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Supply Chain Risk Management: a content analysis approach

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Abstract

Although Supply Chain Risk Management (SCRM) has become more popular over the last decade, attempts to synthesize research within this field have seldom been conducted. Aiming to fulfill part of this gap, this paper presents a systematic review of the literature on SCRM using a content analysis approach. Forty six papers published between 2004 and 2011 in 17 peer reviewed international journals have been retrieved. Interest in the subject is growing, as evidenced by the number of papers recently published on different aspects of SCRM reaching a pick in 2011. The paper provides a discussion of main definitions available. Although there is no universal definition of the concept, the authors agree that the main issue is the identification and management of risk events that impact supply chains. The collected papers are classified in the theoretical, empirical and theoretical empirical dimension, allowing a reasonable comprehensive assessment of research approaches taken in the current body of literature on the subject. The results highlight the high number of definitions for SCRM, the main topics in SCRM research and research applications, identify the key issues addressed in these researches, and emphasise remaining gaps that deserve special attention in future research.

Keywords: supply chain; risk management; literature review.

1 Introduction

Systematic literature reviews are a means of providing an objective theoretical evaluation of a particular topic (Hopayian, 2001). A systematic literature review facilitates the identification, evaluation, and interpretation of studies in a given area by examining existing concepts, practices, and theories and ultimately summarising the state of the reproducible research in a specific area (Rowley and Slack, 2004; Seuring and Müller, 2008).

Although Supply Chain Risk Management (SCRM) has become more popular over the last decade (Autry and Bobbitt, 2008; Thun and Hoenig, 2011; Tang and Musa, 2011), attempts to synthesize research within this field have seldom been conducted. Aiming to fulfill part of this gap, this paper presents a systematic review of the literature on SCRM using a content analysis approach. The research is restricted to papers published in academic journals between 2004 and 2011.

This paper is divided into four main sections, the first of which this introduction. Section 2 describes the research method used. Section 3 presents the analysis of results. Finally, the last section offers the conclusions of the study.

2 Research method

The present research uses the content analysis approach to develop the literature review. This approach allows researchers to select, filter, and summarise large volumes of data, thereby facilitating data analysis (Gao, 1996), being a systematic technique that is replicable by other researchers because it is based on explicit rules (Weber, 1990).

The review examines publications found in the Elsevier and Emerald electronic databases, technique that facilitates objective and systematic inference (Holsti, 1969), that were published between 2004 and 2012. The data gathered for this review was exclusively from scientific journals, as academics and professionals generally use such journals to acquire knowledge and disseminate new results (Nord and Nord, 1995; Ngai and Wat, 2002, Ngai et al., 2009).

In accordance with recommendations for initial research synthesis found in the literature, the keywords selected were sufficiently broad to avoid artificially limiting results and still provided limitations to avoid undesirable results. In pseudo code, the following phrase was adapted to the search engines in each database: "Supply Chain Risk Management", using as reference the title, abstracts and keywords of the papers. The use of this Boolean expression in the selection process, of just two electronic databases and scientific journals may have caused the researchers to omit studies that address this theme using other words or terms or that are available in other databases or dissimilation source (e.g. theses, dissertations and conference papers), however it is believed that the articles reviewed comprise a reasonably representative and comprehensive body of the research work being accomplished in this area. It is not the intention of this paper to be exhaustive.

Forty six papers have been retrieved. All the selected articles were computer managed. For the purposes of this study, a Microsoft Excel database was designed containing the key issues addressed in each paper. A special effort was given to the SCRM definitions to identify a possible lack of a single consistent definition of the concept or a universal accepted definition. The collected papers have been classified in the theoretical and empirical dimension (see scheme developed by Olsen and Ellram (1997), Croom et al. (2000) and Luo et al. (2001), allowing a reasonable comprehensive assessment of research approaches taken in the current body of literature on the subject by highlighting both the basic methodology used and the aim or focus of studies. Theoretical papers primarily develop models, concepts or conceptual frameworks, while empirical ones generally that report practice by means of surveys, case studies, interviews or anecdotal information. Some papers can be classified both theoretical and empirical: these works typically develop a number of hypotheses and test them empirically.

3 Presentation and analysis of results

This section presents and analyses the results obtained from the systematic review on SCRM based in two broad categories: study identification, including definitions for SCRM, and key issues addressed.

3.1 Study identification and SCRM definitions

Figure 1 presents the 46 papers retrieved for the systematic review analysis. Interest in the subject is growing, as evidenced by the number of papers recently published with a peak in 2011.

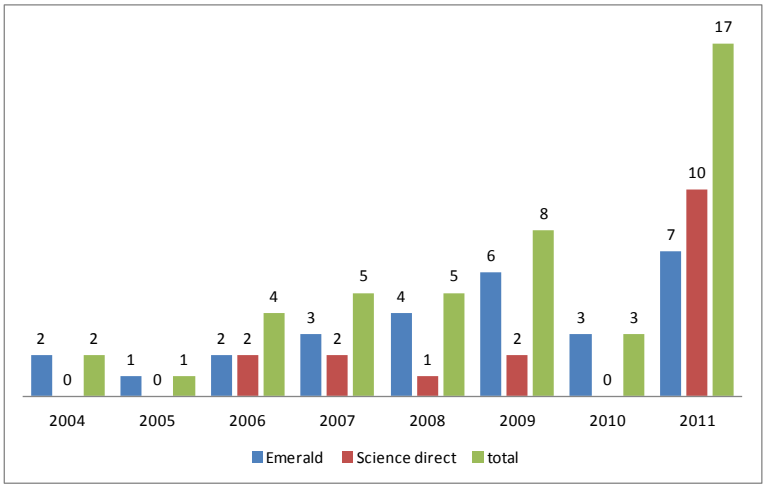

Figure 1: Number of publications on SCRM by year

Main SCRM definitions are depicted in Table 1. The first column displays the considered references, while the second presents the definitions themselves and the third provides the other papers that have adopted the mentioned definition in their work.

Table 1: Main SCRM definitions

Reference	Definition of SCRM	Papers that adoped the definition
Jütttner et al. (2003)	SCRM is defined as the identification and management of risks for the supply chain,through a co-ordinated approach amongst supply chain members,to reduce supply chain vulnerability as a whole.	Jüttner (2005); Williams et al. (2008); Jia and Rutherford (2010), Jüttner and Maklan (2011); Thun and Hoenig (2011); Vilko and Hallikas (2011); Lavastre et al. (2011).
Norrman and Lindroth (2002)	SCRM is to [collaborate] with partners in a supply chain apply risk management process tools to deal with risks and uncertainties caused by, or impacting on, logistics related activities or resources.	Norman and Jansson (2004); Faisal et al. (2006)
Norrman and Jansson(2004)	The focus of SC risk management is to understand, and try to avoid, the devastating effects that disasters or even minor business disruptions can have in a SC. The aim of SC risk management is to reduce the probability of risk events occurring and to increase resilience, that is, the capability to recover from a disruption.	Pujawan and Geraldin (2009);
Manuj and Mentzer (2008)	Global SCRM is the identification and evaluation of risks and consequent losses in the global supply chain, and implementation of appropriate strategies through a coordinated approach among supply chain members with the objective of reducing one or more of the following – losses, probability, speed of event, speed of losses, the time for detection of the events, frequency, or exposure – for supply chain outcomes that in turn lead to close matching of actual cost savings and profitability with those desired.	Christopher et al. (2011)
Brindley (2004)	SCRM is defined as the management of supply chain risks through coordination or collaboration among the supply chain partners so as to ensure profitability and continuity.	Blos et al. (2009)
Goh et al. (2007)	SCRM is defined as the identification and management of risks within the supply network and externally through a co-ordinated approach amongst supply chain members to reduce supply chain vulnerability as a whole.	
Lavastre et al. (2011)	SCRM refers to risks that can modify or prevent part of the movement and efficient flow of information, materials and products between the actors of a supply chain within an organization, or among actors in a global supply chain (from the supplier's supplier to the customer's customer). SCRM can be seen as the capacity to be agile.	
Tummala and Schoenherr (2011)	SCRM process is a tool to provide management with useful and strategic information concerning the SC risk profiles associated with a given situation. This is in contrast to the traditional approach based on single point estimates. The SCRMP ensures SC managers adopt strategic thinking and strategic decision making in evaluating options to improve supply chain performance.	

In the academic literature there is no unanimous definition for SCRM. The most adopted definition within literature is proposed in Jüttner et al. (2003), being mentioned in seven articles. The others definitions are mentioned at most in twice academic papers. Most papers propose definitions that are not used in others articles. However, every proposed definition embraces the process perspective and systemic view, since they point the identification, understanding and management as the core of SCRM. Another important fact that appears in most of the definitions is the collaborative and coordinated participation among the chains' members, emphasizing the idea that competition occurs based on chains and not on individual companies level, i.e. the risk management along the chain is dependent on the relationship and integration among its members.

The definitions bring as SCRM main objective the chain's vulnerability reduction, once the risks are identified and analyzed, it is possible to act on them reducing their impacts, their occurrences, or even use strategies to prevent them to happen (avoidance).

The vulnerability reduction pointed in the definitions in some papers is directly correlated with chain's performance, its response speed and profitability, since with the chain reduction vulnerability it is possible to mitigate the adverse effects associated with the risk, avoiding loss. Some definitions point clearly the relations between chain profitability and its performance associated with risk management.

3.2 Key issues addressed

The 46 papers address different aspects of SCRM, the next subsections presents the main aspects that should be highlighted. Within this presentation, the papers are classified in theoretical, empirical and theoretical-empirical studies and are presented chronologically, as done in Leão et al. (2011).

The result analysis indicates that most of the papers retrieved are theoretical (59% of the total). The remaining articles are purely empirical (28%) or both empirical and theoretical (13%). Empirical studies are predominantly focused on two manufacturing sectors (automotive and electronic) and one service sector (logistic service providers). This further emphasises the need for more empirical studies on other industry sectors exposed to risk in their supply chains (i.e. oil & gas).

3.2.1 Theoretical studies

The focus of the main theoretical studies is presented in this section.

Faisal et al. (2006) present an approach to effective supply chain risk mitigation by understanding the dynamics between various enablers that help to mitigate risk in a supply chain. Cucchiella and Gataldi (2006) individualize a framework for the management of uncertainty in supply chain finalized to reduce the firm risks. Tang (2006) reviews various quantitative models for managing supply chain risks and develops a unified framework for classifying SCRM articles. Wu et al. (2006), reinforce inbound supply chain risk management by proposing an integrated methodology to classify, manage and assess inbound supply risks. Goh et al. (2007) present a stochastic model of the multi-stage global supply chain network problem, incorporating a set of related risks, namely, supply, demand, exchange, and disruption. Ritchie and Brindley (2007) purpose to examine the constructs underpinning risk management and explores its application in the supply chain context through the development of a framework. Khan and Burnes (2007) develop a research agenda for risk and supply chain management. These authors show that there are a number of key debates in the general literature on risk, especially in terms of qualitative versus quantitative approaches, which need to be recognized by those seeking to apply risk theory and risk management approaches to supply chains. In addition, they show that the application of risk theory to supply chain management is still in its early stages and that the models of supply chain risk which have been proposed need to be tested empirically. Li and Chandra (2007) investigate and develop a generic knowledge integration framework that can handle the challenges posed in complex network management. Williams et al. (2008) develop and present a categorization of supply chain security based on existing research. Rao and Goldsby (2009) review the growing literature examining supply chain risk management (SCRM) and to develop a typology of risks in the supply chain. Sodhi and Tang (2009) survey various modeling and solution choices developed in the asset–liability management (ALM) literature and

discuss their applicability to supply-chain planning. This survey can be a basis for making modeling/solution choices in research and in practice to manage the risks pertaining to unmet demand, excess inventory, and cash liquidity when demand is uncertain. Trkman and McComack (2009) propose an approach to the identification and prediction of supply risk. Olson and Wu (2010) review published approaches to supply chain risk management, to include identification and classification of types of risks, cases, and models. Jia and Rutherford (2010) add a cultural-relational dimension to the supply chain risk management (SCRM) literature. Inter-firm learning and cultural adaptation literatures are reviewed, missing themes identified and a conceptual model proposed. Wu and Olson (2008) propose a supply chain model and use simulated data with representative distributions. The results show that the proposed approach allows decision makers to perform trade-off analysis among uncertainties. They also provide alternative tools to evaluate and improve supplier selection decisions in an uncertain supply chain environment. Manuj et al. (2009) develop a framework based on some of the most rigorous studies published in leading journals and illustrate the simulation model development process using a supply-chain risk management study. Christopher et al. (2011) propose to understand how managers assess global sourcing risks across the entire supply chain and what actions they take to mitigate those risks. Tummala and Schoenherr (2011) propose a comprehensive and coherent approach for managing risks in supply chains. The authors develop a structured and ready-to-use approach for managers to assess and manage risks in supply chains. Olson and Wu (2011) compare tools to aid supply chain organizations in measuring, evaluating, and assessing risk in this environment. Tse et al. (2011) explore the issues of quality and safety problems in global supply networks, and introduce a supply chain risk management (SCRM) framework to reduce the quality risk. Sawik (2011) The problem of allocation of orders for parts among part suppliers in a customer driven supply chain with operational risk is formulated as a stochastic single- or bi-objective mixed integer program. Given a set of customer orders for products, the decision maker needs to decide from which supplier to purchase parts required for each customer order to minimize total cost and to mitigate the impact of delay risk. The selection of suppliers and the allocation of orders is based on price and quality of purchased parts and reliability of on time delivery. To control the risk of delayed supplies, the two popular percentile measures of risk are applied: value-at-risk and conditional value-at-risk. The proposed approach is capable of optimizing the supply portfolio by calculating value-at-risk of cost per part and minimizing mean worst-case cost per part simultaneously. Numerical examples are presented and some computational results are reported. Lavastre et al. (2011) based their paper on an empirical study to demonstrate that for organizations to be effective, SCRM must be a management function that is inter-organizational in nature and closely related to strategic and operational realities of the activity in question. Tang and Musa (2011) investigate the research development in supply chain risk management (SCRM), which has shown an increasing global attention in recent years. Tang et al. (2011) investigate newsvendor problem with random demand and random yields, in which the price decision will be postponed and determined upon recognition of random yield and prior to realizing demand uncertainties. Giannakis and Louis (2011) develop a framework for the design of a multi-agent based decision support system for the management disruptions and mitigation of risks in manufacturing supply chains. Finally, Schmitt and Snyder (2012) consider one case where a firm's only sourcing option is an unreliable supplier subject to disruptions and yield uncertainty, and a second case where a second, reliable (but more expensive) supplier is available. The authors develop models for both cases to determine the optimal order and reserve quantities.

3.2.2 Empirical studies

The focus of the main empirical studies is presented in this section.

Finch (2004) presents a secondary analysis of the literature, supplemented by case studies to determine if large companies increase their exposure to risk by having small- and medium-size enterprises as partners in business critical positions in the supply chain, and to make recommendations concerning best practice. Norrman and Jansson (2004) describe how Ericsson, after a fire at a sub-supplier has implemented a new organization, new processes and tools for SCRM. Jüttner (2005) seeks to understand business requirements for supply chain risk management (SCRM) from a practitioner perspective. Khan et al. (2008) address the increasingly important issue of the impact of product design on supply chain risk

management in an era of global supply arrangements. The authors provide a framework for design-led supply chain risk management and thus present a case for recognizing design as more than a creative function but as a platform to manage risk in supply chains. Blos et al. (2009) identify the supply chain risks in the automotive and electronic industries in Brazil, and to highlight the urgency of supply chain risk management (SCRM) implementation. Elangovan et al. (2010) investigate the various forms of expected loss producing events due to major time delays in supply chain activities of manufacturing organizations and justify the necessity and more attention needed for SCRM strategies for better, systematic and dynamic executions using risk mitigation with appropriate strategies. The authors also emphasize the need for more dynamic models for achieving loss reduction with a future scope of risk. Lin and Zhou (2011) address the impact of product design changes on supply chain risk, and to identify the supply chain risk dimensions in the Chinese special-purpose vehicle (SPV) industry in the context of product design change. Blome and Schoenherr (2011) develop a set of propositions about how companies manage supply risks in financial crises, highlight how their risk management approaches have shifted, and illustrate how they are related to Enterprise Risk Management. Jüttner and Maklan (2011) conceptualize supply chain resilience (SCRES) and to identify and explore empirically its relationship with the related concepts of supply chain vulnerability (SCV) and supply chain risk management (SCRM). Vilko and Hallikas (2011) present preliminary research concepts and findings concerning the identification and analysis of risks in multimodal supply chains and finally, Thun and Hoenig (2011) analyze the status quo of supply chain risk management in Germany based on a study conducted in the automotive industry. The authors investigate the relevance of different risks in terms of their probability of occurrence and their potential impact on the supply chain.

3.2.3 Theoretical-empirical studies

The focus of the main theoretical-empirical studies is presented in this section.

Manuj and Mentzer (2008) explore the phenomenon of risk management and risk management strategies in global supply chains. Pujawan and Geraldin (2009) provide a framework to proactively manage supply chain risks. The framework will enable the company to select a set of risk agents to be treated and then to prioritize the proactive actions, in order to reduce the aggregate impacts of the risk events induced by those risk agents. MeiDan et al. (2011) present a model of risk control in equipment manufacturing supply chain. They provide a new solution methodology to measure risk in electronic manufacturing supply chain, the model combines the unascertained theory with fuzzy method. Finally, Kern et al. (2012) develop a model for upstream supply chain risk management linking risk identification, risk assessment and risk mitigation to risk performance and validate the model empirically.

4 Conclusion

This paper offers a systematic literature review on SCRM using the content analysis approach. Although this research is not exhaustive, the forty six selected papers constitute a significant and representative portion on the scientific research carried out on SCRM. It serves as a comprehensive base for an understanding of the main definitions, the main topics and research applications, and the key issues addressed in these researches.

The review highlights the lack of a unanimous definition for SCRM among researchers; however, they share a similar point of view about SCRM definition. Another point noticed was the need of conducting more empirical and theoretical-empirical studies. There are many industries that present many risk sources and events that are not yet covered in the literature, for instance, the oil and gas / petroleum industry.

The literature lacks an integrated and accepted framework for SCRM. Many models need to be tested in real supply chains. Further studies are need about the assessment stage in SCRM, with the conduction of more research on how risk can be analyzed and treated.

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