supply Chain Risk Management
SCM	Supply Chain Management
SCRM	Supply Chain Risk Management
SLR	Systematic Literature Review

2 ABSTRACT

Introduction: The topic is risk management in multi-tier supply chains. The study is a systematic literature review that will compile and analyse recent literature in the field of risk management in multi-tier supply chains. The review investigates what activities should be used to manage risks in multi-tier supply chains.

Purpose: The purpose of the study is to develop a research overview and agenda for researchers, as well as a guiding overview of multi-tier risk management activities for practitioners.

Method: The paper applies a systematic literature review method as presented by (Durach, C. F., Wieland, A. and Kembro 2014). A number of key words were used to form search strings in EBSCO BSC. A librarian was consulted for quality inspection. To filter the vast amount of published research, the study also included several inclusion criteria for filtering the articles. The articles were documented in reference manager Mendeley.

Analysis: A total number of 389 articles were located in EBSCO BSC, of which only 30 articles were selected for further analysis.

Result: The analysis resulted in a matrix figure outlining the currently studied activities needed to manage risk in multi-tier supply chains. The figure also pointed towards a research agenda, in which nine research propositions were outlined.

Originality/value: The paper extends theory on risk management by looking at it from a multi-tier supply chains perspective. It outlines a much needed research agenda on the topic and a state-of-the-art go to reference for practitioners.

Limitations: The systematic literature review relied heavily on secondary data sources and was conducted by one researcher.

Keywords: Systematic Literature Review, Multi-tier Supply Chains, Risk Management, Supply Chain Management

Paper type: Systematic Literature Review

3 INTRODUCTION

The thesis topic is risk management in multi-tier supply chains. The study is a systematic literature review that will compile and analyse recent literature in the field of risk management in multi-tier supply chains. The purpose of the thesis is to develop a research agenda for scholars in the field, as well as a guiding overview of MSCRM activities for practitioners of risk management in multi-tier supply chains.

Supply chain risks are increasing due to economic and environmental changes (Chen et al. 2013)(Harland et al. 2003). "Risk is everywhere and part of every operation. Therefore, today, risk management is becoming critical part of the organizations' long term goals. Capabilities to managing diverse risks are considered important attributes that differentiate a successful business from others" (Ali & Shukran 2016). Many more scholars agree on this perspective (Blome & Schoenherr 2011) (Cavinato 2004) (Ceryno et al. 2015)(Chang et al. 2015)(Elleuch et al. 2014)(Ellinger et al. 2015). While risk management in supply chains is gaining increasing attention from both practitioners and researchers (Cagliano et al. 2012)(Colicchia et al. 2011)(Fahimnia et al. 2015)(Lavastre et al. 2014) there are still authors who emphasise the need for better risk management practices that can cope with the increasing level of supply chain risks. "Globally expanding supply chains have grown in complexity increasing the nature and magnitude of risks companies are exposed to. Effective methods to identify, model and analyze these risks are needed" (Badurdeen et al. 2014). Several authors subscribe to the idea that due to today's complex business environment supply chain managers are required to manage risks (Faisal et al. 2007)(Giunipero & Eltantawy 2004). The consequences of a lack of risk management in supply chains are high and can have significant negative outcomes. "Understanding and managing supply chain risks is a critical functional competency for today's global enterprises. A lack of this competency can have significant negative outcomes, including costly production and delivery delays, loss of future sales, and a tarnished corporate image. The ability to identify and mitigate risks, however, is complicated as supply chains are becoming increasingly global, complex, and interconnected" (Basole & Bellamy 2014a)(Basole & Bellamy 2014b). Academics argue that it is especially "global supply chains are more risky than domestic supply chains due to numerous links interconnecting a wide network of firms" (Manuj & Mentzer 2008)(Lassar et al. 2010). Activities that could interrupt these links are for example related to political issues, technology, nature and a growing supplier base in multiple countries (Jüttner 2005). Characteristics of today's market place are turbulence and uncertainty (Christopher & Lee 2004). "Risks are associated with every member of the supply

chain” (Daultani et al. 2015). It is necessary to look beyond the first tier of suppliers when analysing risk in the supply chain, and a multi-tier perspective is needed.

It is not only researchers who have focused increasingly on supply chain risk management. Industry experts are also recognising the importance of risk management in supply chains. For example, in a study by global advisory firm KPMG, it is argued that, “the issue of complexity has risen to the top of the business agenda” (KPMG). “Complexity within the supply chain system can be defined as a condition occurring due to the association of numerous inter-related and inter-dependent entities in the supply system using several process inter-connections” (Ghadge et al. 2013).

To capture and leverage opportunities, companies must be able to assess and manage the risk, thus risk management has become increasingly important for many companies. A disruption affecting an entity anywhere in the supply chain can have a direct effect on a corporation’s ability to continue operations, get finished goods to market or provide critical services to customers (Jüttner 2005). A survey by the *Business Continuity Institute (BCI)*, sponsored by Zurich Insurance, looked into the predominant sources of supply chain disruption. The most striking finding was that 31% of the respondents do not analyse the full supply chain to identify the original source of the disruption, and 21% find that the source of disruption was with their supplier’s supplier (tier 2), and 8% find it much lower down the supply chain (BCI, 2015).

In sum, researchers and companies around the world are acknowledging the importance and significance of risk management in supply chains. At the same time, risk management in supply chains has gone from mainly focusing on first tier relationships to encompass multi-tier networks of suppliers. This paper will particular focus on the management of risk in supply chains beyond the first tier, including multiple tiers. It is also an emerging, but still scattered field of research, which has developed and gained increasing interest the past few years.

4 RESEARCH MOTIVATION

There is an emerging field of literature focusing on risk management and multi-tier supply chains. Yet, the literature combining those two fields are scattered and emergning. Thus, this paper aims to map the current MSCRM literature, develop a research agenda and a guiding overview of MSCRM activities for practitioners.

Firstly, the chapter presents previous studies on the topic to define the research motivation behind the study; secondly, a research question for guiding the research and analysis will be proposed, and finally the chapter will conclude by presenting an overview of keyword definitions.

4.1 LITERATURE REVIEW

Main takeaway from the overview of supply chain risk management reviews is that already many research articles has been published, but there is a need for a multi-tier perspective on risk management in supply chain research. Secondly, a brief overview of research on multi-tier risk management in supply chain reveals that the field is scattered and evolving.

This section will introduce previous studies on risk management in a supply chain context and multi-tier supply chains. It will start by outlining most recent literature reviews on supply chain risk management and afterwards an overview of published literature on risk management in multi-tier supply chains. The outcome is a clear overview of the most recent studies in the field, and it should provide a clear research motivation. Based on this research motivation overview, the next section will provide a research question and agenda that will guide the analysis of this paper. The literature review shows that there are already many reviews on risk management literature in the supply chain domain, but also that a multi-tier perspective on risk management is emerging and a review of this literature is overdue.

4.2 (A) OVERVIEW OF LITERATURE REVIEWS ON RISK MANAGEMENT IN SUPPLY CHAINS

This sections aims to provide an insight into the topic of risk management in supply chains. The section will outline the most recent and relevant articles focusing on literature reviews of supply chain risk management. The following paragraph provides an overview of the latest literature reviews on risk management and risk related topics in the field of supply chain management.

Jüttner, Peck, & Christopher (2003) have in their article, made one of the earliest attempts to synthesise supply chain risk management literature. The authors provide a working definition of supply chain risk management and a future research agenda. What is unique about this study is that the authors not only review the literature, but they also compare it to findings from exploratory interviews with practitioners (Jüttner et al. 2003). The paper makes a major contribution to the area of defining the field of SCRM.

Khan and Burnes (2007) review literature to develop a research agenda for risk and supply chain management. They identify key issues and research questions, which need to be addressed in applying risk management to supply chains. Interestingly, they show that there are a number of key debates in the general literature on risk, especially in terms of qualitative versus quantitative approaches, which needs to be recognised by those seek to apply risk theory and risk management approaches to supply chain. Published in 2007, the authors find that studies of risk management in supply chain is in the early stages (Khan & Burnes 2007a). From this point in time, the field of SCRM started to develop more quickly as seen in the increased amount of published literature.

The unique findings from Rao and Goldsby's (2009) paper, is the development of a supply chain risk typology. Their typology includes typology of risk sources, consisting of environmental factors, industry factors, organizational factors, problem specific factors, and decision maker related factors (Rao & Goldsby 2009). By outlining a typology for risk sources, the paper makes a major contribution to practitioners of risk management in supply chains by giving them a guide. This paper has put emphasis on operationalisation of SCRM through the typology development.

More recently, authors have started to look beyond the typical management approach to risk management by looking into more alternative directions. The authors of this review present an integrated perspective on supply chain resilience through an extensive review of the literature in a number of disciplines including developmental psychology and eco systems, as well as identifying some of the gaps in existing literature. They attempt to integrate existing perspectives on resilience through a literature review. They develop a conceptual model they proposed researchers to test empirically (Ponomarov & Holcomb 2009). It is a good example of how the field is pushing boundaries and seek to expand the field. However, this research will focus on reviewing literature only within the supply chain management domain.

Other authors analyse conceptual papers and empirical studies. From summarising the previous research, the authors identify the main principles of supply chain risk management and the steps for its implementation. An interesting contribution of the paper is roadmap to implementation of risk management in supply chains (Pfohl et al. 2010).

In Colicchia & Strozzi 's (2012) literature review of supply chain risk management, they investigate the process of knowledge creation, transfer and development from a dynamic perspective within the context of SCRM. Applying a systematic literature review as method, the authors use a citation network analysis to find the

relevant articles for the literature review. The authors defines this methodology as systematic literature network analysis. The major contribution of this paper is the identification and discussion of research directions found in the paper's analysis, as well as a research agenda that may facilitate the development of models for managing supply chain risk (Colicchia & Strozzi 2012) .

Next, Ghadge et. al (2012) take a holistic systems thinking perspective by considering the different typologies that have evolved because of earlier research. They identify strategic changes in the field as well as future research opportunities. They analyse articles published between 2000-2010. In terms of their method used, the authors cross validated their findings against results obtained from associated text mining activity. They applied a multi perspective descriptive and thematic data analysis. They conclude by stating that supply chain risk management has grown into an established activity over the past decade (Ghadge et al. 2012).

Only recently, literature reviews on risk management in supply chains started to focus more and more on subfields. For example, in one of the most recent attempts to synthesise risk management, Hohenstein et al. (2015) develop propositions to guide future research and identify research needs. The focus of their study is supply chain resilience, and thus only focus on a specific sub theme of risk management. Their findings includes a framework for supply chain resilience (Hohenstein et al. 2015). In another paper published recently, (Durach et al. 2015) review and synthesise studies on supply chain robustness. Their study's findings include a formal definition of supply chain robustness and establishment of a comprehensive theoretical framework. While being a dimension within or around risk management, this study see a need for compiling studies on risk management in multi-tier supply chains particularly (Durach et al. 2015).

One of the most recent, published literature reviews on supply chain risk management provide practitioners and researchers with the most comprehensive overview of the field to date. Besides providing a very comprehensive review and synthesis of ten years of SCRM literature, they provide an important recent definition of supply chain risk and SCRM (Ho et al. 2015).

The most recent papers proves that the field has established itself and is developing into a more mature state. To emphasize this observation, take a look at the recent publication of (Durach et al. 2015; Hohenstein et al. 2015). They explore developing subfields of risk management in supply chains, which indicates that the field of SCRM has developed to a more mature state with room for more exploration of topics. The purpose of this paper is to contribute to the field of SCRM by exploring an extended field of supply chain management: a multi-tier perspective.

In sum, many reviews on risk management in supply chain has been published the past decade, all contributing to defining the topic, providing research agendas, guides for practitioners as well as operationalizing the topic. Not only has there been an increase in attention and publications, journals such as *Supply Chain Management: An International Journal*, have for a number of years had a dedicated publication of systematic reviews of supply chain. The increase in published literature indicates that SCRM has entered a more developed stage. The overview shows, that more authors are also exploring the developments of SCRM via subfields such as robustness (Durach et al. 2015). However, so far there has been no substantial contribution or attempt to make a review on multi-tier SCRM. The next section aims to explore the current academic contributions of SCRM in a MSC perspective. It will produce a brief overview of the literature, which will contribute to the formulation of a research question.

Figure 1: overview of SCRM literature reviews

Authors	Summary: Main focus and contribution
(Jüttner et al. 2003)	An early attempt in which the authors synthesize literature on SCRM and provide a working definition of SCRM
(Khan & Burnes 2007b)	Discover that SCRM begins to gain momentum. Points out key debates on qualitative and quantitative approaches in SCRM which must be recognised.
(Rao & Goldsby 2009)	Develops a supply chain risk typology, which is major contribution to practitioners.
(Ponomarov & Holcomb 2009)	Article indicates the beginning of subfield research in SCRM. Authors focus on resilience.
(Pfohl et al. 2010)	Focus on implementation of SCRM.
(Colicchia & Strozzi 2012)	Investigates aspects of knowledge within the context of SCRM.
(Ghadge et al. 2012)	Applies a holistic approach to SCRM, while focusing on the typologies of SCRM to identify

	strategic changes in SCRM. Finds that SCRM has become an established activity in the past decade.
(Hohenstein et al. 2015)	Focus on supply chain resilience, a subset of SCRM. The changes of focus in SCRM research, indicates the establishment SCRM.
(Durach et al. 2015)	Focus of robustness, a subset of SCRM. Directs SCRM research towards a multi-tier perspective.
(Ho et al. 2015)	The most comprehensive literature review on SCRM to date. Main contribution is a definition of supply chain risk and SCRM.

4.3 (B): OVERVIEW OF RESEARCH ON RISK MANAGEMENT AND MULTI-TIER RISK MANAGEMENT IN SUPPLY CHAIN PERSPECTIVE

This section will explore literature on MSC risk management to develop a foundation for formulating a research question. The section finds that MSC risk management is an emerging but scattered field. Some literature emphasise the importance of multi-tier perspective in SCRM without elaborating further.

Norrman and Jansson (2004) define risk management, in their case study of Swedish company Ericsson's sub supplier fire incident, as: "the process whereby decisions are made to accept a known or assessed risk and/or the implementation of actions to reduce the consequences or probability of occurrence". They elaborate on their definition, saying that generally used actions for risk management are to avoid, reduce, transfer, share or even take the risk. To avoid is to eliminate the types of event that could trigger the risk. To reduce applies both to reduction of probability and consequence" (Norrman & Jansson 2004). Without using the word multi-tier, the case study discuss how supply chain risk management is not only to analyse, assess and manage internal risk, and try to plan for business continuity for the own company, but how it means widening the approach to the chain of suppliers and suppliers' suppliers. It could be done by proactively make them implement supply chain risk management approaches themselves, which guarantees a further spread upstream (Norrman & Jansson 2004). As their case study reveals, the joint cooperation between company and upstream tiers has

been very positive (Norrman & Jansson 2004). This study certainly opens the discussion of multi-tier risk management, but it has still to undergo research and discussion, and yet no formal definition has been coined.

In researching the supply chain risk/vulnerability in the aircraft industry, the authors' Interviews with managers representing five tiers of the network involved in the production of four distinct aircraft types. In suggestion of further research, the authors state that it would have been desirable to conduct multi-tier case studies to validate the results (Peck 2005). This study point in direction of new perspective on risk management. With this study, researchers have started to gain more interest in the multi-tier perspective.

Several scholars have encouraged academia and managers to research and analyse the whole supply chain network. In their paper (Craighead et al. 2007) "reacts to the encouragement to consider the entire supply network the appropriate unit of analysis for supply chain disruption research (Harland, Branchley, & Walker, 2003) in (Craighead et al. 2007), and for managers to move beyond individual firm and functional analyses to more systemic, holistic understanding of the network of nodes". (Buhman, Kekre, & Singhal, 2005) in (Craighead et al. 2007). "Research also shows that supply risk often involves second-tier suppliers; that is, companies which provide products to an organisation's immediate suppliers (Zsidisin 2003) in (Kull & Closs 2008). Therefore, to study risk management in supply chain including the lower-end tiers are crucial.

(Manuj & Mentzer 2008) discuss risk management and risk management strategies in global supply chains. They combine a literature review and qualitative interviews to form a model where six risk management strategies are outlined for global manufacturing supply chain companies. The study is extensive, but further research is required. The authors states "Future research should also focus on refining and testing the model with qualitative and quantitative data across different industries and companies, including tier one or tier two suppliers, retail chains, and 3PL service providers" (Manuj & Mentzer 2008).

A study by Zsidisin, (Zsidisin, 2003), reveals that "supply management professionals view supply risk beyond the dyadic first-tier supplier relationship and include the second-tier and third-tier supply base as well" and that "supply risk often involves second-tier suppliers" (Zsidisin, 2003) in (Kull & Closs 2008). From an inventory perspective, risk and inventory in dyadic relationships in the supply chain has been studied, however there is still limited research on second-tier supply dynamics and supply risk (Kull & Closs 2008).

(Trkman & McCormack 2009) emphasize the importance of including multiple tiers in research analysis due to the fact that the supplier network provide input to the focal company so it can perform and deliver its services or products. They write that "in order to understand a firm's position a larger network has to be studied and

not just a dyadic relationship with a supplier (Wathne and Heide, 2004) in (Trkman & McCormack 2009) since the quality, cost and risks of a product or service offered in the market is a function not only of the particular firm's capabilities but also the supplier network that provides inputs to the enterprise" (Modi and Mabert, 2007) in (Trkman & McCormack 2009). However the authors do not include supplier's suppliers into their framework of analysis.

(Pfohl et al. 2010) argues that "supply chains tend to increase in complexity. The fact that numerous suppliers, service providers and end consumers may be involved in a network of relationships causes risks and vulnerability for everyone. It is not sufficient to just analyse the risks with regard to one focal company, but potential domino effects upon all partners and relations have to be examined" (Pfohl et al. 2010). Their research suggests that multi-tier perspective on risk management in supply chains is necessary, simply because "companies in the supply chain differ in risk attendance and risk acceptance level. It is necessary to aim for mutual goal setting and planning across the entire supply chain network" (Pfohl et al. 2010). The study emphasise the importance of including multi-tiers in risk management, and thus encourage this study to explore this further.

In a comprehensive literature review on global supply chain design models published in 2005 by (Meixell & Gargeya 2005), it is concluded that "global supply chain models need a broader emphasis on multiple production and distribution tiers in the supply chain" (Meixell & Gargeya 2005) in (Christopher et al. 2011). This statement both confirms the relevancy of the topic studied, but also explains the relatively scattered and low frequency of articles focusing on multi-tier supply chains, and especially risk management in MSC. Some authors focusing on supply chain risk management are aware of the significance of multi-tier focus on supply chain, but still neglect the MSC focus in their analysis of risk management in supply chains (Christopher et al. 2011). This could both reflect the infancy the topic is in, and/or the complexity and difficulty of the topic as it may require significant larger amount of resources to study multi-tiers.

In (Khilwani et al. 2011), the authors describes the importance of a holistic approach when analysis supply chains. They write that "traditionally, each facility performs its activities independently thereby optimising their own functional objectives and belittling the importance of others" (Munson and Rosenblatt 2001) in (Khilwani et al. 2011). To stress the importance of the holistic approach, they further write that "in order to overcome these shortcomings, a process oriented approach is implied that co-ordinates the process across all the departments and all functions involved in value delivery process" (Chopra and Meindl 2001) in (Khilwani et al.

2011). In this short introduction to their paper, the authors establish the importance of a holistic approach when studying and analysing supply chains. This study, will aim to follow this recommendation.

“Effective supply chain management requires focal firms to develop the capabilities to manage a series of multitier, interconnected relationships between multiple suppliers, manufacturers, assemblers, distributor, and retailers spanning a wide variety of industries” (Basole & Bellamy 2014a). The authors pinpoint the importance of managing multi-tiers to achieve an effective supply chain. This is becoming more important, as “globally expanding supply chains have grown in complexity increasing the nature and magnitude of risks companies are exposed to. Effective methods to identify, model and analyse these risks are needed” (Badurdeen et al. 2014). As argued by (Basole & Bellamy 2014b), “in today’s complex, global supply networks it has become increasingly challenging to identify, evaluate and mitigate risk of disruption. Traditional supply chain practices have primarily focused on dyadic risk management, rarely considering risks in the sub-tier supply network” (Basole & Bellamy 2014b). This calls for an increased focus on MSC risk management. Thus, this topic will be investigated further in this paper.

As a conclusion, it is reasonable to say that during the past decade, SCRM has been studied carefully and extensively. Some studies have also started to look into risk management in multi-tier supply chains, but this research field is still scattered and emerging. Further academic research suggestions points in the direction of a multi-tier perspective on SCRM. This clearly indicates how the field has gained momentum and is developing. A few articles focus on risk in multi-tier supply chains. Although, there have been several studies published on risk management, the research on multi-tier supply chains is emerging and scattered and a review is overdue.

The review of literature has outlined the reason for doing a systematic literature review of risks management in multi-tier supply chains. The first part concluded that research on risk management in supply chains need a multi-tier perspective. The second step builds upon the first step, and provides a brief overview of research on risk management in multi-tier supply chains. The paragraph concludes that the field is scattered and evolving. To the authors knowledge there has been no published reviews of multi-tier risk management in supply chains (MSCRM).

4.4 RESEARCH QUESTION

In sum, there are many reviews on risk management in supply chain, but no one has attempted to make a review on multi-tier supply chain risk management. Hence, this study seeks to investigate what activities should you use to manage risk in a multi-tier supply chain

This study aim to provide structure and orientation for researchers and practitioners of risk management in multi-tier supply chains. It will do so by sorting academic research articles to create an academic overview of recent relevant published articles and then categorise areas for future research. There is not a particular timeframe applied, but the study will include most relevant literature. The purpose is to increase and expand the knowledge of risk management in supply chains by summarizing the literature with a multi-tier perspective. In particular the following research question was asked to guide the literature search and analysis:

RQ: What activities should be used to manage risk in a multi-tier supply chain?

In particular, the scope of this paper dives beyond the first dyad relationship, and will look into multi-tier supply chains and review literature in this more complex supply chain relationships and emerging field of literature. This particular research question was asked, as a must-needed synthesis of literature to guide the field in next direction is overdue. No one has carried out a similar research before, and it is therefore relevant for researchers in the field of SCRM as well as practitioners. Little is known about the topic, thus the paper will add to the understanding of MSCRM.

4.5 DEFINITIONS OF KEYWORDS

Before the paper proceeds with the systematic literature review, this paragraph aims to create an overview and define the concepts used in this paper. The purpose of establishing a transparent terminology is to make sure the reader understands the concepts without any confusion. It also helps creating a reliable and consistent definition of the concepts when they are used in search strings in academic databases.

4.5.1 Supply Chain Management

The definition of supply chain management has taken many forms and been used loosely by many authors over the past few decades. To establish a working definition for this paper, the following paragraph will outline a set of relevant definitions of supply chain management and settle with the most appropriate one. This should enable the reader to comprehend the meaning of supply chain management in this paper, and eliminate any confusion about the meaning and use of the term, supply chain management.

An early attempt to tackle and define the emerging concept of supply chain management was performed by (Stevens 1989). The article tried to facilitate understanding and encourage organizations to exploit the potential for managing their supply chains as part of a joined up (integrated) whole (Stevens & Johnson 2015). It addressed the need to manage supply chain at the strategic, tactical and operational levels as well as recognize that the scope of an organization's supply chain extended to the furthest reaches of its network of customer and supplier relationships (Stevens & Johnson 2015). With today's knowledge and with access to a realm of peer-reviewed literature on supply chain management, Stevens' definition of supply chain management may seem dated. However, it was one of the earliest attempts to develop a common understanding and definition of supply chain management. Stevens defines supply chain as "the connected series of activities which is concerned with planning, coordinating and controlling material, parts and finished goods from suppliers to the customer. It is concerned with two distinct flows through the organisation: material and information." (Stevens 1989). However, since 1989, much has changed in the field of supply chain. The context within which supply chain operate, and the enablers of change and performance improvement (Stevens & Johnson 2015).

Thus, the paper will look for a recent definition of supply chain management by briefly looking at the development of definitions. Briefly reviewing the definitions of supply chain management is important to establish a common understanding as well as to make the right foundation for improving the literature.

(Cooper & Ellram 1993) writes what differentiates supply chain management from other channel systems are characteristics like working more closely together, such as coordination across firms and management levels within firms, sharing and monitoring of information, and joint planning. Supply Chain Management also requires a long-term orientation; the relationship is expected to extend over an indefinite horizon with sharing of risks and rewards balanced over time (Cooper & Ellram 1993). In an earlier paper by, they define supply chain management as "an integrative philosophy to manage the total flow of a distribution channel from the supplier to the ultimate user" (Cooper & Ellram 1993; Ellram & Cooper 1990).

Cooper et al. (1997) use the definition of supply chain management developed by members of the The International Center for Competitive Excellence in 1994: "Supply Chain Management is the integration of business processes from end user through original suppliers that provides products, services and information that add value to customers". (Cooper et al. 1997).

(Mentzer et al. 2001) defines a supply chain as a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer. They further emphasise that organisations can be part of several supply chains, as supply chains are a phenomena that exists in business. And they distinguish supply chains from the management of those (Mentzer et al. 2001). They further classify SCM definitions into three categories: a management philosophy, implementation of a management philosophy, and a set of management processes (Mentzer et al. 2001).

Through a qualitative analysis of SCM definitions, the authors (Stock & Boyer 2009) aim to establish an encompassing definition. The outcome of their study is this consensus SCM definition: “The management of a network of relationships within a firm and between interdependent organizations and business units consisting of material suppliers, purchasing, production facilities, logistics, marketing, and related systems that facilitate the forward and reverse flow of materials, services, finances and information from the original producer to final customer with the benefits of adding value, maximizing profitability through efficiencies, and achieving customer satisfaction.” (Stock & Boyer 2009). The authors point out that despite their efforts and thorough analysis of published SCM definitions, no optimal definition may ever be determined because SCM is developing and evolving continuously (Stock & Boyer 2009). Lastly, a more simple but equally relevant definition of SCM is presented by Li et al. (201) Supply Chain Management is concerned with close collaboration among chain members to enhance the chain’s overall performance (Li et al. 2015).

Figure 2: Definition of supply chain and supply chain management

Source	Definition
(Stevens 1989), page 3	<p>“Supply chain is the connected series of activities which is concerned with planning, coordinating and controlling material, parts and finished goods from suppliers to the customer. It is concerned with two distinct flows through the organisation: material and information.”</p> <p>“The objective of managing the supply chain is to synchronise the requirements of the customer</p>

	with the flow of material from suppliers in order to effect a balance between what are often seen as the conflicting goals of high customer service, low inventory investment and low unit cost”
(Cooper & Ellram 1993; Ellram & Cooper 1990), page 13	“an integrative philosophy to manage the total flow of a distribution channel from the supplier to the ultimate user”
(Cooper et al. 1997)	“Supply Chain Management is the integration of business processes from end user through original suppliers that provides products, services and information that add value to customers”
(Mentzer et al. 2001), page 4	<p>“A supply chain is a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer.”</p> <p>“Management of supply chains [...] requires overt management efforts by the organisations within the supply chain”</p>
(Stock & Boyer 2009), page 706	“The management of a network of relationships within a firm and between interdependent organizations and business units consisting of material suppliers, purchasing, production facilities, logistics, marketing, and related systems that facilitate the forward and reverse flow of materials, services, finances and information from the original producer to final customer with the benefits of adding value, maximizing profitability through efficiencies, and achieving customer satisfaction.”

According to (Lummus et al. 2001), there has been a confusion between the business terms logistics and supply chain management among business practitioners and operations professionals. In their paper, the authors examine the historical definitions of logistics and supply chain management and proposes a hierarchy for the relationship between logistics and supply chain management. Citing The Council of Logistics Management (CLM), (Lummus et al. 2001) defines logistics as “the process of planning, implementing, and controlling the efficient, effective flow and storage of goods, services and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirements. Note that this definition includes inbound, outbound, internal and external movements, and return of materials for environmental purposes.” (Lummus et al. 2001). By doing this, the authors aims to make a clear understanding of the differences between SCM and logistics.

To sum up, the definition used in this paper is the one provided by (Stock & Boyer 2009). It encompasses themes and subthemes of supply chain management, and is one of the most recent rigorous attempts to define the term, supply chain management. With a clear definition of SCM, it should now be clear how SCM differentiates itself from logistics.

4.5.2 Risk

Risk is not a new idea. However, the understanding of risk has developed over the years. In business, companies face many risks, and must not only learn how to cope with them, they also have to manage them. Introducing this paragraph, the next few lines will briefly outline a definition of risk, and later a definition for risk management will be outlined. It is also important to keep in mind that there are many types of risks depending on the perspective.

Exploring the nature of risk, (Holton 2004) discuss various concepts of risk as presented throughout history. According to Holton, risk is exposure to a proposition of which one is uncertain, and it requires two essential components: exposure and uncertainty. It is important to notice that the articles predominantly takes a view on risk from a financial risk management perspective, since it was published in financial analyst journal. The author also acknowledges that fact that his definition is flawed, but offers insights. The most interesting point from this article is that it does not view organizations as risk takers, but the individuals inside organisations (Holton 2004). Rao and Goldsby (2009), adopts Holton’s definition of risk as being exposure to an event and the uncertainty of possible of outcomes, to exposure to a premise, the outcome of which is uncertain (Rao & Goldsby 2009). Pure risk is viewed as “a combination of the probability or frequency of an event and its

consequences, which is usually negative” (Dionne 2013). The author avoids using the term uncertainty to describe risk as “uncertainty is less precise because the probability of an uncertain event is often unknown, as is its consequence” (Dionne 2013). In defining corporate risk management, (Dionne 2013) argues that risks are present in nearly all of firms’ financial and economic activities. The author defines it as “a set of financial or operational activities that maximize the value of a company or a portfolio by reducing the costs associated with cash flow volatility” (Dionne 2013). Opening the discussion of risk management definition, the next paragraph will move closer to risk management in supply chain management.

Figure 3: Definition of risk and risk management

Source	Definition
(Holton 2004), page 22	“Risk requires two essential components: exposure and uncertainty [...] Risk is exposure to a proposition of which one is uncertain”
(Rao & Goldsby 2009)	“exposure to a premise, the outcome of which is uncertain”
(Dionne 2013)	Risk management is “a set of financial or operational activities that maximize the value of a company or a portfolio by reducing the costs associated with cash flow volatility”

4.5.3 Supply Chain Risk

(Ho et al. 2015) define supply chain risk as “the likelihood and impact of unexpected macro and/or micro level events or conditions that adversely influence any part of a supply chain leading to operational, tactical, or strategic level failures or irregularities”. The types of risk found in supply chains have been compiled in a literature review by (Ho et al. 2015). The authors provides the field of SCRM with a new holistic view of supply chain risks. They argue that previously academics have defined supply chain risks focusing only on a specific function of or part of the supply chain and did not span across the entire chain (Ho et al. 2015). Authors they refer to includes (Jüttner et al. 2003; Wagner & Bode 2006). Supply chain risks refer to the risks transmitted among supply chain members (Li et al. 2015).

Figure 4: Supply Chain Risk

(Jüttner et al. 2003)	“variation in the distribution of possible supply chain outcomes, their likelihood, and their subjective value”
(Wagner & Bode 2006)	“risk as the negative deviation from the expected value of a certain performance measure, resulting in negative consequences for the focal firm”
(Ho et al. 2015)	“the likelihood and impact of unexpected macro and/or micro level events or conditions that adversely influence any part of a supply chain leading to operational, tactical, or strategic level failures or irregularities”
(Li et al. 2015)	“risks transmitted among supply chain members”

4.5.4 Supply Chain Risk Management (SCRM)

For quite a while now, scholars within the field of SCM research, have begun to explore risk management in supply chain management. Combining these two field of research has resulted in a wealth of new studies and findings. In order to clearly understand what is meant by supply chain risk management and how it differs from other types of risk management, the following paragraph will outline a brief overview of definitions in recent literature.

According to (Lavastre et al. 2014), SCRM can be defined as “the management of risk that implied both strategic and operational horizons for long-term and short-term assessment. It refers to risks that can modify or prevent part of the movement and/or efficient flow of information, materials and products between the actors of a supply chain within an organisation, or among actors in a global supply chain (from the supplier’s supplier to the customer’s customer)” (Lavastre, Gunasekaran, & Spalanzani, 2012, page 830) in (Lavastre et al. 2014). Kajuter in (Pfohl et al. 2010) defines SCRM: “Supply Chain Risk Management is a collaborative and structured approach to risk management, embedded in the planning and control processes of the supply chain, to handle risks that might adversely affect the achievement of supply chain goals”

As summarized in a literature review by (Ho et al. 2015), SCRM definitions have emphasised collaboration with supply chain partners, some of the definitions limitations are related to their focus on specific elements of SCRM and their lack of spanning the SCRM processes in their entirety, type of SCRM methods and types of events (Ho et al. 2015). Some of the definitions which the author base the new definition on included studies from (Jüttner et al. 2003; Norrman & Jansson 2004; Tang 2006; Thun & Hoenig 2011). (Ho et al. 2015) defines SCRM as an “inter-organisational collaborative endeavour utilising quantitative and qualitative risk management methodologies to identify, evaluate, mitigate and monitor unexpected macro and micro level events or conditions, which might adversely impact any part of a supply chain”. The paper will adopt this definition of SCRM.

4.5.5 Multi-Tier Supply Chain (MSC)

Acknowledging the importance of multi-tier relationships in supply chain management is nothing new, however to include suppliers beyond the first dyad relationship in analyses is an emerging trend in supply chain management research. The simplest form of an MSC is a three-tier system or triad (Mena et al. 2013).

4.5.6 Further Clarifications of Concepts and Keywords

While searching scientific databases for articles using the keywords, a number of similar expressions for the keywords appeared. Synonyms that described the same phenomena as the original keyword, would be included in the search for articles, however similar expression with a different meaning would be examined and then either included or excluded. Especially, for the search string keyword “multi-tier” a number of similar expressions were found. However, to be able to distinguish and apply the inclusion/exclusion criteria it was necessary to define some of the similar expressions.

For example, in combination with the word “multi”, the word “modal” was often used, hence a definition and description of this keyword was searched for in various articles. “Multimodal supply chains are international transport combinations of various modes of transport such as ship, rail, and road, primarily through the use of containers” (Vilko & Hallikas 2012). Hence, multi-modal supply chains are different from multi-tier supply chains as modes refers to transport combinations, whereas tiers refers to companies at different stages (tiers) in the supply chain. However, the article by (Vilko & Hallikas 2012), were read in entirety and included due to the fact that the authors analysed one supply chain which is “responsible for transporting containers carrying various good of high significance for both business life and the population in general”. The authors carried out 22 interviews, and “all of the companies were part of the multi-modal maritime supply chain and were acting in

various roles, representing shipping companies, ports and port operators and administrators, customs, road and rail transportation, insurance companies and international logistics operators". Thus, performing a risk assessment of a complex supply chain setup like presented by (Vilko & Hallikas 2012) was found relevant for this study.

Many articles located in the literature search on electronic database EBSCO BSC, describes supply chain networks. In order to proceed with the review of articles, a definition of networks was needed. According to (Jarillo 1988), "strategic networks can be defined as long term, purposeful arrangements among organisations that allow the operating organisation to get long-term sustainable competitive advantage" (Jarillo 1988) in (Hallikas et al. 2004). A more generic definition of networks are provided by (Harland 1996), who defined networks as "a specific type of relation linking a defined set of persons, objects or events" (Harland 1996) in (Hallikas et al. 2004). Deriving meaning from the definitions above, it seems that networks are generally focusing on relationships, some of which are strategic, between the actors in the network. How these actors are connected is not clear, thus it is difficult to distinguish the level in the supply chain these network actors are located. On the other hand, when looking specifically at multi-tier supply chains in research, the tier-level of the businesses analysed, is often described (Basole & Bellamy 2014a).

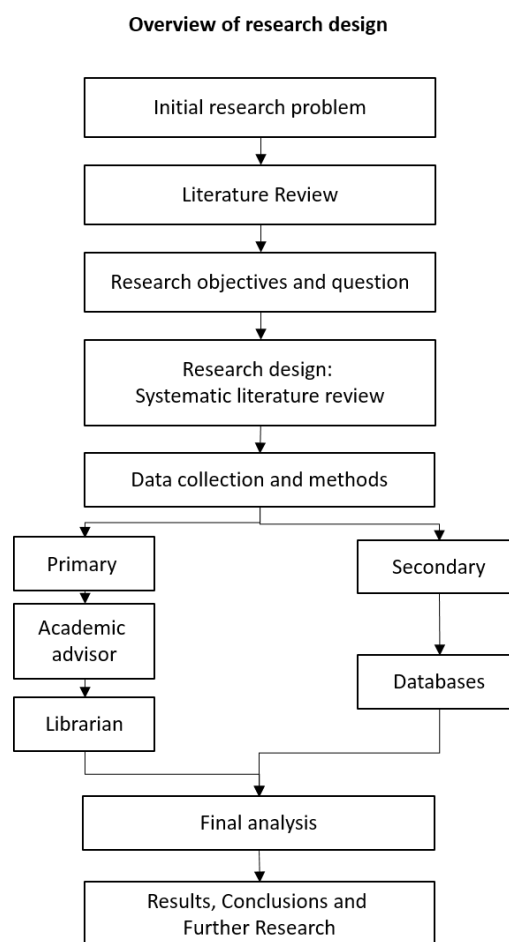
Ultimately, it was determined by the author that articles that studies multi-agent, network or multiple actors in less than two tier supply chains are not included. For example, (Hua et al. 2011), study supply chain networks and create a multi-agent model. However, the focus of study is still confined to a two-stage supply chain.

5 METHODOLOGY

5.1 RESEARCH DESIGN

Below is a figure of the overall research design of this study. Particularly for this chapter, the process of conducting a Systematic Literature Review (SLR) will be explained in detail.

Figure 5: Overview of research design



This study employs a systematic literature review (SLR) approach. The findings will be organized in the same way authors (Durach, C. F., Wieland, A. and Kembro 2014) approach the systematic literature review.

Initially, to start the research, multiple database were used to explore and familiarise the author with the topic, current research and terms. The databases included EBSCO BSC, Google Scholar, Science Direct and Emerald. The unstructured and explorative initial search helped the author get a feeling for the relevant keywords, understand why the topic is relevant and later help with EBSCO BSC search strings and the formulation of the inclusion and exclusion criteria. For seasoned researchers specialized in this field, this step might not be relevant. However, for this level of study and as a newcomer to the field of MSCRM research, this step was very helpful.

From a research perspective, the random searches on multiple databases clarified the importance of a systematic approach to the literature search in terms of validity, quality and replication purposes. The importance of a valid method when conducting a SLR is paramount, hence the study uses the rigorous approach as presented by (Durach, C. F., Wieland, A. and Kembro 2014). To conduct the systematic literature review, EBSCO BSC was selected as the database where the literature search was to be carried out. It covers many reliable and peer-reviewed journals and allows for a sophisticated advanced search setting. The search for articles was limited to include research related to the initial research question exclusively. All of the search strings used on EBSCO BSC are documented and allows for replicability.

The following paragraph will shortly define the meaning of a systematic literature review versus a traditional review, and give an overview of the methodological steps by explaining each step of the process using the SLR guide by (Durach, C. F., Wieland, A. and Kembro 2014).

5.2 SYSTEMATIC LITERATURE REVIEW (SLR)

This paragraph serves the purpose of clarifying the meaning of a systematic literature review. There are several types of literature reviews, and thus to avoid any confusion about the type of literature review this paper conducts, the following overview will help simplify matters.

Definition of systematic literature review: “a review with a clear stated purpose, a question, a defined search approach, stating inclusion and exclusion criteria, producing a qualitative appraisal of articles” (Jesson, J., Matheson, L., & Lacey 2011). To be systematic you need to follow some methodological stages, or a systematic protocol. So just by taking an ordered approach to reviewing literature does not mean that it is systematic. The authors define systematic as “to work in an ordered or methodological way, rather than in a haphazard or random way.” (Jesson, J., Matheson, L., & Lacey, 2011, page 12)

“The terminology of literature review is confusing and ambiguous because as a subject or research method in its own right it is still in its infancy” (Jesson, J., Matheson, L., & Lacey, 2011, page 13).

The authors distinguish between two styles or approaches in reviewing literature. The traditional reviews published are usually critical approach reviews, which assess theories or hypothesis by critically examining the methods and results. There are also conceptual, state of the art, expert, and scoping reviews. What characterizes these approaches is the fact that the author select the material on a personal basis. The material is then used to weave together and to form an argument or to tell a story. However, the outcome is typically a one sided or even biased argument. The systemic review avoid these pitfalls by including exclusion and quality controls. Put together, the traditional approach is useful for promoting research knowledge and to identify gaps in literature and to clarify where no further research is needed for the time being. The systematic review is a more neutral, and technical process which is rational and standardized. It demonstrates objectivity and a transparent process to the reader. (Jesson, J., Matheson, L., & Lacey 2011). Criteria for inclusion in the review is key to the quality of the data (Jesson, J., Matheson, L., & Lacey, 2011, page 30).

The paper follows a five step SLR methodology as proposed by (Durach, C. F., Wieland, A. and Kembro 2014). Their paper is a systematic literature review of SLR methodologies. The main contribution of the paper is a five-step method for writing a SLR. As the paper synthesise the most relevant literature of SLR methodology, it is the go-to paper for finding the latest and best methods for writing a SLR. Thus, following their methodology, the paper will ensure the quality of the literature search, data collection and structure.

Figure 6: Five-step guide for SLR (Durach, C. F., Wieland, A. and Kembro 2014)

Guide for SLR	Applications of method:
Step 1: Determination of Focus of Review	Study must make a theoretical contribution and follow a SLR method
Step 2: Preparation for the Literature Search	Create inclusion/exclusion criteria prior to literature search. Study will focus on peer/reviewed articles, but in no specific time frame.
Step 3: Search for Literature	Choose search method and craft database search strings. For this study, EBSCO BSC is used for literature search for analysis. For initial scanning

	of literature, multiple databases and outlets are used.
Step 4: Selection of Pertinent Literature	Apply inclusion and exclusion criteria to abstracts. Only focuses on peer-reviewed journals.
Step 5: Analysing and Synthesizing Literature	Systematic approach in analysis, not selective. Emerging content analytical approach – identifying themes from literature.
Step 6: Reporting and Using the Results	Provide a complete list of literature reviewed. Present the key message of findings in a table or figure.

1. Step: Determination of focus of review

Making a significant contribution

“An ideal topic is one where a number of articles have accumulated without previous review efforts”. In other words, the author must justify why the research is needed and how it contribute to academia (Durach, C. F., Wieland, A. and Kembro 2014). For a SLR there is a specific methodology which is recommended to follow. “Rigorously following the methodology of SLR is a critical step in a successful research project” (Durach, C. F., Wieland, A. and Kembro 2014). Thus, this paper aim to make a significant research contribution, as outline previously in the literature review section, and will do so by following the steps recommended by (Durach, C. F., Wieland, A. and Kembro 2014).

Involving stakeholders

The authors also finds that involving academicians or practitioners could help improve the ability to make a significant theoretical contribution (Durach, C. F., Wieland, A. and Kembro 2014). In this study, an academic supervisor was involved in creating the research question and to ensure the relevance of the study.

2. Step: Preparation for the literature search

Crafting inclusion and/or exclusion criteria

“A SLR requires researchers to apply inclusion and/or exclusion criteria to manually assess whether the literature that is to be identified helps to answer the research question, but this process is prone to researcher bias” (Durach, C. F., Wieland, A. and Kembro 2014). It is important to keep this in mind when formulating the inclusion and/or exclusion criteria for this research, as it may influence the result of the analysis. It is further argued by Alexander et al., 2014 in (Durach, C. F., Wieland, A. and Kembro 2014) that this step can sometimes be conducted before the literature search instead of after the research has been conducted (Durach, C. F., Wieland, A. and Kembro 2014). This approach may reduce bias as it allows the researchers to “use the list of criteria to objectively and independently assess the relevance of literature used to craft search strings and judge the outcome quality of the databases searches” (Durach, C. F., Wieland, A. and Kembro 2014).

Deciding on Pre-limitations of the literature search

(Durach, C. F., Wieland, A. and Kembro 2014) suggests, “Researchers need to align their search strategy with the research question(s). For example, the authors suggests that “reviews that seek to identify what is known and not known about a certain topic could incorporate a larger number of different publication types” (Pilbeam et al., 2012 in (Durach, C. F., Wieland, A. and Kembro 2014)). At the same time, research on emerging topics, like multi-tier supply chain risk management, “could due to relatively longer publication lead times of journals, also benefit from including studies published in proceedings of recent conferences (Guo et al., 2011 in (Durach, C. F., Wieland, A. and Kembro 2014)). Following the recommendation in (Durach, C. F., Wieland, A. and Kembro 2014), this study would benefit from looking at a larger number of different publication types and also include studies published in proceedings of recent conferences. However, this study restrict itself to only looking at peer-reviewed articles in academic journals due to the fact, that the study aims to only include very high quality articles and ensure the relevancy of the analysis. Specifying this from the beginning is important, as argued by (Durach, C. F., Wieland, A. and Kembro 2014) who writes that specifying the type of literature reviewed and justifying the choice is important. The literature search will not be limited to a specific time frame as there will be a risk of not including relevant literature and publications (Durach, C. F., Wieland, A. and Kembro 2014). As this literature review does not align with any previous research, it will not limit the literature search to a certain timeframe.

Step 3: Search for literature

Choosing an appropriate procedure for the literature search

According to (Durach, C. F., Wieland, A. and Kembro 2014), pre-determining the search procedures for literature search is of high important. They further argues that there are many ways to search for literature, for example electronic database searches, manual searches, asking for recommendations from experts and cross references (Briner et al., 2009 in(Durach, C. F., Wieland, A. and Kembro 2014)).

Most commonly used are databases such as EBSCO, ABI/INFORM, Science Direct and Emerald (Durach, C. F., Wieland, A. and Kembro 2014). This study uses EBSCO BSC, Science Direct, Emerald and Google Scholar in the initial exploratory literature search. However, in the final literature search, only EBSCO BSC is used. This issue is elaborated below. (Durach, C. F., Wieland, A. and Kembro 2014) also stress the fact that “not all journals and studies are accessible through or listed in periodical databases (Adriaanse and Rensleigh, 2013 in(Durach, C. F., Wieland, A. and Kembro 2014)). They further recommend to “use at least two databases in order to decrease the probability of missing out on relevant literature” (Durach, C. F., Wieland, A. and Kembro 2014). As suggested by the authors, the study will involve experts like specialized librarians to get valuable insights about the features and pitfalls of certain search engines (Duff, 1996 in (Durach, C. F., Wieland, A. and Kembro 2014)). When searching for literature, “researchers must choose between searches for literature in full text databases (Nolan, 2009 in (Durach, C. F., Wieland, A. and Kembro 2014)) or citation databases (Adriaanse and Rensleigh, 2013 in(Durach, C. F., Wieland, A. and Kembro 2014)) or a combination of both” (Durach, C. F., Wieland, A. and Kembro 2014). As mentioned above, this study use EBSCO BSC for full text database search.

Despite using only EBSCO BSC, and potentially excluding relevant material, the study greatly benefitted from using only EBSCO BSC as it helped the author keep focus and deliver quality. Keeping focus, helped the study to reduce the probability for overseeing relevant literature, and enable the study to find impactful relevant literature. However, adding literature through multiple search procedures, is consistent with the SLR methodology (Mulrow, 1987 in(Durach, C. F., Wieland, A. and Kembro 2014)). When using several databases for literature search, it is important to document the search process. As pointed out by (Durach, C. F., Wieland, A. and Kembro 2014) “researches need to be aware that using multiple procedures makes it more challenging to transparently report on the search process, a fundamental requirement of SLRs.

Crafting search strings for electronic dataset searches

(Durach, C. F., Wieland, A. and Kembro 2014) recommends to “identify literature and keywords on the topic before starting to build search strings”. Following this recommendations, this paper begins the literature search with a preliminary outline of literature and keywords on the topic. For example, the paper includes a literature

review which scopes the paper, and there is also a section which defines the terms used and keywords of the study. Secondly, (Durach, C. F., Wieland, A. and Kembro 2014) recommends “that keywords should then be crafted into search strings”, and that is “critical to devote considerable effort in crafting the search string” as algorithms of different search engines often require different search strings. Therefore, the authors find it very important to report on the particular search strings applied and the date of the searches (Durach, C. F., Wieland, A. and Kembro 2014). This allows for replicability (Durach, C. F., Wieland, A. and Kembro 2014) and thus enhances the quality of the study.

Step 4: Selection of Pertinent Literature

Applying Inclusion and/or Exclusion Criteria to Select Pertinent Literature

This stage is important in order to answer the research questions. (Tranfield et al., 2003 (Durach, C. F., Wieland, A. and Kembro 2014)) argues that, “to reduce the previously identified set of literature to a subset that helps to answer the research question, the literature needs to be selected based on the list of inclusion and/or exclusion criteria”. This argument reflects the high importance of transparency and criteria. For instance, (Durach, C. F., Wieland, A. and Kembro 2014) argues that it is important to reveal which part of an article that the criteria applies to, for example title, keywords, abstract and/or full text (Durach, C. F., Wieland, A. and Kembro 2014). This will enable other scholars to replicate the study and also enable them to access and work with the data. This is an important part of any study and work as it reduces bias. Other researchers suggest that “bias in applying the criteria can be reduced through the use of multiple researchers (cf., Narayana et al., 2014 in (Durach, C. F., Wieland, A. and Kembro 2014)). Lastly, (Durach, C. F., Wieland, A. and Kembro 2014) recommends calculating either Cohen’s K, Fleiss’ K or the r_{wg} index to test for and show inter-rater agreement.

Appraising Literature Quality or Validity

According to (Durach, C. F., Wieland, A. and Kembro 2014), it is important to appraise the quality or validity of the literature when conducting a SLR. For example, in order to enhance validity of the literature, the SLR can focus specifically on peer-reviewed journals. This can prevent the inclusion of studies with biases and errors (Durach, C. F., Wieland, A. and Kembro 2014). However, they further argue that for SCM SLR this is a very delicate task (Durach, C. F., Wieland, A. and Kembro 2014). For example, if too many quality limitations are used, researchers may risk missing out on relevant literature. It is argued that “the SCM field tends to have its research dispersed in a wide range of publication outlets (Mckinnon, 2013 in (Durach, C. F., Wieland, A. and

Kembro 2014)), thus it is necessary to justify the journals that are included or excluded (Durach, C. F., Wieland, A. and Kembro 2014).

To ensure the quality of this study, only peer-reviewed journals will be included. This limitation criteria means that the literature search is restricted to only focusing on journals with a rigorous peer review process, as suggested by (Durach, C. F., Wieland, A. and Kembro 2014). Manually formulating a quality and validation checklist, and applying this to assess the quality of the literature requires the inclusion of experts from different areas, such as appropriate specialist and research methodologist to help develop the checklist and rank the literature (Mulrow, 1987 in (Durach, C. F., Wieland, A. and Kembro 2014))

Step 5: Analysing and Synthesizing Literature

This step is perhaps the most impactful part of the SLR. In this part, the findings of the literature search will be presented, and thus this is the part which can make a significant contribution to the field of study. As described by (Durach, C. F., Wieland, A. and Kembro 2014), the goal of this step is to "extract and synthesize the relevant data from the pertinent literature". In order to create something meaning from the literature, the analysis should integrate and juxtapose the literature to create unique and novel insights (Durach, C. F., Wieland, A. and Kembro 2014). However, when conducting the analysis and synthesizing the literature, it is important to "follow a systematic rather than a selective analysis and integration of the literature content" (Durach, C. F., Wieland, A. and Kembro 2014). Following a systematic approach can enhance validity of the study, and it also allows the reader to fully understand the background of the analysis steps and therefore be able to discuss the findings, conclusions and limitations of the study (Durach, C. F., Wieland, A. and Kembro 2014). (Durach, C. F., Wieland, A. and Kembro 2014) identified two approaches in the content analytical approach in SLR. *A Priori* analysis via coding of articles into predefined dimensions, and an *Emergent* approach which identifies key themes from the literature. To make this study transparent, the content analytical approach applied in this study is the *emerging* analytical approach. From the literature, a set of themes will be identified.

Step 6: Reporting and Using the Results

(Durach, C. F., Wieland, A. and Kembro 2014) suggests that findings of the reviewed literature are reported in comprehensive table or figure summarizing the key message. To increase transparency, they also suggests to incorporate a complete lists of the literature reviewed. For this study, a complete list of the literature reviewed will be presented, as well as a table or figure summarizing the key message of findings. The main goal of following this methodology is to make the study replicable, so any researcher can do the same type of research

following the steps described in this paper. Overall, following this methodology should provide this study with a transparency and objectivity.

6 DATA COLLECTION

This section will explain in more detail how the SLR steps were carried out.

6.1 PREPARING FOR LITERATURE SEARCH

This step was conducted before the literature search was carried out. It help reduce article selection bias as it allows the author to independently asses and evaluate the articles (Durach, C. F., Wieland, A. and Kembro 2014). The criteria were formulated solely by the author, and was guided by the research question and research task at hand. However in (Durach et al. 2015), the authors both discussed, formulated the criteria and selected the articles. This study suffers from being conducted by a single person and this issue will be discussed later in this paper as it may cause some bias (Durach, C. F., Wieland, A. and Kembro 2014). The criteria were formulated as follows:

Figure 7: Inclusion and Exclusion Criteria

Inclusion and Exclusion Criteria:	Rationale
1. Articles must include multiple tiers in their analysis and not only a dyadic relationship	1. Ensure the inclusion of only multi-tier studies and relevancy for the RQ
2. Articles focusing on multi-agents, networks or multiple actors in less than two tier supply chains are not included	2. Articles must go beyond the dyadic relationships in the analysis
3. Focus of article must be supply chain management and risk management	3. Ensure relevancy for RQ
4. Article must be published in peer-reviewed journals	4. Ensure validity, quality and impact
5. Multi-tier supply chain risk management or a concept that is identical, must be mentioned in the abstract	5. Multi-tier risk management must be the focus of study
	6. To ensure accessibility and full understanding

6. The language of the articles must be in English	
--	--

Initially, multiple searches was carried out. This approach enabled the author to become more familiar with the advanced search on EBSCO BSC. Several searches using different keywords and combinations were conducted. For example, using an asterix (*) at the end of the search word stem, the search engine will look for all endings after the stem. The advanced search function was used on EBSCO BSC. Using the advanced search function enables the user to define a very detailed search string and later to refine the literature search. Ultimately, this strategy helped the author become more confident in creating the right search string, as well as getting detailed feedback when consulting a librarian on the university campus.

It is important to define which part of the article the keywords should be located. For example, the EBSCO BSC database can look for a keyword in for example the abstract, title, or whole article. The keywords used in the search string can also be combined by using “AND” or “OR”. As the words indicate, the database search for the keywords dependent on the combination of “AND” and “OR. For example, by combining two keywords in the search string by “AND” will make the database look for both keywords. Using “OR” will make the database search for words like “risk” or “risks”, and not both. It is also possible to limit the search to only include peer-reviewed articles.

Regarding time period, it is difficult to say if there has been any major contributions to the field in any period of time as it is a fairly new and emerging field of research. Thus, the time period for published articles is not predetermined.

6.2 SEARCH FOR LITERATURE

The literature search was solely conducted via the electronic database EBSCO BSC. To start the literature search, a university librarian was consulted when formulating the search strings on EBSCO BSC. The librarian helped in understanding of the database functions and search algorithms. Ultimately, it helped formulate the best possible search strings for the topic and research question.

The database, EBSCO BSC, serve the purpose of scanning several databases for relevant articles in a large number of journals. Using EBSCO as an encompassing database it should also decrease bias towards certain journals and broaden the field of included journals.

Below is the list of EBSCO BSC search results and strings:

Figure 8: EBSCO BSC Search Strings

EBSCO BSC Search String	Search options	Results
AB multi-tier OR multi OR tier AND AB supply chains AND AB risk management OR supply chain management OR risk ⁱ Publication date: 1975 – 2016	Limiters: - Scholarly (Peer Reviewed) Journals Source Type: Academic Journal Narrow by Subject Thesaurus: - supply chain management Narrow by Subject Thesaurus :- supply chains Narrow by Subject Thesaurus: - risk management in business Search modes: - Boolean/Phrase	389
multi-tier OR multi AND risk management AND supply chain management AND supply chain ⁱⁱ	Search modes: - Boolean/Phrase	385
2nd try		
AB multi-tier OR AB multi OR AB tier OR AB echelon OR AB node AND supply chain management AND AB supply chain AND AB risk management AND AB risk ⁱⁱⁱ	Limiters: - Scholarly (Peer Reviewed) Journals: - Published Date: 19750101-20161231	41

	<p>Narrow by Subject Thesaurus2: - risk management in business</p> <p>Narrow by Subject Thesaurus1: - supply chain management</p> <p>Narrow by Subject Thesaurus0: - supply chains</p> <p>Search modes: - Boolean/Phrase</p>	
--	--	--

The relatively low outcome of 389 peer reviewed articles from the search on EBSCO BSC, is somewhat expected as the topic is emerging and in a developing phase. In comparison, (Durach et al. 2015) found 1356 articles in two databases. However, it will not refrain the study from proceeding with the literature review as the purpose is to synthesize and map the current field and point the research field in a new direction, so more research can be produced. The results of the search was exported to Mendeley, a free reference manager, where each article's abstract were analysed according to the inclusion and exclusion criteria.

When importing the export file of 389 articles from EBSCO, only 385 articles are shown in Mendeley. This issue may be due to duplicates of articles, and is therefore ignored and treated as a margin of error. Thus, no further investigation were initiated. For the first search string used in EBSCO BSC, 4 out of 389 articles were in another language than English. Two articles were in French, one article in Lithuanian and one article in Portuguese. These articles were also reviewed according to the inclusion and exclusion criteria in order not leave out important literature. The review and application of criteria to these articles were possible due to the fact that the articles abstracts were in English.

After the first literature search, the article on multi-tier supply chains by (Mena et al. 2013) was revisited to find more key words related to multi-tier supply chains. To find more related key words, a search for related literature on Google Scholar was carried out. Initially, this was done because the first literature search indicated that words like "triad" were also used to describe multi-tier supply chains. The search for related literature revealed a set of articles using other words to describe multi-tier. Several authors have explored the concept of multi-tier supply chains by focusing on the triadic relationship of actors in the supply chain. (Choi &

Wu 2009b)(Mena et al. 2013). Other authors argue that the smallest unit in a network is the triad, which is made up of three nodes and the links that connect them (Choi & Wu 2009a). Other authors use the word “multimodal” to describe a supply chain with more than two actors (Beresford et al. 2013). A logistic triad comprise buyers, suppliers and logistics service providers (Larson & Gammelgaard 2001). This search helped the author to understand the field and terms used. Some articles also use the word “stage” to describe another level or tier in the supply chain (Hua et al. 2011).

After importing all the articles into Mendeley a search for synonyms of multi-tier were carried out. And research on multi-tier supply chains revealed that other words were also used to describe a supply chain with more than two actors. It turned out that some authors use “echelon” or “node” to describe the tiers in a supply chain. Therefore, when searching for multi-tier supply chains the words “node”, “echelon” were included. Another search string was developed in EBSCO Business Source Complete. This revealed another 41 articles. After importing them into Mendeley, all 41 were found out to be duplicates. Duplicates were removed from the database and 385 articles were left for further selection.

Finally, 389 articles were located of which 2 were French, 1 Lithuanian and 1 Portuguese. The fact that, not more articles were found using more keywords in the EBSCO BSC search string reveals the consistency and validity of the search string used.

	Locating Articles in EBSCO Business Source Complete using multiple search strings	Eliminating duplicates of articles found via search strings and import into Mendeley	First round of Article selection: Articles left after first round of applying inclusion and exclusion criteria	Second Round of Article Selection: Articles left after application of inclusion and exclusion criteria
Number of articles	389	385	43	30

The aim of a two round article selection is to limit the bias and reduce the risk of leaving out relevant articles. This was crucial when conducting the research without a second researcher. In the first round, articles were included even if the relevancy of the article needed further review. For example, after the first round it became clear, that some of the articles that were included and described multi-agent scenarios or networks of actors, not necessarily focused on multi-tiers. Thus in the second round of article selection, these articles were excluded as they did not fulfil the criteria. It also helped the study clarify the differences between multi-agents, networks, multi-modal etc. Ultimately, it increased the validity of the study as well as reduced the bias and risks of excluding relevant articles.

After initially selecting articles by being inclusive and applying the inclusion and exclusion criteria, the articles were read once more in order to apply a more critical perspective and exclude non relevant articles. This step was not specifically recommended by (Durach, C. F., Wieland, A. and Kembro 2014), but it helped this research, as it was conducted by a single author, to ensure that all articles were reviewed and analysed carefully.

6.3 SELECTION OF PERTINENT LITERATURE

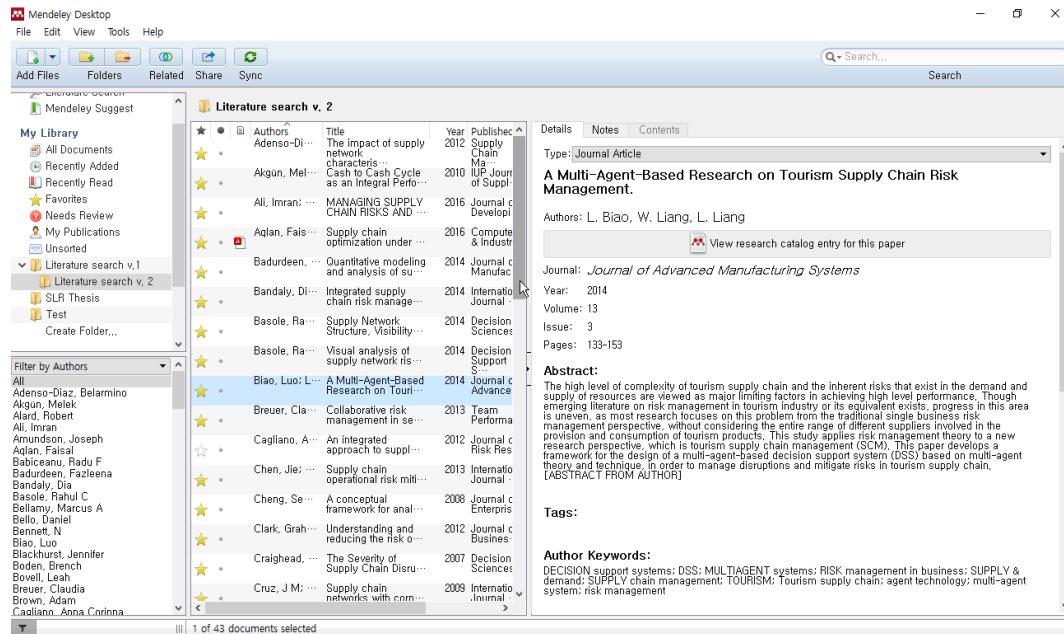
6.3.1 Using Mendeley When Applying The Inclusion and Exclusion Criteria

After conducting the literature search on EBSCO BSC, all of the located articles were imported from EBSCO BSC into the free reference manager solution, Mendeley. Based on the inclusion and exclusion criteria, each of the articles were checked individually. Despite being a very useful reference manager, Mendeley also proved very useful in sorting and keeping an overview of the relevant articles from the literature search. Mendeley were used to check for duplicates and afterwards used to sort all of the relevant articles by separating them from the articles located in the literature search. Similarly to (Durach et al. 2015), decisions on whether to include the articles were based on the content of the summaries and were inclusive rather than exclusive (Durach et al. 2015).

Once downloaded, the Mendeley desktop application provides the user with an intuitive interface and desktop view. The intuitive interface and desktop view allows easy sorting, browsing and reviewing of articles. Firstly, a folder for the articles located via the EBSCO BSC literature search was created. Secondly, a second folder for all the articles that lived up to the inclusion criteria was created. The purpose of the secondly folder was to have a space to store all the selected articles and to have an easy to access space with the articles for further analysis. To begin the review of the 385 articles, the first folder with all the articles listed were opened. In Mendeley, the

list of articles have several headers. For example, you can mark your favourite articles with a star, mark all read articles with a one click on the mouse, and see the title, year and journal the articles was published in. When clicking on an article, a window on the right hand side showing the details of article shows up. The window allows you to get details on the article such as abstract, authors, year, tags, and author keywords. It also has a tab, which after you click on it, allow you to write notes to the article. After reading an article, the button for marking the article as being read was clicked. This enabled a clear overview of what articles had already been reviewed and which ones needed reviewing. If the article was relevant for further review and analysis the *Favourites* button was clicked and the articles was then moved to the second folder.

Figure 9: Screenshot of Mendeley Desktop



6.3.2 Inclusion and Exclusion of Articles

After carefully reviewing all 385 articles by applying the inclusion and exclusion criteria a total of 43 articles were selected. Many of the 385 articles were read in entirety for relevancy due to the fact that the article abstract did not provide enough or ambiguous information on MSCRM. For example, in some abstracts, the authors refer to supply networks when describing their focus of study or analysis. Since this is not clarifying whether the authors focus on a multi-tier supply chain, most of the articles are read in full or scanned in order to find out if it is relevant or not. Examples include among many (Garvey et al. 2015)(Hachicha & Elmsalmi 2014) (Basole & Bellamy 2014b)(Basole & Bellamy 2014a). As a result, the selection of articles were carried out

in a very careful and detailed manner in order not to leave any relevant article out of the selection process. If any of the articles did not fulfil the criteria, they were excluded from selection. The initial selection of 43 articles raised some concerns regarding the potential impact of this study. Literature reviews in supply chain management that selects articles using a similar method as this study collects more than 50 articles in their article selection (Durach et al. 2015)(Kamalahmadi & Parast 2016).

After the initial selection of articles from literature search, all 43 articles were reviewed again before they were inserted and coded in a Microsoft Excel Spreadsheet database created by the author. The database will be elaborated later. A number of articles did not make the cut after further in-depth review. For example, one article studies multiple retailers and manufacturers, however despite the complexity and high number of retailers and manufactures studied, the article focus only on two tiers and is therefore not included. The decision to exclude this article could only be made after reading the full article, as the abstract was ambiguous in terms of whether it included multi-tiers or not (Adida & DeMiguel 2011).

At the same time, some articles led to the discovery of relevant articles for inclusion. From investigating the article by (Aqlan & Sarah S Lam 2015), another article by the authors published a year later in 2016 were located and found to have a multi-tier focus on supply chain risk management (Aqlan & Lam 2016). This article was included in the database for further analysis. Investigating more research published by Aqlan and Lam (Aqlan & Sarah S. Lam 2015) , led to a discover of an article on risk assessment in multimodal supply chains, an article which was not discovered initially via the EBSCO BSC literature search (Vilko & Hallikas 2012). This discovery confirms the importance of thoroughly researching each of the articles located via EBSCO BSC. As shown, reading the articles in full may lead to the discovery of relevant articles that were not included in the literature search. Reading the full articles by (Olson & Wu 2011), a relevant article was located. The authors apply a multi-echelon perspective in their research (Kull & Closs 2008).

Being able to critically reduce the number of relevant articles was an important step when carrying out the research single-handed. If the research was carried out by two researchers, the number of eliminated articles when coding could have been reduced due to a more rigorous selected process. When analysing the initially selected articles and inserting them into the Excel Spreadsheet, the entire article were investigated in depth. For some articles the full article could not be retrieved either via the University's library or EBSCO BSC. This was perhaps due to the fact that the articles were only published recently. Unfortunately, the article was left out for further analysis (Han & Shin 2016)(Parenreng et al. 2016)(Simchi-Levi et al. 2015).

6.3.3 Journal and Impact Factor Concerns

There are many databases and journals related to supply chain management research. Actually, there are so many that it is necessary to consider which journals and academic databases that are most relevant. To ensure the high quality of articles included in this paper, it is important to be aware of the journals articles are published in (Durach, C. F., Wieland, A. and Kembro 2014). It can give another dimension and perspective to the analysis, however it is important to stay open towards relevant articles in journals not considered high impact journals. Some impactful journals listed below, were identified via research (Zsidisin et al. 2007). The search will be restricted to peer reviewed academic articles in recognized journals, however the type of journal will not influence the inclusion or exclusion of article. Despite the main literature search was conducted via EBSCO BSC, attention was given to the journals in which the articles were published. The type of journal outlet did not influence the inclusion or exclusion of article, however the consideration of journal outlet would later be used in the analysis when considering the impact of publications.

Below is a number of high quality journals related to supply chain management and are likely to contain relevant material and content. Being aware of the journals allows the researcher to assess and reflect on the quality of the studies reviewed. The figure below simply raise the awareness of different journals's impact in supply chain management research

Figure 10: Impact factor

Journal	Database	Impact factor 2015
Journal of Business Logistics (JBL)	Wiley Online Library	2.34
Journal of Supply Chain Management (JSCM)	Wiley Online Library	4.57
International Journal of Physical Distribution & Logistics Management (IJPDLM)	Emerald Insights	2.10
Production and Operations Management (POM)	Emerald Insights	2.25
Supply Chain Management: An International Journal (SCM:IJ)	Emerald Insights	2.73

Journal of Operations Management (JOM)	Science Direct	4.00
---	----------------	------

To raise awareness about the validity of the study, the type of journals and their Thomson Reuters' Journal Citation Report Impact Factor will be discussed and presented. (Durach et al. 2015) finds that research outcomes would not have been different if they had chosen only to include articles with an Impact Factor above the threshold of 1.3 (Durach et al. 2015).

7 ANALYSIS

To proceed with the analysis, all of the articles were read in order to code them in an Excel. In Excel, a database was created to store the articles and later be able to perform coding and analysis. The Excel database was created to manage the articles and to perform in-depth analysis and coding of the articles. Besides the headings for describing the articles such as "Title", and "Journal title" etc., headings for coding were added continuously to perform the analysis. In total, the database ended up having 19 headings and 30 articles:

*"Article ID", "Authors names", "Title", "Year", "Journal title", "Impact factor", "Method",
"Quantitative/Qualitative method (Coding)", "Type of study (empirical/research)(Coding)", "Synonyms for Tier",
"Description of multi-tier supply chain in article", "Description of MSCRM activity", MSCRM activity (Coding)",
"Risk Management Approach (Coding)", "Type of Risk Management (Coding)", "Description/remarks".*

The coding headings were developed organically as the articles were being reviewed, while some were created to clarify issues. For example, some of the articles used "tier" to describe lengthy and complex supply chains, whereas some authors used the word "node". A column for the types of word describing "tier" was created to better understand the articles approach to describing multi-tier supply chains. The procedure for coding was solely conducted by the author alone. There were no predetermined categories for coding, which were all defined as the analysis progressed. The research question was also a guiding factor in the analysis and helped shape the relevant coding categories. The following section will present the analytical findings. It is in this section, that the research question will be answered and the novel insights will be presented.

7.1 RESEARCH FINDINGS

The figure below shows the number of articles published on MSCRM according to the final article selection done in this study. The number of articles published each year is rather low, however there seems to be a trend towards an increasing interest in the field of research. The field of research is new, scattered and still emerging. However the visualisation also brings out a few concerns regarding the literature and the process of selecting articles. From the graph, there is a sudden drop in published articles after year 2011 and year 2014 despite an upwards going trend. Perhaps the sudden drop in published literature stem from the fact that the field is emerging and scattered with no clear research direction. Or, the drop could stem from this study's literature search and selection process, which would have a high negative impact on this study. The author believes, the reason is the former rather than the latter. The fluctuation in published articles is due to the fact that authors so far haven't had any guidance and research direction from a literature review such as this. Hence, the relevancy of this study can be concluded from this graph.

Figure 11: Overview of published MSCRM articles

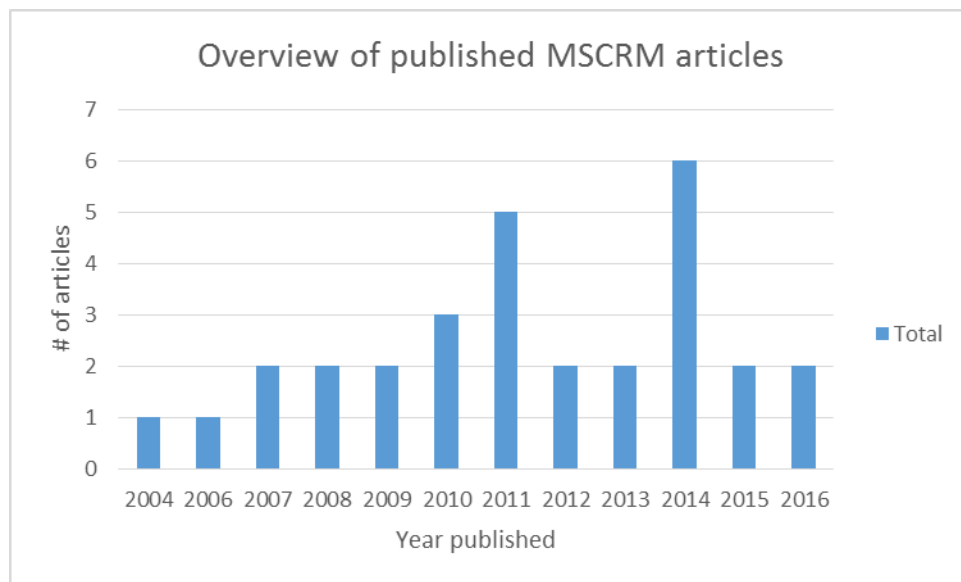


Figure 12: Full list of articles

#	Authors names	Title of article	Year	Journal title	Thomson Reuters Impact factor (*Researchgate IF)

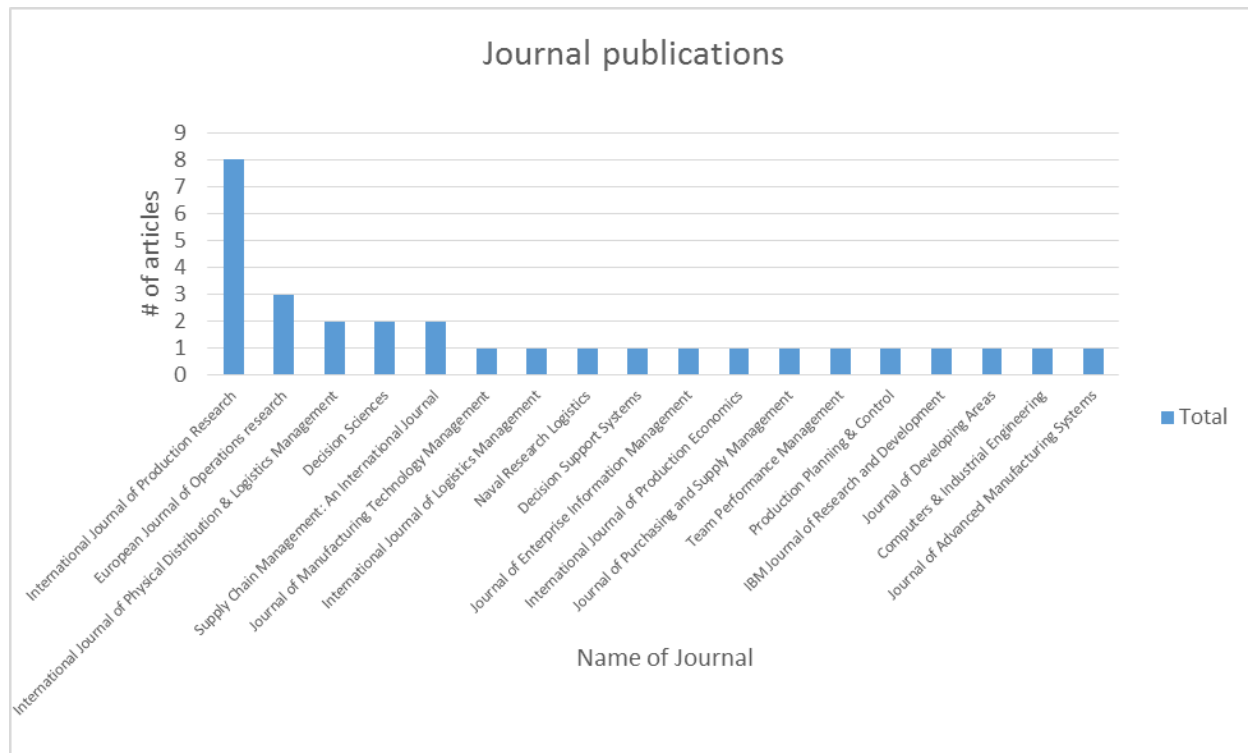
1	(Norrman & Jansson 2004)	Ericsson's proactive supply chain risk management approach after a serious sub-supplier accident	2004	International Journal of Physical Distribution & Logistics Management	2.101
2	(Cruz et al. 2006)	Financial engineering of the integration of global supply chain networks and social networks with risk management.	2006	Naval Research Logistics	0.787
3	(Goh et al. 2007)	A stochastic model for risk management in global supply chain networks	2007	European Journal of Operations research	2.679
4	(Craighead et al. 2007)	The Severity of Supply Chain Disruptions: Design Characteristics and Mitigation Capabilities.	2007	Decision Sciences	1.418
5	(Keow Cheng & Hon Kam 2008)	A conceptual framework for analysing risk in supply networks.	2008	Journal of Enterprise Information Management	n/a
6	(Kull & Closs 2008)	The risk of second-tier supplier failures in serial supply chains: Implications for order policies and distributor autonomy	2008	European Journal of Operations research	2.679
7	(Cruz & Matsypura 2009)	Supply chain networks with corporate social responsibility through integrated environmental decision-making.	2009	International Journal of Production Research	1.693
8	(Oehmen et al. 2009)	System-oriented supply chain risk management.	2009	Production Planning & Control	1.532
9	(Dillon & Mazzola 2010)	Management of disruption risk in global supply chains.	2010	IBM Journal of Research and Development	0.626
10	(Kumar et al. 2010)	Minimisation of supply chain cost with embedded risk using computational intelligence approaches.	2010	International Journal of Production Research	1.693
11	(Sanchez-Rodrigues et al. 2010)	Evaluating the causes of uncertainty in logistics operations.	2010	International Journal of Logistics Management	0.917
12	(Giannakis & Louis 2011)	A multi-agent based framework for supply chain risk management	2011	Journal of Purchasing and Supply Management	2.562
13	(Khilwani et al. 2011)	Hybrid Petri-nets for modelling and performance evaluation of supply chains.	2011	International Journal of Production Research	1.693

14	(Wakolbinger & Cruz 2011)	Supply chain disruption risk management through strategic information acquisition and sharing and risk-sharing contracts.	2011	International Journal of Production Research	1.693
15	(Pfohl et al. 2011)	Interpretive structural modeling of supply chain risks.	2011	International Journal of Physical Distribution & Logistics Management	2.101
16	(Tse & Tan 2011)	Managing product quality risk in a multi-tier global supply chain	2011	International Journal of Production Research	1.693
17	(Adenso-Diaz et al. 2012)	The impact of supply network characteristics on reliability.	2012	Supply Chain Management: An International Journal	2.731
18	(Vilko & Hallikas 2012)	Risk assessment in multimodal supply chains	2012	International Journal of Production Economics	2.782
19	(Breuer et al. 2013)	Collaborative risk management in sensitive logistics nodes.	2013	Team Performance Management	1.53*
20	(Mizgier et al. 2013)	Bottleneck identification in supply chain networks.	2013	International Journal of Production Research	1.693
21	(Badurdeen et al. 2014)	Quantitative modeling and analysis of supply chain risks using Bayesian theory.	2014	Journal of Manufacturing Technology Management	1.75*
22	(Bandaly et al. 2014)	Integrated supply chain risk management via operational methods and financial instruments.	2014	International Journal of Production Research	1.693
23	(Basole & Bellamy 2014b)	Visual analysis of supply network risks: Insights from the electronics industry.	2014	Decision Support Systems	2.604
24	(Basole & Bellamy 2014a)	Supply Network Structure, Visibility, and Risk Diffusion: A Computational Approach.	2014	Decision Sciences	1.418
25	(Biao et al. 2014)	A Multi-Agent-Based Research on Tourism Supply Chain Risk Management.	2014	Journal of Advanced Manufacturing Systems	0.27*

26	(Soleimani & Govindan 2014)	Reverse logistics network design and planning utilizing conditional value at risk.	2014	European Journal of Operations research	2.679
27	(Daultani et al. 2015)	A supply chain network equilibrium model for operational and opportunism risk mitigation.	2015	International Journal of Production Research	1.693
28	(Petersen & Lemke 2015)	Mitigating reputational risks in supply chains.	2015	Supply Chain Management: An International Journal	2.731
29	(Ali & Shukran 2016)	MANAGING SUPPLY CHAIN RISKS AND VULNERABILITIES THROUGH COLLABORATION: PRESENT AND FUTURE SCOPE.	2016	Journal of Developing Areas	0.50*
30	(Aqlan & Lam 2016)	Supply chain optimization under risk and uncertainty: A case study for high-end server manufacturing	2016	Computers & Industrial Engineering	2.086

Most notably, the journal with the highest amount of research included for this study is the “International Journal of Production Research”. The “European Journal of Operations Research” is represented by three articles, while the journals “Supply Chain Management: An International Journal”, “Decision Sciences” and “International Journal of Physical Distribution & Logistics Management” are represented by two articles each. An interesting finding in a literature review supply chain risk modeling by (Fahimnia et al. 2015), is that “International Journal of Production Research” is ranked first in top journals contributing to the area of supply chain risk modeling, while “European Journal of Operations Research” is ranked third. When comparing this study’s finding with (Fahimnia et al. 2015)’s result on supply chain risk modeling, it is interesting that these journals rank high and are top contributing for MSCRM. The articles published in these journals are using MSCRM activities such as simulation (Mizgier et al. 2013; Goh et al. 2007) or computational and mathematical modeling (Daultani et al. 2015; Khilwani et al. 2011; Kumar et al. 2010; Soleimani & Govindan 2014). Later, this chapter will look into the quantitative aspects and discuss them in more detail.

Figure 13: Journal publications



There are in total five articles with an impact factor below 1.3 (Dillon & Mazzola 2010; Cruz et al. 2006; Sanchez-Rodrigues et al. 2010; Biao et al. 2014; Ali & Shukran 2016). It is worth paying attention to the low impact factor as done by (Durach et al. 2015). (Durach et al. 2015) found that articles with an impact factor below 1.3 did not contribute with knowledge or insights that was not found in articles with an IF higher than 1.3. In their articles, they argue that their theoretical framework could have been developed by only including articles with an IF higher than 1.3. However, for this study, the articles will be included as to produce a transparent overview of the MSCRM research as possible. The articles and journal IF are highlighted for transparency and validity purposes.

Figure 14: Journal Impact Factor

Journal	# of articles	Thomson Reuters IF in 2015
International Journal of Production Research	8	1.693
European Journal of Operations research	3	2.679
Supply Chain Management: An International Journal	2	2.731

Decision Sciences	2	1.418
International Journal of Physical Distribution & Logistics Management	2	2.101
Journal of Manufacturing Technology Management	1	1.75 ^{1iv}
Journal of Developing Areas	1	0.50 ^{2v}
IBM Journal of Research and Development	1	0.626
Journal of Purchasing and Supply Management	1	2.562
Journal of Enterprise Information Management	1	n/a
Naval Research Logistics	1	0.787
International Journal of Logistics Management	1	0.917
Decision Support Systems	1	2.604
Production Planning & Control	1	1.532
International Journal of Production Economics	1	2.782
Team Performance Management	1	1.53 ^{3vi}
Computers & Industrial Engineering	1	2.086
Journal of Advanced Manufacturing Systems	1	0.27 ^{4vii}

A breakdown of the *type of study* and the *type of method* used in the study reveals a very interesting point.

Type of study refers to empirical studies where researchers have collected empirical data on which they perform the analysis and research based article where researchers focus on theoretical material as basis for the analysis. On the other hand, the type of method refers to quantitative or qualitative methods applied in data collection and processing. The interesting point is, there is an overwhelming amount of literature using quantitative methods in research type of studies. Looking at the top left and top right quadrant (empirical/qualitative & empirical/quantitative), there is less empirical studies than research based studies. The reason could be that gathering valid and high quality empirical data in a multi-tier supply chain is more difficult

¹ This value is calculated using ResearchGate data and is based on average citation counts from work published in this journal. The data used in the calculation may not be exhaustive. See Endnote for link.

² This value is calculated using ResearchGate data and is based on average citation counts from work published in this journal. The data used in the calculation may not be exhaustive. See Endnote for link.

³ This value is calculated using ResearchGate data and is based on average citation counts from work published in this journal. The data used in the calculation may not be exhaustive. See Endnote for link.

⁴ This value is calculated using ResearchGate data and is based on average citation counts from work published in this journal. The data used in the calculation may not be exhaustive. See Endnote for link.

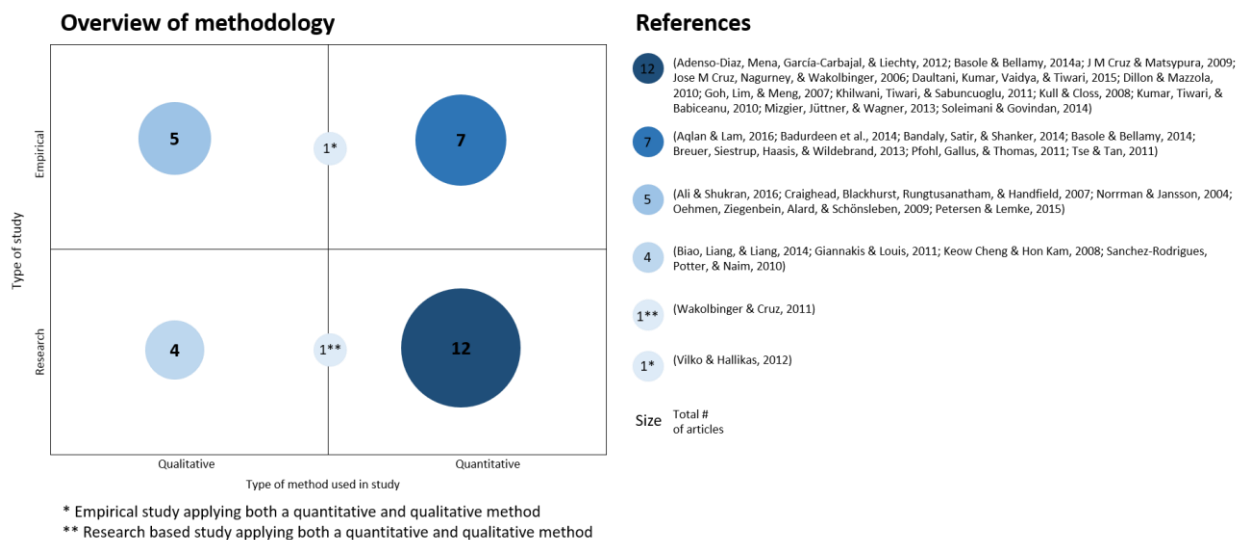
than in a dyadic relationship. Secondly, there is less qualitative approaches than quantitative; the reason for this could be due to the complexity of multi-tier supply chain and the accessibility of quality data. Qualitative studies gather data using semi-structured and open interviews (Norrman & Jansson 2004; Craighead et al. 2007; Oehmen et al. 2009; Petersen & Lemke 2015; Ali & Shukran 2016). Overall, studies analysing empirical data tends to focus on quantitative methods. This include, interpretive structural modelling (Pfohl et al. 2011), marginal incremental analysis (Tse & Tan 2011), agent based simulation (Breuer et al. 2013), Bayesian theory (Badurdeen et al. 2014), operational methods and financial instruments (Bandaly et al. 2014), network analysis and information visualisation (Basole & Bellamy 2014b) and optimisation and simulation modelling (Aqlan & Lam 2016). One article, also combines qualitative and quantitative methods (Vilko & Hallikas 2012). Again, the reason for the majority of the authors using quantitative method could be due to complexities of MSCRM. Constructing meaningful and significant results from very complex data increase in difficulty as more supply chains tiers are including in the study. Hence, authors tends to refer to quantitative method, which can help them quantify and analyse the results.

On the research side, bottom left and bottom right quadrant (research/qualitative and research/quantitative), there is a tendency towards more quantitative applications. However, qualitative studies use theories to address risk management in MSC. Authors primarily create conceptual frameworks or models using theory (Keow Cheng & Hon Kam 2008; Sanchez-Rodrigues et al. 2010). (Sanchez-Rodrigues et al. 2010) also use focus groups to test their conceptual model. Others, use a multi-agent based approach (Giannakis & Louis 2011; Biao et al. 2014). For the quantitative studies, the application of methodology is a bit more colourful. It includes financial engineering (Cruz et al. 2006), Moreau-Yosida Regularization (Goh et al. 2007), simulation (Kull & Closs 2008; Adenso-Diaz et al. 2012; Daultani et al. 2015), network theory and modelling (Cruz & Matsypura 2009; Mizgier et al. 2013), and computational techniques and modelling (Dillon & Mazzola 2010; Kumar et al. 2010; Khilwani et al. 2011; Basole & Bellamy 2014a; Soleimani & Govindan 2014). In this case, authors are not restricted by any empirical data, thus are therefore able to apply a wider array of techniques and methods to analyse MSCRM. It also reflects the fact that supply chain management as a research field is very open for creative applications of methods, as well as being subject to many fields of research.

Distilling this information, it is possible to draw some conclusions on the some trends in MSCRM methodology. There are more published researched focused articles than empirically based ones. In fact, that is 16 research based compared to 11 empirically based. Overall, out of 30 articles, 19 apply a quantitative methodology, nine articles a qualitative methodology and only two articles a mixed methodology. All in all, this raise some

concerns in terms of future research directions. Researchers should seek to conduct more empirically based studies. For example, researcher could start focusing on validating research by collecting empirical data and test results. There is also a relative low amount of qualitative research in MSCRM. More qualitative research could provide some interesting insights into MSCRM that could unlock future research implications and proposition, for example via case studies. The type of qualitative methods applied should extend beyond the interview based data collection to include for example shadowing and company specific information. On the other hand, the overarching use of quantitative methods also points to the fact that studying MSC is a complex topic and task, as it requires techniques that can easily distil the large amount of data produced by multiple tiers. Also, creating meaningful contribution can require quantification which quantitative methods more easily can handle. To address this issues, more research should aim for a mixed method approach. Currently with an equal amount of empirical and research based mixed method studies, more mixed method research in any type of study is appreciated. Emphasising the importance of methodology and discussing currently methodological approaches is crucial for quality of a research field in general, but particularly for the field of MSCRM as it is emerging and somewhat scattered and needs a direction.

Figure 15: Overview of methodology



7.2 MSCRM ACTIVITY MAP AND RESEARCH PROPOSITIONS

The MSCRM activity map along with the description of each MSCRM activity is the main deliverable of the paper and the answer to the research question. The map presents the type of activities useful to manage risk in

multi-tier supply chains. The activities are mapped in a matrix with “risk management approach” on the Y-axis, and “type of risk management” on the X-axis. The categories on both the Y and X-axis are developed from coding the articles. The coding was conducted by the author in an Excel spreadsheet database. The size of the bubbles represented the number of articles describing the particular type of activity. For example, there are three articles using a mathematical approach such as computational modelling for managing risk in multi-tier supply chains. These three articles focus specifically on how to mitigate risk (Basole & Bellamy 2014a; Soleimani & Govindan 2014; Daultani et al. 2015). As indicated by the map, there is a high number of articles, in fact 19 out of 30, applying a mathematical approach to risk management, which include both algorithms, financial engineering, computational modelling techniques, collaboration, mathematical modelling and simulation. By looking at the map, the quantitative mathematical approach to risk management has a strong presence. This comes as no surprise, as the methodology applied in the studies were mainly quantitative as discussed earlier. At the same time, the majority of the risk management activities are focused on how to mitigate or assess risk, as these are more quantifiable and thus subject to a mathematical approach. The mathematical approaches are less used on risk identification and analysis, which could be argued, has a qualitative nature and is industry or company specific. In fact, more qualitative approaches such as conceptual frameworks and models are more likely to be used in risk identification. Overall, MSCRM activities are consolidated in the top rows, mainly being strategy and mathematical approaches to risk assessment and mitigation. The activities will be described in the following paragraphs to answer the research question, but also to propose some research propositions. However, this of course, also shows the huge potential to tap into unexplored corners of this research fields. The author believes, that future MSCRM research will keep focusing on the mitigation, assessment and identification risk management aspects. However, more research in the bottom left corner of the matrix is expected. That is, increasing focus on conceptual frameworks and models and perhaps case studies, as researchers now have become more aware of the importance of studying multi-tiers as thus will collect data beyond the dyadic relationship of supply chain actors. Through increased access to empirical material, the author also expects an trend towards an analytics, big data and advanced analytical techniques approach in risk management research. This field is currently rather unexplored and delivers huge potential for research in the future. The “MSCRM activity map with trends” shows the current research trend and future research area.

Bridging the mathematical and conceptual approach with mixed method case studies. It seems, researchers have explored useful risk management activities, which now needs validation and testing in an empirical setting. A mixed method approach could provide valuable insights into such empirical endeavour.

Figure 16: MSCRM activity map

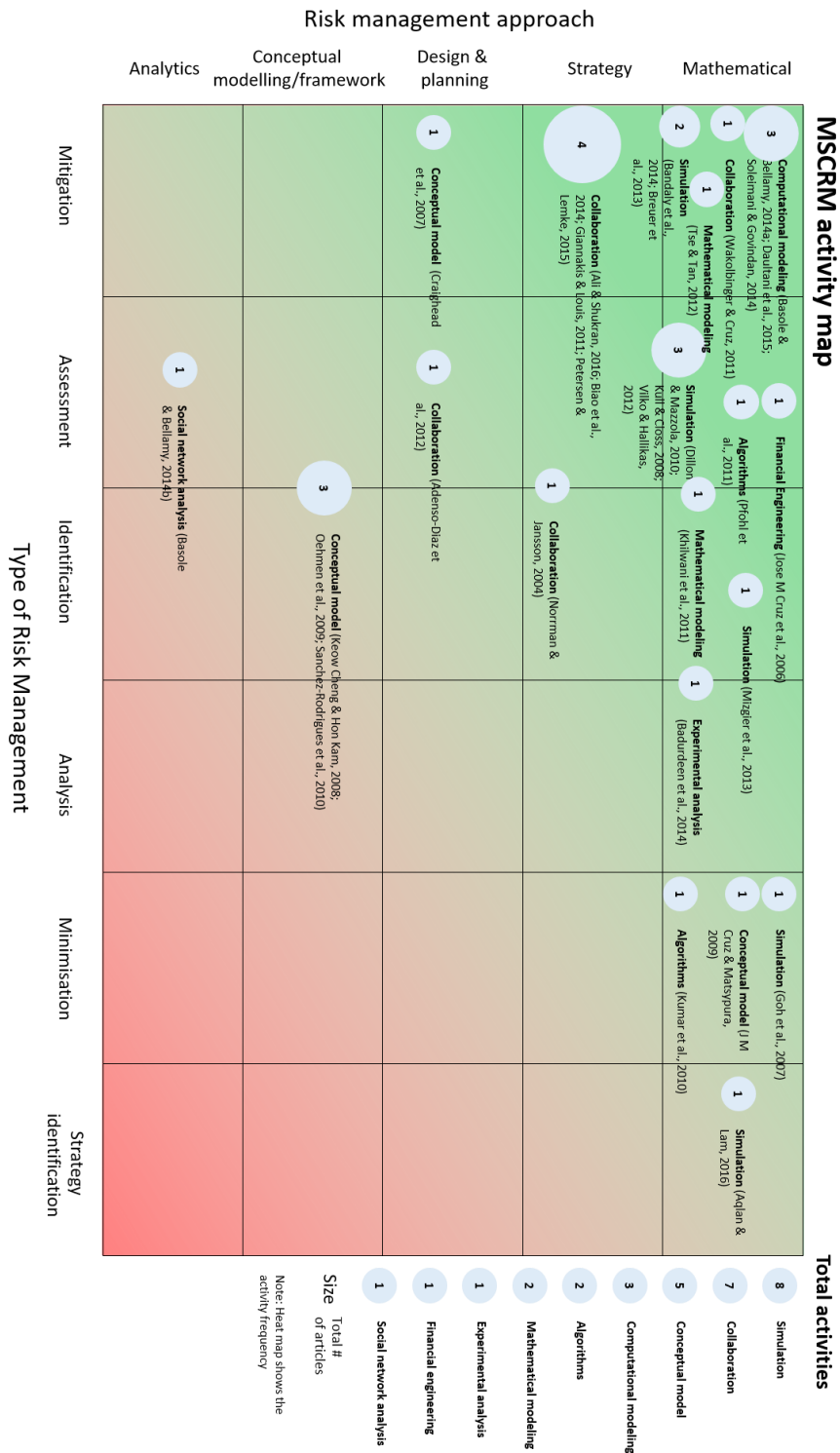
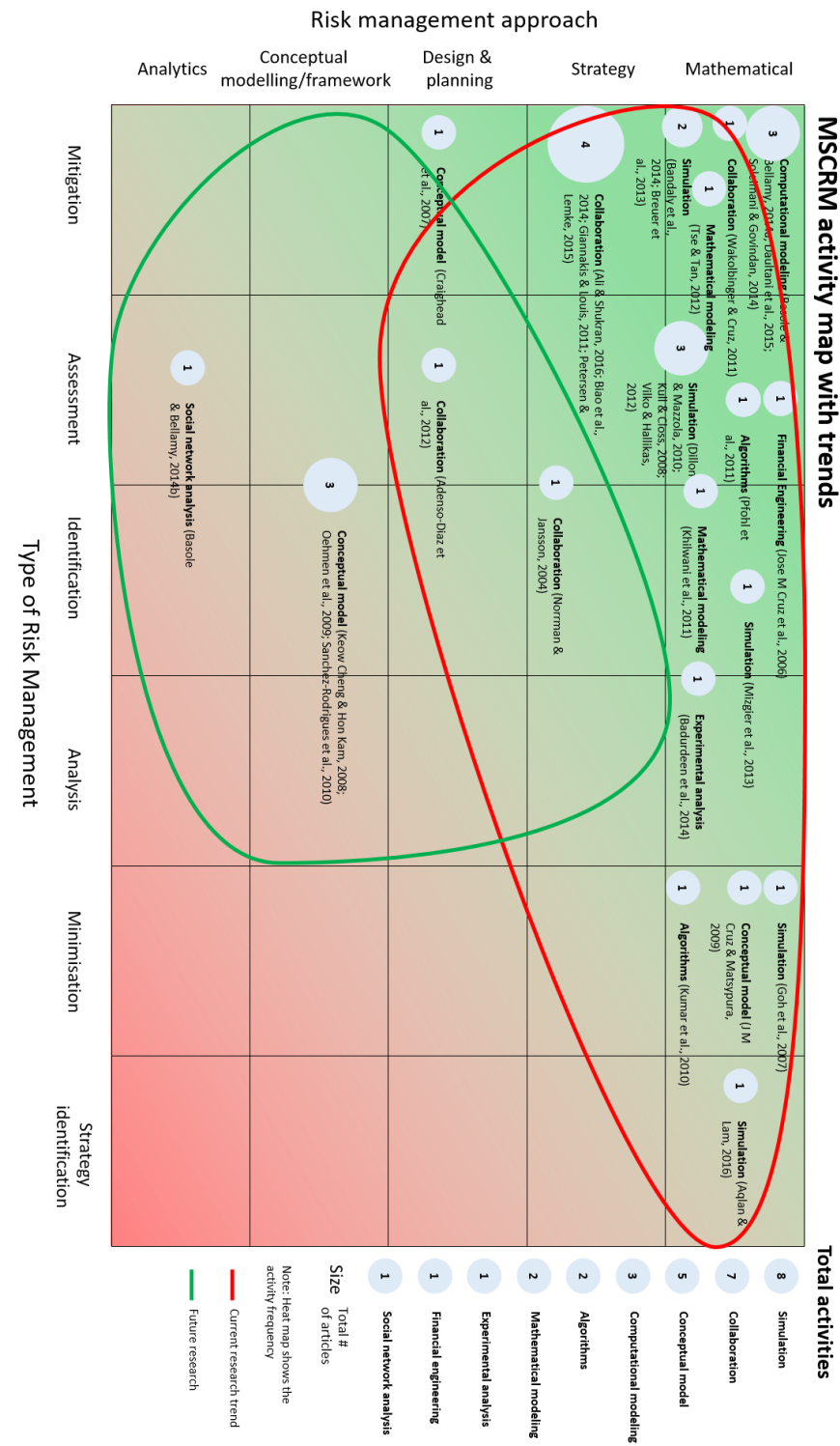


Figure 17: MSCRM activity map with trends



Now, it is time to look more closely into the specific activities for managing risks in multi-tier supply chains. The following paragraphs will describe the activities in detail, and based on the model, derive some research proposition to extend the research of risk management in multi-tier supply chains.

Simulation

Several authors studies how simulation can be applied in risk mitigation and minimisation. In the first example, stochastic modelling are applied to a multi-stage global supply chain network and used to minimise risk (Goh et al. 2007). Another study on collaborative risk management in logistics nodes, focus on collaborative planning using simulation approach (Breuer et al. 2013). (Bandaly et al. 2014) build a stochastic optimisation model which "integrates operational and financial risk management decisions to minimise the expected total opportunity cost of a beer supply chain exposed to uncertainties from upstream (commodity price fluctuations) and downstream (demand variability)".

Grounded in inventory and resource dependency theories (Kull & Closs 2008), create a simulation environment for risk assessment in which they study a serial supply chain consisting of customer, retailer, distributor and supplier. They argue that companies should take a systems perspective (Kull & Closs 2008). Their "research demonstrates that the level of an organization's resource dependence, as measured by days on hand inventory, is not an adequate indicator of a supply chain's supply failure sensitivity. Other channel characteristics such as inventory policy parameters, level of supply chain coordination, and second-tier supplier lead-times all interact to influence supply risk" (Kull & Closs 2008). Adding to the risk assessment perspective, (Dillon & Mazzola 2010) study a five node supply chain a apply a stochastic disruption risk model. More interestingly, (Vilko & Hallikas 2012) show how simulation can be used in a mixed method approach. They use 22 qualitative interviews for risk assessment purposes and then analyse the risk impacts by means of Monte-Carlo-based simulation software. Their study is focused on shipping companies, ports, port operators and administrators, customs, road and trail transportation, insurance companies and international logistics operators. (Mizgier et al. 2013) focus on bottleneck identification using stochastic modelling and loss contribution method. In an empirical study of a high-end server manufacturing supply chain, optimisation and simulation are used to find the best mitigation strategies (Aqlan & Lam 2016).

Simulation is a very versatile approach to managing risk, as it can easily quantify risk and make large and complex supply chain risk manageable for decision makers in various industries.

Proposition 1: Simulation can help companies both identify, asses, mitigate and minimize risk in a multi-tier supply chain, if stochastic modelling is used.

Collaboration

Early explorers of MSCRM, (Norrman & Jansson 2004), discovers via their case study how a strategic co-operative and collaborative approach in risk management can help companies evaluate and identify risks. Using a supply chain design and planning approach, (Adenso-Diaz et al. 2012) finds that “simplicity and redundancy are most critical factors when designing reliable supply networks. To improve reliability, simplicity and interconnectedness are needed”. As such, a collaborative approach to supply chain network design is helpful for risk assessment. (Giannakis & Louis 2011) develops a framework for the design of a collaborative multi agent based decision support system for the management and mitigation of risk. Most interestingly (Petersen & Lemke 2015), adopt a CSR perspective in MSCRM. They "suggest that a CSR policy adopted by associated members may address reputational risk and may also apply to the mitigation of generic supply chain risks related to quality and disruptions." They further “recommend the adoption of a more holistic practice of forming an association, whereby participants or members agree to a set of CSR policies that serve as a foundation for good governance.” “In this sense, all members would be strategically aligned to design and control for varying risks in the chain” (Petersen & Lemke 2015). (Biao et al. 2014; Ali & Shukran 2016) both propose a collaborative approach to risk mitigation, in a global tourism supply chain and agricultural supply chain. Two very distinct supply chains, but it must be noted, that these articles are published in journals not given an impact factor by Thomson Reuters, and a relatively low one on ResearchGate.com. See Figure 12: Full list of articles. (Wakolbinger & Cruz 2011) argues that risk can be mitigation via information sharing and risk sharing contracts. This requires collaboration between supply chain members. The authors develops an equilibrium model and test it using numerical methods, and therefore represent one out of two articles applying quantitative and qualitative methods.

Collaboration between supply chain members can facilitate risk mitigation, assessment and identification. However, to successfully collaborate beyond the dyadic relationship is a challenge as companies move further away from each other. Collaboration is a delicate endeavour, and most researchers tend to study collaboration in supply chain qualitatively.

Proposition 2: Collaboration as risk management in multi-tier supply chains is a strategic endeavour, which can help decision-makers asses and mitigate risk

Conceptual framework/model

Another pair of authors combine the domain of CSR with MSCRM to develop a model for risk management (Cruz & Matsypura 2009). They develop a mathematical network model for risk minimisation and say that "increasing the level of social responsibility activities between decision makers are assumed to reduce risk" (Cruz & Matsypura 2009). (Craighead et al. 2007) employs a design and planning approach to risk mitigation. They develop a conceptual framework with six propositions for risk mitigation via supply chain design. The design characteristics are density, complexity and node criticality. The mitigation capabilities are recovery and warning. Conceptual models and frameworks are also employed by a number of other authors (Keow Cheng & Hon Kam 2008; Oehmen et al. 2009; Sanchez-Rodrigues et al. 2010).

Proposition 3: Conceptual models and frameworks can be developed by combining, or using multiple, research theories to mitigate and assess risk.

Computational modelling

The differences between computational modelling and mathematical modelling are subtle. All of the quantitative studies somewhat belongs to the realm of mathematics, however the author distinguish between the quantitative and mathematical approaches to develop a more nuanced overview of the MSCRM activities. The differences that distinguish each coded activity, should become clear in the descriptions below. (Basole & Bellamy 2014a) finds that there is a "significant association between supply network structure and both risk diffusion and supply network health", and a "greater visibility greatly enhances risk mitigation regardless of the structural properties of the supply network". They use a computational modelling to develop their findings. (Soleimani & Govindan 2014) looks into risk mitigation in reverse logistics network design and planning by testing a mean conditional value at risk two-stage model via computational analysis. (Daultani et al. 2015) develops a multi-period equilibrium model for operational and opportunism risk mitigation and test is via computational modelling. Risk mitigation characteristics are flexibility and social relationship. As literature shows, computational modelling is often used to test models or develop findings, and is therefore a strong technique for developing risk mitigation schemes. However is sometimes overlaps with other mathematical approaches such as simulation.

Proposition 4: Computational modelling as risk mitigation via testing of risk and equilibrium models

Algorithms

(Kumar et al. 2010) focus on risk minimisation and considers a multi-echelon supply chain while using computational intelligence techniques to minimize risk factors and create a robust supply chain design. In particular, generic algorithms such as particle swarm optimisation and artificial bee colony are used. (Pfohl et al. 2011), develops an interpretive structural modelling (ISM) algorithm that can uncover interdependencies between risks. The algorithm "Creates conditions for rational decision making" and can assist decision makers in risk assessment (Pfohl et al. 2011)

Proposition 5: Algorithms can be used to minimise and assess risk

Mathematical modelling

(Tse & Tan 2012) integrate incremental calculus in their Product quality and visibility assessment framework for risk mitigation. (Khilwani et al. 2011) , use Hybrid Petri Nets for modelling. The "model is used for risk management to investigate the issues of supply chain vulnerability and risk", and as such it can be considered a method for risk assessment. They also argue that the "The assessment of risky events on probability and consequence assessment scale provides a helping aid for experts to focus on the prime aspects responsible for the vulnerability of a supply chain. The methodology presented in the paper, can help experts to model, evaluate the performance and identify and assess the risk factors prevalent in their network" (Khilwani et al. 2011)

Proposition 6: Mathematical modelling can assist decision makers to assess the risk in the supply chain network

Experimental Analysis

Probability theory and statistics can quantify risk in multi-tier supply chains and prove to be effective methods to identify, model and analyse complex supply chain risk. (Badurdeen et al. 2014), use Bayesian theory to perform quantitative modelling and analysis of supply chain risks through which they develop a risk analysis tool. In particular, the tool is based on Bayesian Belief Networks, statistical modelling, to model and study the effects of supply chain risks (Badurdeen et al. 2014).

Proposition 7: Probability theory and statistical analysis, such as Bayesian Network, can help decision makers identify, model and analyse MSC risks.

Financial Engineering

(Cruz et al. 2006), apply the process of financial engineering to risk management in integrated global supply chain networks and social networks. The authors propose a discrete-time algorithm. Other authors, use both stochastic simulation and financial instruments to mitigate risks (Bandaly et al. 2014).

Proposition 8: Financial engineering principles and processes can be applied to MSCRM and help decision makers in risk assessment and evaluation

Social Network Analysis

Social Network Analysis is coded as Analytics approach to risk management. So far, the least studied of all MSCRM activities, while being a research field with many opportunities. (Basole & Bellamy 2014b) conduct a social network analysis and visualisation of supply chain networks in the electronics industry. Advanced analytics is a very powerful tool to provide valuable insights, uncover, and disclose complexities of multi-tier supply chains.

Proposition 9: Higher use of data driven decision-making can help decision makers more easily assess risk in multi-tier supply chains.

8 DISCUSSION

This chapter will open a discussion of the results and how the results and study could be further improved to enhance quality and validity. The discussion of results will look into how the initial research problem can now be understood, if the study has produced any new insights or knowledge compared to what was already known, and how the study fills a gap in literature. The second part of the discussion are focusing on how the study could be further improved by looking into validity issues related to the data collection.

8.1 RESULTS

To start where the introduction ended, this study filled out a gap in literature, which was identified in the first scanning of existing literature. To the author knowledge, no one has discussed the activities needed for management of risk in multi-tier supply chains in a systematic literature before. The simple answer to the research question is, decision makers in multi-tier supply chains should engage in risk management activities such as simulation, specifically Monte Carlo methods, to mitigate, asses and identify risks. If used strategically in the supply chain network design, collaboration between multi-tier actors is useful for risk assessment and

mitigation. For example, findings reveals how collaboration can be facilitated with CSR initiatives to improve risk management (Petersen & Lemke 2015), or how risk sharing contracts can minimize risks. Conceptual models and frameworks are also widely used to assess MSC risks, but are less strict in their structure and definition due to their qualitative nature. For example, (Cruz & Matsypura 2009) integrate the domain of CSR into their mathematical risk model, while other develops frameworks according to the specific industry, such as a logistics triad (Sanchez-Rodrigues et al. 2010). Computational modelling is used to quantify, test and develop risk management. It is an activity, overlapping with other quantitative activities such as algorithmic and mathematical modelling. Activities includes algorithms such as particle swarm optimisation and artificial bee colony, and Hybrid Petri Networks. Probability theory and statistical analysis are inspiring authors to apply Bayesian Belief Networks to identify, assess and analyse risks. Financial engineering has traditionally been concerned with risk and quantification, and it was just a matter of time before some took the principles and applied them to multi-tier supply chain risk management (Bandaly et al. 2014; Cruz et al. 2006). Lastly, Social Network Analysis is successfully being applied to risk assessment in MSC. Still a rather unexplored area, however with huge potential to be explored further.

In sum, there are some trends in the current research and some areas of research which needs to be explored further and some areas which needs validation and testing. Currently, it seems there is a high number of quantitative applications and methods in as seen in MSCRM Figure 16: MSCRM activity map. The qualitative approaches are less generic and more loosely defined in terms of risk management activities needed to perform MSCRM. An interesting observation was the increasing trend towards combination of research areas, such as CSR and risk management (Sanchez-Rodrigues et al. 2010; Petersen & Lemke 2015). Authors found that CSR could transcend the gap between multiple tiers to enable actors perform MSCRM. In that sense, CSR could be seen as an enabler of MSC risk management, as it lets multiple supply chain actors engage and interact more closely.

The research findings and MSCRM activity map provided basis for new research in the field of MSCRM, as seen in Figure 15: Overview of methodology. The analysis of methodological approaches in MSCRM research revealed that the majority of researchers use a quantitative method, however only very few use a mixed method approach. A mixed method approach could be highly relevant for future research as the topic proves to be very complex and requires knowledge of both qualitative and quantitative aspects in order to provide meaningful content and valuable research insights. Secondly, articles on MSCRM are published in a wide array

of academic journals, which proved to show that supply chain management as a research field is spanning many different areas.

8.2 FURTHER IMPROVEMENTS

Further improvements to the research could tackle and accommodate the challenges of conducting a SLR without having a critical second opinion or researcher. A rigorous validation of the results as well as the method could significantly increase the quality of this study. As quality of the articles are very important for producing any significant and impactful results, involving another researcher to validate and participate in the selection and analysis of article is crucial for producing quality results. This would also address the issue of bias in the methodology and analysis. At this stage and with the information collected, another researcher would first have to test the results of this paper. Any issues should be logged in a file to be discussed with the author. This would ensure all issues related to validity would be discussed. Secondly, the second researcher should critically evaluate the literature search method and the results stemming from this study's literature findings. Then, the researcher should evaluate the inclusion/exclusion criteria and then apply them to the articles found via the literature search. All these steps should be carried out by a second researcher independently and perhaps together with the author. Despite being very rigorous and detailed, it would be necessary to ensure the quality standards of the SLR as mentioned in (Durach, C. F., Wieland, A. and Kembro 2014). Finally, the coding and analysis of the findings should be conducted by minimum two researcher to produce more valid and high quality results.

The low number of articles located raised some concerns regarding the impact of relevance of this study. One of the reasons could be because the topic is emerging and not much literature has been published yet. A mere 385 articles were located in the literature search on EBSCO BSC. Another important factor, which must be considered in order to increase the validity of this study, is the inclusion of only one database. For this study only the EBSCO BSC was used as a database, but to increase the number of articles and scan the entire field, another database search could be included as recommended by (Durach, C. F., Wieland, A. and Kembro 2014). Had the study carried out a similar literature search on other databases such as Web of Science or ABI INFORM, perhaps more articles could have located. Alternatively, to increase the number of relevant review articles, all of the referenced literature of the located articles could have been reviewed. This process is very time consuming, but could have proved useful in finding more relevant articles. Another method used by several scholars is the citation network analysis (Colicchia & Strozzi 2012)(Fahimnia et al. 2015)(Tang & Nurmaya Musa

2011). The inclusion of another researcher could also help the study include the calculation of Cohen coefficient to increase the validity of the study.

It turned out when reviewing all 385 articles individually, that the literature search via EBSCO BSC did not reveal all relevant articles. Some relevant articles were discovered when investigating more individual articles for clarification purposes. Since not all 385 articles were read in their entire format, as the abstract were sufficient for most of the articles, there will undoubtedly be some articles undiscovered. This must be considered a margin of error when conducting this type of research. Not including other expert and researchers' recommendations pose the risk of overlooking relevant material. However, a librarian was consulted. Ideally, more researcher should be included to critically assess the search strings. Secondly, included other researchers with different background and experience could provide valuable insights such as article recommendations.

Nonetheless, the selection ratio between articles located from literature search and articles selected using the inclusion/exclusion criteria is relatively high. Investigating the selection ration in (Durach et al. 2015) by dividing the located articles after elimination of duplicates (1356) by selected articles (94) equals a ratio of 14,4. Conducting a similar simple calculation for this study, the ratio equals 12,8. This means, that the selection ration for this study is actually higher than the ratio by (Durach et al. 2015). In their study one article was selected for every 14,4 article, whereas in this study an article was selected by every 12,8 located article (385 articles divided by 30 articles). Having a more frequent selection ratio in this study, while the published literature on the subject may be lower, could indicate some selection bias. Perhaps, articles were more frequently selected because the author was concerned not enough articles were relevant for conducting an impactful analysis. Another reason could be, due to the inclusion/exclusion criteria. This important step of the literature search determines what articles are selected, therefore having different inclusion/exclusion criteria can produce very different results. To reduce this bias, ideally two or more researchers should be involved in the selection process. However to provide the reader with full transparency and to increase the validity of the study, a list of all the located articles are included, Figure 12: Full list of articles, as well as the search string used on EBSCO BSC, Figure 8: EBSCO BSC Search Strings. To the extent of the author's knowledge, researchers conducting systematic literature reviews fail to comment on the selection ratio. The ratio could be a useful measure to include in studies when discussion the validity of the study. As shown in this discussion, it creates comparability between studies but also illuminates any potential selection bias, which must be discussed. For example, as in this study where the literature search only revealed 385 articles, but a relatively high number of

articles were selected for analysis. It can also help the researcher to re-evaluate the selection of articles and consider whether some has to be excluded. Like suggested by (Durach, C. F., Wieland, A. and Kembro 2014), this study focus on quality and validity of the located articles by only including peer-reviewed articles. Harvard Business Review is not considered a peer-reviewed journal, thus limiting the search to only include peer reviewed journals a popular outlet such as Harvard Business Review is not included. Despite not being a peer-reviewed journal, it could provide some interesting insights into the MSCRM and the related research.

To gauge the impact of this study, this study could be expanded by creating a total evaluation of the impact of the journals included in this study. Even though it perhaps would not be a determining factor for the total quality of this study, it could create some interesting insights for researchers as well as open a discussion of the articles included. As the field of MSCRM is emerging, articles were included despite having a low impact factor because they could make a meaningful contribution to the analysis.

8.3 LIMITATIONS

As this study is a systematic literature review, it relies heavily on secondary data and not on primary data. Only using electronic databases might have limited the number of relevant articles due to an error margin in the search strings. For example, sitting with each printed journal could have improved the inclusion and exclusion of relevant articles. Limited knowledge of languages, confined the author to only look for articles written in English. This would have excluded a number of relevant articles. Suggestions for further research would be to include foreign researchers in the study. This could provide a more objective view on the literature search and analysis, as well as enable the study to collect more relevant data. Ultimately, it would increase the validity of the study. The study has followed a rigorous SLR methodology, but this would also be subject to criticism as researchers from different background have different opinions. However, to the authors knowledge, the SLR method applied in this paper is the most rigorous and reliable SLR method described so far in supply chain management (Durach, C. F., Wieland, A. and Kembro 2014). Lastly, the study was also limited by the university's access to databases and relevant academic material online. For example, some of the located articles was irretrievable by the university.

9 CONCLUSION

In conclusion, this paper has investigated what different activities can be used to manage risk in multi-tier supply chains. The method for data collection and analysis was guided by a systematic literature review approach. 389 articles were located on EBSCO BSC, and 30 articles were selected for further analysis in an Excel database. The research findings reveals, that published MSCRM literature is scattered. The majority of the published literature is restricted to a few selected journals, but literature has been published in more 18 different peer reviewed academic journals. In terms of methodology, most research have so far focused on quantitative methods and been research types of studies. However, mixed methods is a welcome approach and still rather unexplored. Five risk management approaches and six types of risk management themes was identified in the 30 articles. In total nine different MSCRM activities were identified and mapped in the MSCRM activity matrix. Most MSCRM activities are quantitative in nature and focus primarily on risk mitigation, assessment, identification and analysis. Lastly, nine propositions related to the MSCRM activities were derived to inspire new research in MSCRM. The study was severely limited by the fact that it was only conducted by one English speaking researcher, but has contributed to the research field by mapping the current research field and proposing a new research direction.

10 IMPLICATIONS

Theoretical implications:

One of the main implications for researchers is the mapping of the research area and methodology. The findings can guide researchers towards new unexplored research areas, by which the research field would be extended and developed. Secondly, MSCRM literature is published in a wide array of journals as seen in Figure 13: Journal publications, but what it really tells us, is that researchers must be open to different kinds of research fields when exploring and investigating MSCRM. Contributors to the field could be found many places, even outside the supply chain management research domain. Thirdly, applying mixed methods and collecting and handling complex data would require lots of time, experience, knowledge and resources. Researchers are therefore recommended to consider conducting research together with peers to create maximum value from the collected data and utilise competences from researchers with different backgrounds. This is particular relevant for SCM research, as the field spans across many different areas.

Managerial implications:

The MSCRM activity map, Figure 16: MSCRM activity map, should help managers and decision makers in choosing the appropriate type of risk management activity depending on their needs. However, while simulation seems to be the preferred activity for MSCRM it is also subject to some criticism. “One limitation of many of the conventional simulation approaches (e.g., object-oriented, discrete event) is their limited or lack of ability to reflect the heterogeneity and autonomy of each entity, or to capture the complex interactions among entities” (Basole & Bellamy 2014a). This reminds us, that all activities have a backside and must be critically evaluated before being implemented or developed.

In the future, SC managers would have to look for a more quantitative approach to risk management. Quantitative skills such as programming and knowledge of mathematics are essential skills, if companies wish to conduct quantitative simulations and models for risk in multi-tier supply chains. Supply chain management is a field that covers many areas of business, thus managers should take advantage of this by tapping into talent pools of individuals with more quantitative backgrounds such as IT professionals who can program, statisticians and mathematicians with the prerequisites for complex modelling. Especially large companies with the resources and perhaps large in-house talent pools can take advantage of drawing on the competences from colleagues from other departments within the company.

One must remember, that both research and companies only recently started to focus on multi-tiers and have until now mainly been focused on the dyadic relationship. Hence, to start considering multiple tiers would be a difficult task from an organisational perspective. To make the organisation understand the criticality of a multi-tier perspective, would require a talented and dedicated management team. Managers would have to prepare the organisation to cope with both a new perspective on supply chains, but perhaps also a new quantitative approach to risk management in supply chain, if new or existing talents from other parts of the organisation are welcomed into SCRM.

Another important managerial point, simply because a method or activity for MSCRM is not listed or mapped in Figure 16: MSCRM activity map, does not mean it is not existing, relevant or useful. The map only reflects activities studied by researchers, and there might be many more unknown methods to research, used by organisations. Hence, this is not a definitive list of activities but rather a current snapshot of the studied activities in research and must be used carefully and for inspiration.

If the economic growth in emerging markets someday would halt, it could have implication for supply chain managers and risk management in supply chains. As emerging economies are growing richer and more expensive to operate in for foreign companies, it is argued that the opportunities for cost savings from outsourcing to emerging economies would become scarcer (Christopher & Deull 2014). Thus, the race to achieve the most cost efficient supply chain from outsourcing would lose its pace. A potential scenario could be that fewer companies would choose to outsource in the future, hence the nature of global supply chain would change (Christopher & Deull 2014). If this is true, perhaps the perspective of risk management in multi-tier supply chains will inherit a different nature as well, as global supply chains would contract as companies would start to produce or look for local alternatives. Other trends such as reshoring, robots in manufacturing could also spawn new types of risks not originating and stemming from emerging markets, but something completely different. With different and new types of supply chain risks in the future, the necessary risk management activities would need a re-evaluation and re-visit.

On a reflective note, considering how the level of business environment related risk has developed at an increasingly high pace over the last few decades, while the level of risk has increased, perhaps the awareness and ability to manage and cope with that risk has improved as well. Supporting this argument is the increased number of risk management articles published each year, Figure 11: Overview of published MSCRM articles. Could this make risk management as research field irrelevant? Have academia reached its final destination? The answer is no. New areas of risk management are evolving as changes in the business landscape and technology evolves and develops. However, research must constantly look for gaps and new opportunities and try to fill out these holes. Such is the nature of research and the systematic literature review. Research is here to explore and challenge the status quo and move the world forward.

11 REFERENCES

- Adenso-Diaz, B. et al., 2012. The impact of supply network characteristics on reliability. *Supply Chain Management: An International Journal*, 17(3), pp.263–276. Available at: <http://10.1108/13598541211227108>.
- Adida, E. & DeMiguel, V., 2011. Supply Chain Competition with Multiple Manufacturers and Retailers. *Operations Research*, 59(1), pp.156–172. Available at: <http://10.1287/opre.1100.0863>.
- Ali, I. & Shukran, K., 2016. MANAGING SUPPLY CHAIN RISKS AND VULNERABILITIES THROUGH COLLABORATION: PRESENT AND FUTURE SCOPE. *Journal of Developing Areas*, 50, pp.335–342. Available at: <http://esc->

- web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=115779536&site=ehost-live&scope=site.
- Aqlan, F. & Lam, S.S., 2015. A fuzzy-based integrated framework for supply chain risk assessment. *International Journal of Production Economics*, 161, pp.54–63.
- Aqlan, F. & Lam, S.S., 2016. Supply chain optimization under risk and uncertainty: A case study for high-end server manufacturing. *Computers & Industrial Engineering*, 93, pp.78–87.
- Aqlan, F. & Lam, S.S., 2015. Supply chain risk modelling and mitigation. *International Journal of Production Research*, 53(18), pp.5640–5656. Available at: <http://10.1080/00207543.2015.1047975>.
- Badurdeen, F. et al., 2014. Quantitative modeling and analysis of supply chain risks using Bayesian theory. *Journal of Manufacturing Technology Management*, pp.631–654. Available at: <http://10.1108/JMTM-10-2012-0097>.
- Bandaly, D., Satir, A. & Shanker, L., 2014. Integrated supply chain risk management via operational methods and financial instruments. *International Journal of Production Research*, 52(7), pp.2007–2025. Available at: <http://10.1080/00207543.2013.844376>.
- Basole, R.C. & Bellamy, M.A., 2014a. Supply Network Structure, Visibility, and Risk Diffusion: A Computational Approach. *Decision Sciences*, 45(4), pp.753–789. Available at: <http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=102304748&site=ehost-live&scope=site>.
- Basole, R.C. & Bellamy, M.A., 2014b. Visual analysis of supply network risks: Insights from the electronics industry. *Decision Support Systems*, 67, pp.109–120. Available at: <http://10.1016/j.dss.2014.08.008>.
- Beresford, A., Pettit, S. & Liu, Y., 2013. Multimodal supply chains: iron ore from Australia to China. <http://dx.doi.org/10.1108/13598541111103485>.
- Biao, L., Liang, W. & Liang, L., 2014. A Multi-Agent-Based Research on Tourism Supply Chain Risk Management. *Journal of Advanced Manufacturing Systems*, 13(3), pp.133–153. Available at: <http://10.1142/S0219686714500097>.
- Blome, C. & Schoenherr, T., 2011. Supply chain risk management in financial crises—A multiple case-study approach. *International Journal of Production Economics*, 134(1), pp.43–57. Available at: <http://10.1016/j.ijpe.2011.01.002>.
- Breuer, C. et al., 2013. Collaborative risk management in sensitive logistics nodes. *Team Performance Management*, 19(7/8), pp.331–351. Available at: <http://10.1108/TPM-11-2012-0036>.
- Cagliano, A.C. et al., 2012. An integrated approach to supply chain risk analysis. *Journal of Risk Research*, 15(7), pp.817–840. Available at: <http://10.1080/13669877.2012.666757>.
- Cavinato, J.L., 2004. Supply chain logistics risks: From the back room to the board room. *International Journal of Physical Distribution & Logistics Management*, 34(5), pp.383–387. Available at: <http://10.1108/09600030410545427>.
- Ceryno, P.S., Scavarda, L.F. & Klingebiel, K., 2015. Supply chain risk: empirical research in the automotive industry. *Journal of Risk Research*, 18(9), pp.1145–1164. Available at: <http://10.1080/13669877.2014.913662>.
- Chang, W., Ellinger, A.E. & Blackhurst, J., 2015. A contextual approach to supply chain risk mitigation. *International Journal of Logistics Management*, 26(3), pp.642–656. Available at: <http://10.1108/IJLM-02-2014-0026>.
- Chen, J., Sohal, A.S. & Prajogo, D.I., 2013. Supply chain operational risk mitigation: a collaborative approach. *International Journal of Production Research*, 51(7), pp.2186–2199. Available at: <http://10.1080/00207543.2012.727490>.
- Choi, T.Y. & Wu, Z., 2009a. Taking the leap from dyads to triads: Buyer–supplier relationships in supply networks. *Journal of Purchasing and Supply Management*, 15(4), pp.263–266.

- Choi, T.Y. & Wu, Z., 2009b. TRIADS IN SUPPLY NETWORKS: THEORIZING BUYER-SUPPLIER-SUPPLIER RELATIONSHIPS. *Journal of Supply Chain Management*, 45(1), pp.8–25. Available at: <http://doi.wiley.com/10.1111/j.1745-493X.2009.03151.x> [Accessed July 11, 2016].
- Christopher, C. & Deull, D., 2014. When macroeconomics and global supply chains collide. <http://blog.ihs.com/q14-when-macroeconomics-and-global-supply-chains-collide>.
- Christopher, M. et al., 2011. Approaches to managing global sourcing risk. *Supply Chain Management*, 16(2), pp.67–81. Available at: <http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=59453770&site=ehost-live&scope=site>.
- Christopher, M. & Lee, H., 2004. Mitigating supply chain risk through improved confidence. *International Journal of Physical Distribution & Logistics Management*, 34(5), pp.388–396. Available at: <http://10.1108/09600030410545436>.
- Colicchia, C., Dallari, F. & Melacini, M., 2011. A simulation-based framework to evaluate strategies for managing global inbound supply risk. *International Journal of Logistics: Research & Applications*, 14(6), pp.371–384. Available at: <http://10.1080/13675567.2011.644270>.
- Colicchia, C. & Strozzi, F., 2012. Supply chain risk management: a new methodology for a systematic literature review R. Wilding, ed. *Supply Chain Management: An International Journal*, 17(4), pp.403–418. Available at: <http://www.emeraldinsight.com/doi/abs/10.1108/13598541211246558> [Accessed November 9, 2015].
- Cooper, M.C. & Ellram, L.M., 1993. Characteristics of Supply Chain Management and the Implications for Purchasing and Logistics Strategy. *International Journal of Logistics Management*, Vol. 4(Issue 2), p.p13–24. 12p.
- Cooper, M.C., Lambert, D.M. & Pagh, J.D., 1997. Supply Chain Management: More Than a New Name for Logistics. *The International Journal of Logistics Management*, 8(1), pp.1–14. Available at: <http://emeraldinsight.com.esc-web.lib.cbs.dk/doi/abs/10.1108/09574099710805556> [Accessed October 6, 2015].
- Craighead, C.W. et al., 2007. The Severity of Supply Chain Disruptions: Design Characteristics and Mitigation Capabilities. *Decision Sciences*, 38(1), pp.131–156. Available at: <http://10.1111/j.1540-5915.2007.00151.x>.
- Cruz, J.M. & Matsypura, D., 2009. Supply chain networks with corporate social responsibility through integrated environmental decision-making. *International Journal of Production Research*, 47(3), pp.621–648. Available at: <http://10.1080/00207540701513901>.
- Cruz, J.M., Nagurney, A. & Wakolbinger, T., 2006. Financial engineering of the integration of global supply chain networks and social networks with risk management. *Naval Research Logistics*, 53(7), pp.674–696. Available at: <http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=22968865&site=ehost-live&scope=site>.
- Daultani, Y. et al., 2015. A supply chain network equilibrium model for operational and opportunism risk mitigation. *International Journal of Production Research*, 53(18), pp.5685–5715. Available at: <http://10.1080/00207543.2015.1056325>.
- Dillon, R.L. & Mazzola, J.B., 2010. Management of disruption risk in global supply chains. *IBM Journal of Research & Development*, 54(3), p.10:1-10:9. Available at: <http://10.1147/JRD.2010.2044674>.
- Dionne, G., 2013. RISK MANAGEMENT: HISTORY, DEFINITION, AND CRITIQUE. *Risk management & Insurance Review*, 16(2), pp.147–166.
- Durach, C. F., Wieland, A. and Kembro, J., 2014. “A guide to the systematic literature review methodology in supply chain management: recommendations for authors, reviewers and editors”, paper presented at the CSCMP European Research Seminar (ERS) on Logistics and SCM, 28 April-29 April, Düsseldorf, Ger.

- Durach, C.F., Wieland, A. & Machuca, J.A.D., 2015. Antecedents and dimensions of supply chain robustness: a systematic literature review P. Maria Jesus Saenz & D. Xenophon Koufteros, eds. *International Journal of Physical Distribution & Logistics Management*, 45(1/2), pp.118–137. Available at: <http://www.emeraldinsight.com/doi/abs/10.1108/IJPDLM-05-2013-0133> [Accessed December 18, 2015].
- Elleuch, H., Hachicha, W. & Chabchoub, H., 2014. *A combined approach for supply chain risk management: description and application to a real hospital pharmaceutical case study.*, Routledge. Available at: <http://10.1080/13669877.2013.815653>.
- Ellinger, A.E. et al., 2015. Learning orientation, integration, and supply chain risk management in Chinese manufacturing firms. *International Journal of Logistics: Research & Applications*, 18(6), pp.476–493. Available at: <http://10.1080/13675567.2015.1005008>.
- Ellram, L.M. & Cooper, M.C., 1990. Supply Chain Management, Partnerships, and the Shipper -Third Party Relationship. *International Journal of Logistics Management*, Vol. 1(Issue 2), p.p1–10. 10p.
- Fahimnia, B. et al., 2015. Quantitative models for managing supply chain risks: A review. *European Journal of Operational Research*, 247(1), pp.1–15. Available at: <http://10.1016/j.ejor.2015.04.034>.
- Faisal, M.N., Banwet, D.K. & Shankar, R., 2007. Management of Risk in Supply Chains: SCOR Approach and Analytic Network Process. *Supply Chain Forum: International Journal*, 8(2), pp.66–79. Available at: <http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=35832596&site=ehost-live&scope=site>.
- Garvey, M.D., Carnovale, S. & Yenyurt, S., 2015. An analytical framework for supply network risk propagation: A Bayesian network approach. *European Journal of Operational Research*, 243(2), pp.618–627. Available at: <http://10.1016/j.ejor.2014.10.034>.
- Ghadge, A. et al., 2013. A systems approach for modelling supply chain risks. *Supply Chain Management*, 18(5), pp.523–538. Available at: <http://10.1108/SCM-11-2012-0366>.
- Ghadge, A., Dani, S. & Kalawsky, R., 2012. Supply chain risk management: present and future scope. *The International Journal of Logistics Management*, 23(3), pp.313–339. Available at: <http://www.emeraldinsight.com/doi/abs/10.1108/09574091211289200> [Accessed November 9, 2015].
- Giannakis, M. & Louis, M., 2011. A multi-agent based framework for supply chain risk management. *Journal of Purchasing & Supply Management*, 17(1), pp.23–31. Available at: <http://10.1016/j.pursup.2010.05.001>.
- Giunipero, L.C. & 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. Available at: <http://10.1108/09600030410567478>.
- Goh, M., Lim, J.Y.S. & Meng, F., 2007. A stochastic model for risk management in global supply chain networks. *European Journal of Operational Research*, 182(1), pp.164–173. Available at: <http://10.1016/j.ejor.2006.08.028>.
- Hachicha, W. & Elmsalmi, M., 2014. An integrated approach based-structural modeling for risk prioritization in supply network management. *Journal of Risk Research*, 17(10), pp.1301–1324. Available at: <http://10.1080/13669877.2013.841734>.
- Hallikas, J. et al., 2004. Risk management processes in supplier networks. *International Journal of Production Economics*, 90(1), pp.47–58. Available at: <http://10.1016/j.ijpe.2004.02.007>.
- Han, J. & Shin, K., 2016. Evaluation mechanism for structural robustness of supply chain considering disruption propagation. *International Journal of Production Research*, 54(1), pp.135–151. Available at: <http://10.1080/00207543.2015.1047977>.
- Harland, C., Brenchley, R. & Walker, H., 2003. Risk in supply networks. *Journal of Purchasing & Supply Management*, 9(2), p.51. Available at: [http://10.1016/S1478-4092\(03\)00004-9](http://10.1016/S1478-4092(03)00004-9).
- Harland, C.M., 1996. Supply Chain Management: Relationships, Chains and Networks. *British Journal of*

- Management*, 7(s1), pp.563–580. Available at: <http://doi.wiley.com/10.1111/j.1467-8551.1996.tb00148.x> [Accessed July 17, 2016].
- Ho, W. et al., 2015. Supply chain risk management: a literature review. *International Journal of Production Research*, 53(16), pp.5031–5069. Available at: <http://www.tandfonline.com/doi/full/10.1080/00207543.2015.1030467> [Accessed December 29, 2015].
- Hohenstein, N.-O. et al., 2015. Research on the phenomenon of supply chain resilience P. Maria Jesus Saenz & D. Xenophon Koufteros, eds. *International Journal of Physical Distribution & Logistics Management*, 45(1/2), pp.90–117. Available at: <http://www.emeraldinsight.com/doi/abs/10.1108/IJPDLM-05-2013-0128> [Accessed January 18, 2016].
- Holton, G.A., 2004. Defining Risk. *Financial Analysts Journal*, 60(6), pp.19–25.
- Hua, Z., Sun, Y. & Xu, X., 2011. Operational causes of bankruptcy propagation in supply chain. *Decision Support Systems*, 51(3), pp.671–681. Available at: <http://10.1016/j.dss.2011.03.007>.
- Jarillo, J.C., 1988. On strategic networks. *Strategic Management Journal*, 9(1), pp.31–41. Available at: <http://doi.wiley.com/10.1002/smj.4250090104> [Accessed July 17, 2016].
- Jesson, J., Matheson, L., & Lacey, F.M., 2011. *Doing your literature review: Traditional and systematic techniques*, SAGE.
- Jüttner, U., 2005. Supply chain risk management. *The International Journal of Logistics Management*, 16(1), pp.120–141. Available at: <http://emeraldinsight.com.esc-web.lib.cbs.dk/doi/full/10.1108/09574090510617385> [Accessed December 24, 2015].
- Jüttner, U., Peck, H. & Christopher, M., 2003. Supply chain risk management: outlining an agenda for future research. *International Journal of Logistics: Research and Applications*. Available at: <http://www.tandfonline.com/doi/abs/10.1080/13675560310001627016> [Accessed January 14, 2016].
- Kamalahmadi, M. & Parast, M.M., 2016. A review of the literature on the principles of enterprise and supply chain resilience: Major findings and directions for future research. *International Journal of Production Economics*, 171, pp.116–133. Available at: <http://10.1016/j.ijpe.2015.10.023>.
- Keow Cheng, S. & Hon Kam, B., 2008. A conceptual framework for analysing risk in supply networks E. Hassini, ed. *Journal of Enterprise Information Management*, 21(4), pp.345–360. Available at: <http://emeraldinsight.com.esc-web.lib.cbs.dk/doi/full/10.1108/17410390810888642> [Accessed February 20, 2016].
- Khan, O. & Burnes, B., 2007a. Risk and supply chain management: creating a research agenda. *The International Journal of Logistics Management*, 18(2), pp.197–216. Available at: <http://www.emeraldinsight.com/doi/full/10.1108/09574090710816931> [Accessed September 22, 2015].
- Khan, O. & Burnes, B., 2007b. Risk and supply chain management: creating a research agenda. *The International Journal of Logistics Management*, 18(2), pp.197–216. Available at: <http://emeraldinsight.com.esc-web.lib.cbs.dk/doi/full/10.1108/09574090710816931> [Accessed February 20, 2016].
- Khilwani, N., Tiwari, M.K. & Sabuncuoglu, I., 2011. Hybrid Petri-nets for modelling and performance evaluation of supply chains. *International Journal of Production Research*, 49(15), pp.4627–4656. Available at: <http://10.1080/00207543.2010.497173>.
- Kull, T. & Closs, D., 2008. The risk of second-tier supplier failures in serial supply chains: Implications for order policies and distributor autonomy. *European Journal of Operational Research*, 186(3), pp.1158–1174.
- Kumar, S.K., Tiwari, M.K. & Babiceanu, R.F., 2010. Minimisation of supply chain cost with embedded risk using computational intelligence approaches. *International Journal of Production Research*, 48(13), pp.3717–3739. Available at: <http://10.1080/00207540902893425>.
- Larson, P.D. & Gammelgaard, B., 2001. The Logistics Triad: Survey and Case Study Results. *Transportation Journal*, 41(2/3), pp.71–82. Available at: <http://www.jstor.org/stable/20713494>.

- Lassar, W. et al., 2010. Determinants of Strategic Risk Management in Emerging Markets Supply Chains: The Case of Mexico. *Determinantes del manejo de riesgo estratégico en las cadenas de suministro en mercados emergentes: el caso de México.*, 15(28), pp.125–140. Available at: <http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=51381544&site=ehost-live&scope=site>.
- Lavastre, O., Gunasekaran, A. & Spalanzani, A., 2014. Effect of firm characteristics, supplier relationships and techniques used on Supply Chain Risk Management (SCRM): an empirical investigation on French industrial firms. *International Journal of Production Research*, 52(11), pp.3381–3403. Available at: <http://10.1080/00207543.2013.878057>.
- Lavastre, O., Gunasekaran, A. & Spalanzani, A., 2012. Supply chain risk management in French companies. *Decision Support Systems*, 52(4), pp.828–838. Available at: <http://10.1016/j.dss.2011.11.017>.
- Li, G. et al., 2015. Joint supply chain risk management: An agency and collaboration perspective. *International Journal of Production Economics*, 164, pp.83–94. Available at: <http://10.1016/j.ijpe.2015.02.021>.
- Lummus, R.R., Krumwiede, D.W. & Vokurka, R.J., 2001. The relationship of logistics to supply chain management: developing a common industry definition. *Industrial Management & Data Systems*. Available at: <http://emeraldinsight.com.esc-web.lib.cbs.dk/doi/full/10.1108/02635570110406730> [Accessed January 21, 2016].
- Manuj, I. & Mentzer, J.T., 2008. Global supply chain risk management strategies. *International Journal of Physical Distribution & Logistics Management*, 38(3), pp.192–223. Available at: <http://emeraldinsight.com.esc-web.lib.cbs.dk/doi/full/10.1108/09600030810866986> [Accessed October 12, 2015].
- Meixell, M.J. & 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.
- Mena, C., Humphries, A. & Choi, T.Y., 2013. Toward a Theory of Multi-Tier Supply Chain Management. *Journal of Supply Chain Management*, 49(2), pp.58–77. Available at: <http://doi.wiley.com/10.1111/jscm.12003> [Accessed November 1, 2015].
- Mentzer, J.T. et al., 2001. DEFINING SUPPLY CHAIN MANAGEMENT. *Journal of Business Logistics*, 22(2), pp.1–25. Available at: <http://doi.wiley.com/10.1002/j.2158-1592.2001.tb00001.x> [Accessed December 29, 2015].
- Mizgier, K.J., Jüttner, M.P. & Wagner, S.M., 2013. Bottleneck identification in supply chain networks. *International Journal of Production Research*, 51(5), pp.1477–1490. Available at: <http://10.1080/00207543.2012.695878>.
- Norrman, A. & Jansson, U., 2004. Ericsson's proactive supply chain risk management approach after a serious sub-supplier accident. *International Journal of Physical Distribution & Logistics Management*, 34(5), pp.434–456. Available at: <http://emeraldinsight.com.esc-web.lib.cbs.dk/doi/full/10.1108/09600030410545463> [Accessed February 20, 2016].
- Oehmen, J. et al., 2009. System-oriented supply chain risk management. *Production Planning & Control*, 20(4), pp.343–361. Available at: <http://10.1080/09537280902843789>.
- Olson, D.L. & Wu, D., 2011. Risk management models for supply chain: a scenario analysis of outsourcing to China. *Supply Chain Management*, 16(6), pp.401–408. Available at: <http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=66287165&site=ehost-live&scope=site>.
- Parenreng, S.M. et al., 2016. Mitigating Risk in the Tuna Supply through Traceability System Development. *International Food & Agribusiness Management Review*, 19(1), pp.59–82. Available at: <http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=113386853&site=ehost-live&scope=site>.

- Peck, H., 2005. Drivers of supply chain vulnerability: an integrated framework. *International Journal of Physical Distribution & Logistics Management*, 35(4), pp.210–232. Available at: <http://www.emeraldinsight.com.esc-web.lib.cbs.dk/doi/full/10.1108/09600030510599904> [Accessed January 9, 2016].
- Petersen, H.L. & Lemke, F., 2015. Mitigating reputational risks in supply chains. *Supply Chain Management: An International Journal*, 20(5), pp.495–510. Available at: <http://10.1108/SCM-09-2014-0320>.
- Pfohl, H.-C., Gallus, P. & Thomas, D., 2011. Interpretive structural modeling of supply chain risks. *International Journal of Physical Distribution & Logistics Management*, 41(9), pp.839–859. Available at: <http://10.1108/09600031111175816>.
- Pfohl, H.-C., Köhler, H. & Thomas, D., 2010. State of the art in supply chain risk management research: empirical and conceptual findings and a roadmap for the implementation in practice. *Logistics Research*, 2(1), pp.33–44. Available at: <http://link.springer.com/10.1007/s12159-010-0023-8> [Accessed January 14, 2016].
- Ponomarev, S.Y. & Holcomb, M.C., 2009. Understanding the concept of supply chain resilience. *The International Journal of Logistics Management*, 20(1), pp.124–143. Available at: <http://www.emeraldinsight.com/doi/abs/10.1108/09574090910954873> [Accessed November 16, 2015].
- Rao, S. & Goldsby, T.J., 2009. Supply chain risks: a review and typology. *The International Journal of Logistics Management*. Available at: <http://www.emeraldinsight.com/doi/abs/10.1108/09574090910954864?journalCode=ijlm> [Accessed January 14, 2016].
- Sanchez-Rodrigues, V., Potter, A. & Naim, M.M., 2010. Evaluating the causes of uncertainty in logistics operations. *International Journal of Logistics Management*, 21(1), pp.45–64. Available at: <http://10.1108/09574091011042179>.
- Simchi-Levi, D. et al., 2015. Identifying Risks and Mitigating Disruptions in the Automotive Supply Chain. *Interfaces*, 45(5), pp.375–390. Available at: <http://10.1287/inte.2015.0804>.
- Soleimani, H. & Govindan, K., 2014. Reverse logistics network design and planning utilizing conditional value at risk. *European Journal of Operational Research*, 237(2), pp.487–497. Available at: <http://10.1016/j.ejor.2014.02.030>.
- Stevens, G. & Johnson, M., 2015. Integrating the Supply Chain... 25 years on. *International Journal of Physical Distribution & Logistics Management*. Available at: <http://emeraldinsight.com.esc-web.lib.cbs.dk/doi/abs/10.1108/IJPDLM-07-2015-0175> [Accessed January 21, 2016].
- Stevens, G.C., 1989. Integrating the Supply Chain. *International Journal of Physical Distribution & Materials Management*, 19(8), pp.3–8. Available at: <http://emeraldinsight.com.esc-web.lib.cbs.dk/doi/abs/10.1108/EUM00000000000329> [Accessed July 21, 2015].
- Stock, J.R. & Boyer, S.L., 2009. Developing a consensus definition of supply chain management: a qualitative study. *International Journal of Physical Distribution & Logistics Management*, 39(8), pp.690–711. Available at: <http://www.emeraldinsight.com/doi/full/10.1108/09600030910996323> [Accessed January 21, 2016].
- Tang, C.S., 2006. Perspectives in supply chain risk management. *International Journal of Production Economics*, 103(2), pp.451–488. Available at: <http://www.sciencedirect.com/science/article/pii/S0925527306000405> [Accessed July 10, 2014].
- Tang, O. & Nurmaya Musa, S., 2011. Identifying risk issues and research advancements in supply chain risk management. *International Journal of Production Economics*, 133(1), pp.25–34.
- Thun, J.-H. & Hoenig, D., 2011. An empirical analysis of supply chain risk management in the German automotive industry. *International Journal of Production Economics*, 131(1), pp.242–249.
- Trkman, P. & 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.

- Tse, Y.K. & Tan, K.H., 2012. Managing product quality risk and visibility in multi-layer supply chain. *International Journal of Production Economics*, 139(1), pp.49–57.
- Tse, Y.K. & Tan, K.H., 2011. Managing product quality risk in a multi-tier global supply chain. *International Journal of Production Research*, 49(1), pp.139–158. Available at: <http://www.tandfonline.com/doi/abs/10.1080/00207543.2010.508942> [Accessed June 17, 2016].
- Vilko, J.P.P. & Hallikas, J.M., 2012. Risk assessment in multimodal supply chains. *International Journal of Production Economics*, 140(2), pp.586–595.
- Wagner, S.M. & Bode, C., 2006. An empirical investigation into supply chain vulnerability. *Journal of Purchasing and Supply Management*, 12(6), pp.301–312.
- Wakolbinger, T. & Cruz, J.M., 2011. Supply chain disruption risk management through strategic information acquisition and sharing and risk-sharing contracts. *International Journal of Production Research*, 49(13), pp.4063–4084. Available at: <http://10.1080/00207543.2010.501550>.
- Zsidish, G.A., 2003. Managerial Perceptions of Supply Risk. *Journal of Supply Chain Management*, 39(1), pp.14–23. Available at: <http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=11487636&site=ehost-live&scope=site>.
- Zsidisin, G.A. et al., 2007. Evaluation criteria development and assessment of purchasing and supply management journals. *Journal of Operations Management*, 25(1), pp.165–183.
- Zsidisin, G.A., 2003. Managerial Perceptions of Supply Risk. *The Journal of Supply Chain Management*, 39(1), pp.14–26. Available at: <http://doi.wiley.com/10.1111/j.1745-493X.2003.tb00146.x> [Accessed July 19, 2016].

Other references:

- BCI: Alcantara, Patrick & Riglietti, Gianluca, 2015, Supply Chain Resilience Report 2015, BCI – Business Continuity Institute & Zurich
- KPMG: Confronting Complexity: Research Findings and Insights, Publication number: 110307, May 2011, KPMG International
- Jesson, J., Matheson, L., & Lacey, F. M. (2011). *Doing your literature review: Traditional and systematic techniques*. Sage.

ⁱ [http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&bquery=\(AB+multi-tier\)+OR+\(multi\)+OR+\(tier\)+AND+\(AB+supply+chains\)+AND+\(AB+risk+management\)+OR+\(supply+chain+management\)+OR+\(risk\)&cli0=RV&clv0=Y&login.asp&type=1&site=ehost-live&scope=site](http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&bquery=(AB+multi-tier)+OR+(multi)+OR+(tier)+AND+(AB+supply+chains)+AND+(AB+risk+management)+OR+(supply+chain+management)+OR+(risk)&cli0=RV&clv0=Y&login.asp&type=1&site=ehost-live&scope=site)
Accessed 11/08/2016

ⁱⁱ [http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&bquery=\(multi-tier\)+OR+\(multi\)+AND+\(risk+management\)+AND+\(supply+chain+management\)+AND+\(supply+chain\)&login.asp&type=1&site=ehost-live&scope=site](http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&bquery=(multi-tier)+OR+(multi)+AND+(risk+management)+AND+(supply+chain+management)+AND+(supply+chain)&login.asp&type=1&site=ehost-live&scope=site)
Accessed 11/08/2016

ⁱⁱⁱ [http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&bquery=\(AB+multi-tier\)+OR+\(AB+multi\)+OR+\(AB+tier\)+OR+\(AB+echelon\)+OR+\(AB+node\)+AND+\(supply+chain+management\)+AND+\(AB+supply+chain\)+AND+\(AB+risk+management\)+AND+\(AB+risk\)&cli0=RV&clv0=Y&cli1=DT1&clv1=197501-201612&login.asp&type=1&site=ehost-live&scope=site](http://esc-web.lib.cbs.dk/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&bquery=(AB+multi-tier)+OR+(AB+multi)+OR+(AB+tier)+OR+(AB+echelon)+OR+(AB+node)+AND+(supply+chain+management)+AND+(AB+supply+chain)+AND+(AB+risk+management)+AND+(AB+risk)&cli0=RV&clv0=Y&cli1=DT1&clv1=197501-201612&login.asp&type=1&site=ehost-live&scope=site)
Accessed 11/08/2016

iv https://www.researchgate.net/journal/1741-038X_Journal_of_Manufacturing_Technology_Management
Accessed 11/08/2016

v https://www.researchgate.net/journal/0022-037X_Journal_Of_Developing_Areas
Accessed 11/08/2016

vi https://www.researchgate.net/journal/1352-7592_Team_Performance_Management
Accessed 11/08/2016

vii https://www.researchgate.net/journal/0219-6867_Journal_of_Advanced_Manufacturing_Systems
Accessed 11/08/2016