

Supply chain risk management enablers-A framework development through systematic review of the literature from 2000 to 2015

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Abstract

The present paper delivers a robust and systematic literature review (SLR) on supply chain risk management (SCRM) with the purpose to a) review and analyse the literature concerning definitions and research methodologies applied, to b) develop a classificatory framework which clusters existing enablers on SCRM, and to c) examine the linkage between SCRM and performance. The findings reveal that not only is SCRM loosely defined, but that there are various fragmented supply chain risks enablers and that there is a strong need for a clear terminology for its building enablers. In addition to that, the review points to a lack of empirical confirmation concerning the connection between SCRM and performance. This paper contributes an overview of 80 peer-reviewed journal articles on SCRM from 2000 to the beginning of 2015. We offer an overarching definition of SCRM, synthesise and assemble the numerous enablers into preventive and responsive strategies by means of a conceptual framework. Moreover, indicating the social network theory (SNT) as a potential theoretical foundation for SCRM, we further contribute to the supply chain management (SCM) literature by providing propositions that guide future research.

Keywords: supply chain risk management, supply chain risk(s), supply chain performance, supply chain disruption(s), systematic literature review, enabler(s), conceptual framework

1 INTRODUCTION

The demands of the business environment and the progression of emerging markets are leading to the development of dynamic and complex supply chain (SC) networks (Braunscheidel and Suresh, 2009; Manuj and Mentzer, 2008a; Tummala and Schoenherr, 2011; Spekman and Davis, 2004; Zsidisin et al., 2004). Consequently, these effects lead to an increase in risk exposure, for instance due to shorter technology and product life cycles, increased demand for just-in-time (JIT) deliveries, reduced inventory buffers, and e-business (Brindley, 2004; Fawcett et al., 2011; Giunipero and Eltantawy, 2004; Hallikas et al., 2004; Harland et al., 2003; Narasimhan and Talluri, 2009).

Fuelled by several well-documented events, such as natural disasters and events (e.g. Tsunami, 2004; Hurricane Katrina, 2005; Taiwan earthquakes, 1999, 2009, and 2010), diseases (e.g. foot- and mouth disease, 2001 in the UK; SARS-pandemic, 2003/2004; Avian influenza, 2005; Swine influenza 2009), and terrorist attacks (e.g. New York, 2001; Madrid, 2004; London, 2005; Jakarta, 2009) (Wagner and Neshat, 2012), the Iceland volcano eruption in 2010, the nuclear disaster in Fukushima, 2011, or Hurricane Sandy in 2012, interest in supply chain risk (SCR) issues has steadily grown. However, the literature on SCRM is highly fragmented hindering a throughout understanding of where research lies and what to research next (Pfohl et al., 2010). Although SCRM has become standard in supply chain management (SCM) research, the term and the concept to establish beneficial SCRM is still ambiguous and lacks adequate understanding. In general, a well-grounded, unified, and universally recognised SCRM definition is presently missing. In the same vein, differing concepts of theory building have headed towards an inconsistent use of terminologies to implement SCRM effectively using terms such as moderators, activities, antecedents, principles, capabilities, and elements. Furthermore, a critical still underexplored subject is the relationship between SCRM and performance (Sodhi et al., 2012). Along with increasing (SCR) due to environmental and economic changes, it is of paramount importance to answer the question of how to reduce SCRs (Chen et al., 2013). For the purpose of the study we embrace the following definition of SCRM:

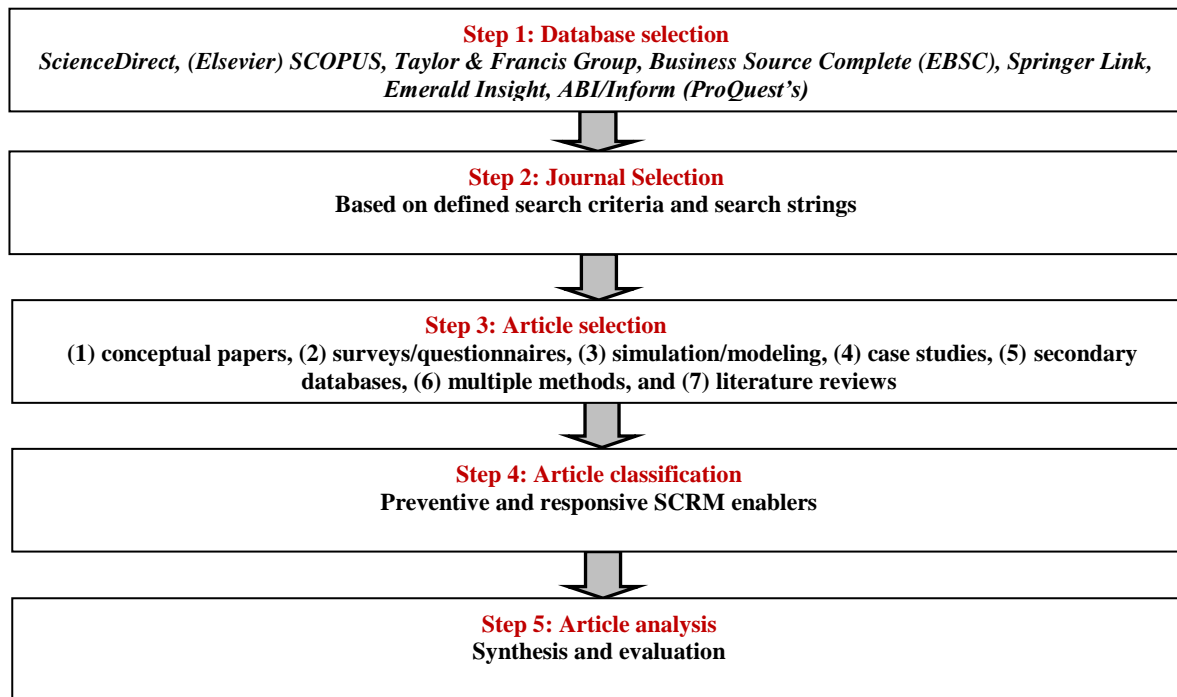
“Supply chain risk management is to [collaborate] with partners in a supply chain apply risk management process tools to deal with risks and uncertainties caused by, or impacting on, logistics related activities or resources” (Norrman and Jansson, 2004, p. 436).

We aim to synthesise the existing research findings to provide a clear overview. In addressing this issue, the study at hand offers an SLR on SCRM by adopting a rigorous research approach. The systematic literature review methodology has been recently used in other supply chain management literature reviews as well (e.g. Gimenez and Tachizawa, 2012; Lightfoot et al., 2013; Pilbeam, et al., 2012). Our findings offer essential theoretical contributions to the SCRM literature on strategic responses to adverse events by synthesising the inconsistent and fragmented literature. We aim at creating a classificatory framework and indicating existing gaps to motivate new research that will add to the current knowledge on SCRM. The paper at hand is structured as follows. The proceeding section deals with the elucidation of the rigorous SLR method and emphasises the constitutional research questions including the criteria drawn on in selecting and evaluating journal articles. Next, literature is analysed and synthesised, then succeeded by the description of the principal findings of the review; resulting in a conceptual framework for the enablers of SCRM. Finally, we work out the underlying implications for practitioners and point out possible directions for future research. This research makes three major contributions. A definition of SCRM is established, 12 top SCRM enablers are proposed, and research propositions are created to guide future research.

2 REVIEW METHODOLOGY AND DATA COLLECTION

The adopted SLR process is inspired by the works of Crossan and Apaydin (2010), Kilubi (2015), Meier (2011), and Wang and Shu (2010) and follows five distinct stages as shown in Figure 1: (1) database selection, (2) journal selection, (3) article selection, (4) article classification, and (5) article analysis.

Figure 1 Research methodology of the present systematic literature review



Source: According to Crossan and Apaydin (2010), Kilubi (2015), Meier (2011), Wang and Shu (2010).

The defined central research trends focused on are: What is the state of SCRM as presented in academic literature and how mature is the literature? Has a supply chain risk management been adequately defined? What are the major enablers that lead to increased performance and could this help researchers and practitioners to build a more grounded case for the implementation? To respond to the questions the following objectives were defined:

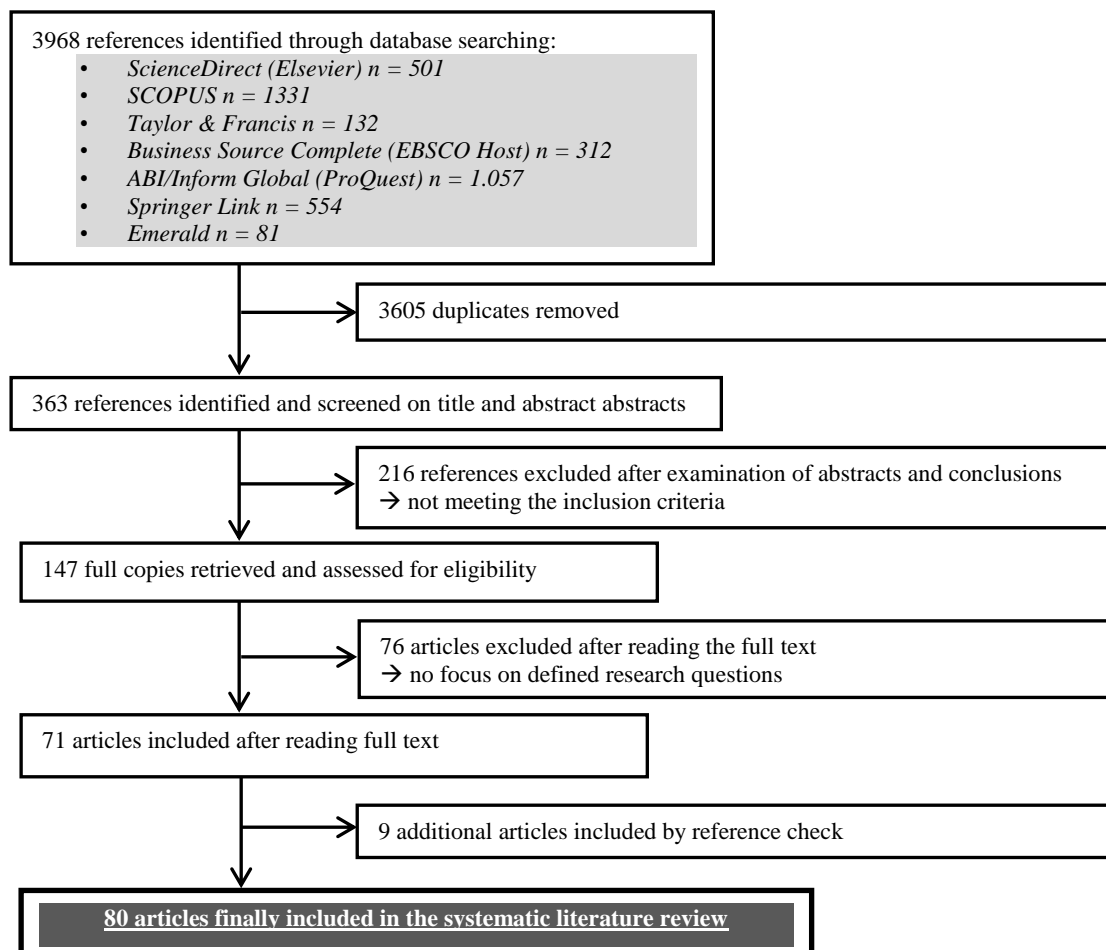
- a) Review and analyse the literature regarding definitions and research methodologies applied.
- b) Develop a classificatory framework that clusters existing enablers on SCRM based on preventive and responsive strategies that may be in light of practical advancement, embraced and further developed into measurement constructs in future research.
- c) Examine the relationship between SCRM and performance.
- d) Establish a research agenda including research propositions by identifying critical research issues in areas where further research is required.

The following databases were drawn on for the retrieval of business-related papers published in the English language in academic journals: *Science Direct (Elsevier)*, *SCOPUS*, *Taylor & Francis Group*, *Business Source Complete (EBSCO Host)*, *Springer Link*, *Emerald Insight*, and *ABI/Inform Global (ProQuest)*. These databases have been applied in previous SLRs, too (cf. Kilubi, 2015; Natarajarathinam *et al.*, 2009; Nijmeijer *et al.*, 2013; Rashman *et al.*, 2009; Soni and Kodali, 2011). We entered the search phrases “Supply Chain Risk” OR “Supply Chain Risk Management” in the article title (TI) solely along with ‘Performance’ in the abstract (AB), keywords (KW) and title (TI) search. The use of the term ‘Supply Chain Risk Management’ is widely acknowledged in the scholarly literature, which supports the choice.

For the article selection process, top-tier peer-reviewed journals with an *ABS (associationofbusinessschools.org)* ranking of 4 or 3 were determined as further inclusion criteria. First of all, we formed a review panel consisting of one university professor and two research assistants to validate the review process and to enhance quality. We then scanned the selected electronic databases under the terms of our defined search strings, with no time restriction. The search resulted in 3963 articles initially; of what 3605 duplicates were removed and 363 references have been identified and screened on title and abstract. Next, 216 references were excluded after the examination of the abstracts and the conclusions because of not meeting the pre-determined inclusion criteria. The analysis led to an initial article set of 147 articles of which 76 articles have been excluded as they lay beyond of the research scope of the study. Thus, journal articles had to show a clear focus on SCRM and the study’s purpose; remaining 71 articles. Besides, while scanning the citations and bibliographies of every article, the reference check revealed further potential contributions that had not been

found or overlooked during the initial key search. Here again, their reference lists were in turn scanned; this process was carried forward until no further journal article was identified. Therefore, nine additional items were included through this cross-referencing approach. The end result is a database of 80 peer-reviewed journal articles from 2000 to the beginning of 2015 (first quarter). A detailed schematic presentation of the process employed for selecting and evaluating studies is shown in Figure 2.

Figure 2: Detailed article selection process



3 STUDY FINDINGS

The synthesis aims at bringing together the findings on a selected topic, the results of which ought to be used to reach a higher degree of comprehension and attain a level of theoretical or conceptual advance beyond that accomplished in any single empirical research (Campbell et al., 2003). Indeed, the aim was to examine and analyse the SCRM literature while synthesising it into a novel format (Denyer and Tranfield, 2009).

3.1 Descriptive features of reviewed SCRM literature

The 80 journal articles identified through the SLR are analysed in this section with respect to the publication year, journal, and the methodological approach in order to understand the trends in the body of literature relevant to SCRM. An analysis of the years in which the 80 selected articles were published manifests that the first articles appeared in 2000. In fact, nearly 89% of the surveyed journal articles (68 out of 80) were published from 2004 onwards. The years 2004 (13%/ n=10), followed by 2012 (each 11%/ n=9), 2011 (9%/ n=7), 2008, 2009, and 2013 (each 8%/ n=6) marked the peaks, providing evidence that research interest in SCRM is still further growing (cf. Table 1).

The sample of 80 articles in the present review was published in 27 business-related academic journals. The highest share of articles (45%) were published in the *International Journal of Physical Distribution & Logistics Management* (n=13), *International Journal of Production Economics* (n = 12), and *Supply Chain Management: An International Journal* (n=11).

Table 1 Number of articles per year published by the academic journal (appearing at least twice)

Academic Journal	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	No. of articles	%
<i>European Journal of Operational Research</i>	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	3	3,75%
<i>International Journal of Logistics Research and Applications</i>	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	2	2,50%
<i>International Journal of Physical Distribution and Logistics Management</i>	0	0	0	0	7	0	0	0	1	1	0	1	2	1	0	0	13	16,25%
<i>International Journal of Production Research</i>	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0	4	5,00%
<i>International Journal of Production Economics</i>	0	0	1	0	1	0	1	1	1	1	0	2	2	0	0	2	12	15,00%
<i>Journal of Business Logistics</i>	0	0	0	0	0	0	0	0	2	0	0	0	0	1	1	0	4	5,00%
<i>Journal of Operations Management</i>	0	0	0	0	0	0	0	0	0	3	1	1	0	0	0	0	5	6,25%
<i>Journal of Purchasing and Supply Management</i>	0	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	3	3,75%
<i>Journal of Supply Chain Management</i>	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	3	3,75%
<i>Management Science</i>	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	2,50%
<i>Omega</i>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	3	3,75%
<i>Production and Operations Management</i>	0	0	0	0	0	2	0	0	0	0	0	0	1	0	0	0	3	3,75%
<i>Supply Chain Management: An International Journal</i>	1	0	0	0	2	0	1	0	1	0	0	2	1	1	2	0	110	13,75%

To assess the research methodologies applied in the selected articles, we looked at seven methodological approaches. Similar to Winter and Knemeyer (2013), we examined methodologies applied in order to compare the existing SCRM research approaches: (1) conceptual papers, (2) surveys/questionnaires, (3) simulation/modeling, (4) case studies, (5) secondary databases, (6) multiple methods, and (7) literature reviews. However, other than Winter and Knemeyer, we chose to leave out delphi methods and include two additional research methodologies as substitutes — since they seem to be prominent in SCRM research (Agrell *et al.*, 2004) — namely conceptual and simulation/modeling papers. We found that simulation/modeling was the primary methodological approach adopted in the reviewed papers (18 out of 80 articles). Furthermore, researchers adopted the case study research design and the survey/questionnaire design (each 16 out of 80 articles), succeeded by conceptual research design (12 out of 80 articles). However, the multiple research design along with literature reviews were only used each in 7 out of 80 articles. Besides, only a small number of papers conducted secondary database research (4 out of 80 articles).

3.2 Defining supply chain risk management

In the present SLR, while we were keen on capturing a broad range of perceptions, we tried to avoid subjective bias. Hence, a definition of SCRM had to be explicitly stated by the original author, not merely inferred, for consideration. The findings of this review indicate that the two propositions, namely, coordination and identification have often been mentioned in SCRM definitions. The elements of coordination and vulnerability reduction were first referred to in the definition of Jüttner *et al.* (2003), who took the first steps to explain risk management within the SCRM context. They posit that the management of risks in the context of SCM represents “the identification and management of risks for the supply chain, through a coordinated approach amongst supply members to reduce supply chain vulnerability as a whole” (p. 124). On the one hand, Norrman and Janssen (2008), as well as Tang (2006), put a primary emphasis on collaboration. On the other hand, Giunipero and Eltantawy (2004) bring forward the argument that SCRM should have a long-term focus and follow a continuous approach, requiring dedication from all supply chain members. It is apparent that only Tang (2006), Manuj and Mentzer (2008b), and the Supply Chain Council included the performance and the cost savings/ profitability dimension in their definition (cf. Table 2). However, Lavastre *et al.* (2012) adopt another perspective on SCRM taking strategic and operational aspects together with short - and long-term assessment into consideration. Wieland and Wallenberg (2012), likewise, hold a strategic perspective on SCRM, perceiving it as an approach to implement strategies to reduce vulnerability and ensure continuity. Nonetheless, we have found that the SCRM definition of Jüttner *et al.* (2003) is the most frequently used one in journal articles studying SCRM. Their definition bases on a synthesis of traditional risk management and SCM principles. Next, Norrman and Jansson (2004), Goh *et al.* (2007), as well as Lavastre *et al.* (2012) proposed concise and relevant SCRM definitions based on research projects. One comprehensive definition of SCRM was suggested by Manuj and Mentzer (2008b). Their definition builds upon existing literature (cf. Jüttner *et al.*, 2003; Norrman and Jansson, 2004) and on several in-depth interviews. They describe (global) SCRM as “the identification and evaluation of risks and consequent losses in 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 match of actual savings and profitability with those desired” (p. 205). Closer investigation of the correspondences and dissimilarities revealed that in most of the papers the elements of coordination, collaboration, and identification across organisations formed part of several SCRM definitions (e.g. Goh *et al.*, 2007; Tang, 2006; The Supply Chain Council). However, there seems to be no distinct consensus on the definition of “supply chain risk management” (see Table 2). Indeed, several authors make evident the predominant heterogeneity by either synthesising earlier SCRM definitions to create a new one (e.g. Giunipero and Eltantawy, 2004; Tang, 2006; Wieland and Wallenburg, 2012) or referring to a certain number of different authors (e.g. Tang and Musa, 2011; Trkman and McCormack, 2009; Zhao *et al.*, 2013). Thus, since no core definition synthesising SCRM understanding has been published yet, we apply our obtained cognition to convey an overarching definition of SCRM, which will be presented in Section 4.

Table 2 Definitions of supply chain risk management (SCRM)

Author(s)	Supply chain risk management definition(s)
Jüttner <i>et al.</i> (2003, p. 202)	SCRM means “the identification and management of risks for the supply chain through a coordinated approach amongst supply chain members, to reduce supply chain vulnerability as a whole.”
Giunipero and Eltantawy (2004, p. 703)	“Risk management is a continual process that involves long-term dedication of supply chain members.”
Norrman and Jansson (2004, p. 436)	“Supply chain risk management 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.“
Tang (2006, p. 453)	SCRM is “the management of supply chain risk through coordination or collaboration among the supply chain partners as to ensure profitability and continuity.”
Goh <i>et al.</i> (2007, pp. 164-165)	SCRM is defined „as the identification and management of risks within the supply network and externally through co-ordinated approach amongst supply chain members to reduce supply chain vulnerability as a whole.”
Manuj and Mentzer (2008, p. 205)	“Global SCRM is the identification and evaluation of risks and consequent losses in 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.“
Thun and Hoenig (2011, p. 243)	”Risk management, in general, is described as the identification and analysis of risks as well as their control. A main particularity of Supply Chain Risk Management (SCRM) contrary to traditional risk management is that it is characterized by a cross-company orientation aiming at the identification and reduction of risks not only on the company level but rather focusing on entire supply chains.“
Wieland and Wallenburg (2012, pp. 890-891)	“SCRM is defined as the implementation of strategies to manage both every day and exceptional risks along the supply chain based on continuous risk assessment with the objective of reducing vulnerability and ensuring continuity.”
Lavastre <i>et al.</i> (2012, p. 830)	“SCRM is the management of risk that implies both strategic and operational horizons for long-term and short-term assessment.”
Supply Chain Council	“SCRM is the systematic identification, assessment and mitigation of potential disruptions in logistics networks with the objective to reduce their negative impact on the logistics network’s performance.”

3.4 Enablers for an effective supply chain risk management

In analysing the enablers to make SCRM work, an inconsistent body of terminologies and wordings in the literature can be noticed. While some refer to SCRM strategies as antecedents (Braunscheidel and Suresh, 2009; Jüttner *et al.*, 2003), or moderators (Manuj and Mentzer, 2008b), others call them activities (Sinha *et al.*, 2004), enablers (Faisal *et al.* 2006), elements (Christopher and Lee, 2004), capabilities (Chen *et al.*, 2013; Sheffi and Rice, 2005), or principles (Kleindorfer and Saad, 2005). Taking into account that capability terms have various definitions in the literature, the present study remains neutral in its descriptive analysis and uses the term ‘enablers’. Hence, our SLR revealed 12 top enablers across various journal articles. The largest number of studies deal with visibility (n=24) to ensure successful SCRM. Furthermore, researchers also discuss flexibility (n=17) and relationships (n=15). Next, redundancy (n=13), followed by coordination as well as postponement (each n=10), and multiple sourcing (each n=9) were considered as vital by several academics. Finally, collaboration was guided with eight articles (n=8). Table 3 illustrates the top 12 enablers that represent a total share of approximately 65% of the selected articles.

Table 3 Analysis of top 12 SCRM enablers in research from 2000 to the beginning 2015

Enabler(s)	Frequency	Author(s)
Visibility	24	Johnson, 2001; Bode <i>et al.</i> , 2011; Spekman and Davis, 2004; Finch, 2004; Kleindorfer and Saad, 2005; Faisal <i>et al.</i> , 2006; Sinha <i>et al.</i> , 2004; Ritchie and Brindley, 2007a, b; Lavastre <i>et al.</i> , 2012; Christopher and Lee, 2004; Nooraie and Parast, 2015; Yang and Yang, 2010; Jüttner <i>et al.</i> 2003; Manuj and Mentzer, 2008a, b; Bandaly <i>et al.</i> , 2014; Tang, 2006b; Tang and Tomlin, 2008; Wagner and Bode, 2008; Speier <i>et al.</i> , 2011; Zsidisin <i>et al.</i> , 2004; Khan <i>et al.</i> 2008; Norrman and Jansson, 2004
Flexibility	17	Talluri <i>et al.</i> , 2013; Knemeyer <i>et al.</i> , 2009; Braunscheidel and Suresh, 2009; Jüttner <i>et al.</i> , 2003; Kleindorfer and Saad, 2005; Sinha <i>et al.</i> 2004; Christopher and Holweg, 2011; Sheffi and Rice, 2005; Zsidisin and Wagner, 2010; Skipper and Hanna, 2009; Johnson, 2001; Khan <i>et al.</i> , 2008; Tang, 2006b; Knemeyer <i>et al.</i> , 2009; Tang and Tomlin, 2008; Thun and Hoenig, 2011; Wieland, 2013
Relationships	15	Groetsch <i>et al.</i> , 2015; Giunipero and Eltantawy, 2004; Faisal <i>et al.</i> , 2006; Ritchie and Brindley, 2007a, b; Lavastre <i>et al.</i> , 2012; Tang 2006b; Speier <i>et al.</i> , 2011; Kleindorfer and Saad, 2005; Hallikas <i>et al.</i> , 2002; Lavastre <i>et al.</i> , 2012; Jüttner <i>et al.</i> , 2003; Khan <i>et al.</i> 2008; Spekman and Davis, 2004; Vilko and Hallikas, 2012
Redundancy	13	Marley <i>et al.</i> , 2014; Bode <i>et al.</i> , 2011; Talluri <i>et al.</i> , 2013; Zsidisin <i>et al.</i> , 2000; Lavastre <i>et al.</i> , 2012; Zsidisin and Ellram, 2003; Tang, 2006b; Kleindorfer and Saad, 2005; Tomlin, 2006; Sheffi and Rice, 2005; Knemeyer <i>et al.</i> , 2009; Schmitt and Singh, 2012; Zsidisin and Wagner, 2010
Coordination	10	Braunscheidel and Suresh, 2009; Ritchie and Brindley, 2007a, b; Knemeyer <i>et al.</i> , 2009; Ellis <i>et al.</i> , 2010; Hallikas <i>et al.</i> , 2004; Speier <i>et al.</i> , 2011; Lavastre <i>et al.</i> , 2012; Sinha <i>et al.</i> , 2004; Jüttner <i>et al.</i> , 2003
Postponement	9	Manuj <i>et al.</i> , 2014; Kleindorfer and Saad, 2005; Yang and Yang, 2010; Jüttner <i>et al.</i> 2003; Manuj and Mentzer, 2008a, b; Bandaly <i>et al.</i> , 2014; Tang, 2006b; Tang and Tomlin, 2008; Wagner and Bode, 2008
Multiple sourcing	9	Sinha <i>et al.</i> 2004; Jüttner <i>et al.</i> , 2003; Knemeyer <i>et al.</i> , 2009; Norrman and Jansson, 2004; Tang, 2006b; Zsidisin and Ellram, 2003; Kleindorfer and Saad, 2005; Ritchie and Brindley, 2007a,b
Collaboration	8	Jüttner <i>et al.</i> , 2003; Spekman and Davis, 2004; Khan <i>et al.</i> 2008; Kleindorfer and Saad, 2005; Christopher and Holweg, 2011; Lavastre <i>et al.</i> , 2012; Vilko and Hallikas, 2012; Chen <i>et al.</i> , 2013
Risk Awareness	7	Braunscheidel and Suresh, 2009; Ritchie and Brindley, 2007a, b; Hallikas <i>et al.</i> , 2002; Manuj and Mentzer, 2008a, b
Agility	7	Faisal <i>et al.</i> , 2006; Wieland and Wallenburg, 2012; Braunscheidel and Suresh, 2009; Khan <i>et al.</i> , 2008; Wieland, 2013; Jüttner <i>et al.</i> , 2003; Lavastre <i>et al.</i> , 2012
Avoidance	6	Manuj and Mentzer 2008a, b; Jüttner <i>et al.</i> , 2003; Tang, 2006b; Tomlin, 2006; Knemeyer <i>et al.</i> , 2009
Contingency planning	6	Finch, 2004; Kleindorfer and Saad, 2005; Norrman and Jansson, 2004; Ellis <i>et al.</i> , 2011; Skipper and Hanna 2009; Zsidisin <i>et al.</i> 2000
Risk monitoring	6	Finch, 2004; Kleindorfer and Saad, 2005; Hallikas <i>et al.</i> , 2004; Norrman and Jansson, 2004; Hendricks and Singhal, 2005; Hoffmann <i>et al.</i> , 2013
Transferring and sharing risks	5	Li <i>et al.</i> , 2015; Peck, 2006; Manuj and Mentzer, 2008a, b; Wagner and Bode, 2008; Knemeyer <i>et al.</i> , 2009; Finch, 2004

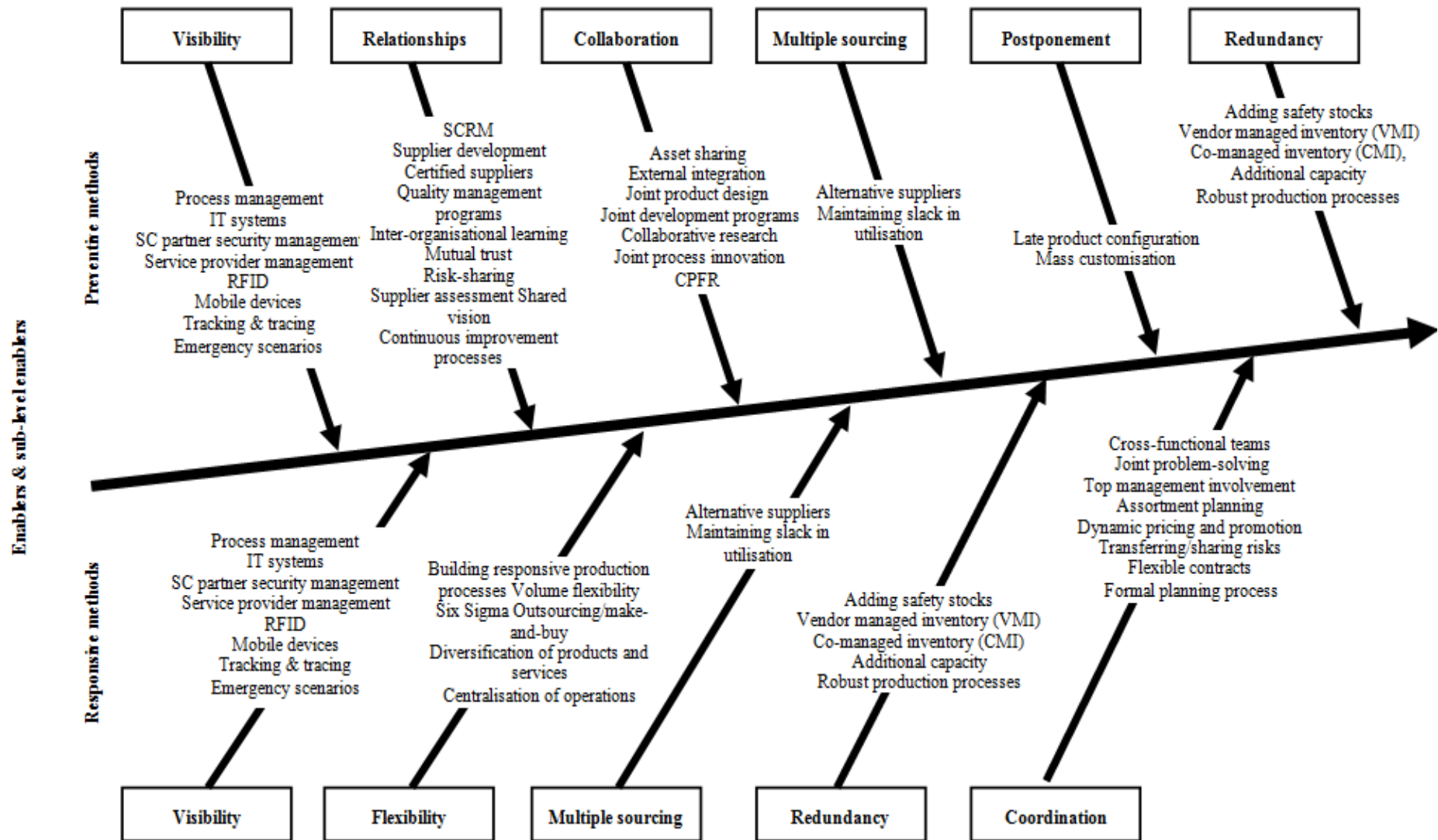
3.5 Grouping and synthesis of enablers

The controversy and disparity that surrounds the SCRM definitions also surrounds the SCRM enablers. A good illustration of the discrepancies in expression is the fact that some researchers referred to redundancy, whereas others spoke about holding surplus inventory, safety stocks, strategic stock, or extra stock — although all researchers might have meant the same. Thus, the findings designate that a greater agreement on specific terms regarding key SCRM enablers is required. To group and synthesise the SCRM enablers, we are consistent with other researchers that make a distinction between preventive and responsive risk mitigating methods (e.g. Knemeyer *et al.*, 2009; Tomlin, 2008; Wieland and Wallenburg; 2013; Zsidisin *et al.*, 2000). Preventive methods are cause-related measurement approaches that aim at reducing the probability of risk to occur (Thun and Hoenig, 2011) and responsive methods are meant to minimise the obstacles of adverse events (Tomlin, 2008). Within the preventive approach, we are of the opinion that six enablers may help protect against potential SCRs,

namely visibility, relationships, collaboration, coordination, multiple, postponement, and redundancy. Responsive methods are effect-oriented approaches that aim at counter measuring the adverse consequence of incidents; they do not immediately fight the risks but attempt to captivate the impairment caused by risks. Accordingly, the respective SC should be designed in a way that the consequences of an incurred risk are moderated (Thun and Hoenig, 2011; Tomlin, 2008). Thus, we propose that the following five enablers for effective SCRM within the responsive approach to respond to SCRs, namely visibility, flexibility, multiple sourcing, redundancy, and coordination.

The findings direct that visibility, multiple sourcing, and redundancy are central enablers needed in each preventive and responsive methods of SCRM. However, while some enablers may be more suited for preventing SCRs, others are more responsive in nature to immediately react to supply chain risks as soon as they emerge. Figure 3 demonstrates SCRM enablers and their corresponding sub-level enablers classified into preventive and responsive strategy. The conceptual framework provides a reference guide for practitioners in considering SCRM implementation. The framework differs from other SCRM frameworks in terms of its scope as it is exclusively centered around SCRM enablers. SCRM may be implemented in all or only selected strategies using each enabler where appropriate, and there are several processes, tools and systems to choose from. Moreover, SCRM benefits can also be identified at first glance.

Figure 3 Supply chain management enablers framework (including sub-level enablers)



3.6 The supply chain risk management–performance linkage

In this section, we will present the published contributions that address the relationship between SCRM or SCRs respectively, and performance. Hendricks and Singhal (2005) illustrate that SC disruptions severely impact the health of affected organisations concerning their profitability. They further found out that those firms affected do only slowly recover from the detriments caused by those disruptions. Papadakis (2006) examined the impact that supply chain disruptions have on the financial performance of companies. His empirical findings proved the decrease in firm's stock price due to supply chain risks. He further declares that risk exposure makes it difficult for companies to anticipate supply chain disruptions, like, for instance, those arising from human-made or natural disasters. Wilson (2007) analysed the effect of disturbances during transportation on supply chain (SC) performance. Briefly, a transportation disruption between the 1st tier supplier and the warehouse has the utmost adverse effect on the supply chain, resulting in high increase in inventory levels and materials in transit, and in turn leading to unfilled customer orders. Wagner and Bode (2008) executed a large-scale quantitative research examining the impact of SCRs on SC performance. They revealed that 6% of the variance of the performance of supply chains was due to the adverse effect of supply chain risks. They concluded that SCRM was of paramount importance in both managing demand- and supply-side risks. Four measures assess the impact of SCRs on SC performance: order fill capacity, delivery dependability, customer satisfaction, and delivery speed. Skipper and Hanna (2009) focused on flexibility and found that top management support, information technology usage, resource alignment, and external collaboration profoundly contribute to the flexibility and thus reduce the exposure to supply chain disruption risks. Flexibility has been demonstrated to enhance the ability to minimise risk exposure in the event of a SC disruption. Braunscheidel and Suresh (2009) showed that augmenting supply chain agility serves as a critical driver for mitigating supply chain risks. According to these researchers, agility is of value for both response and mitigation strategies, highlighting fast, preventive measures when confronted with supply chain risks. Lai *et al.* (2009) showed that systems efficiency can be improved through inventory risk sharing within the supply chain. The authors illustrated that with financial restriction, the combination mode, i.e. sharing inventory risks, delivers the greatest efficiency. In their study, Thun and Hoenig (2011) revealed that organisations with a more mature level of SCRM implementation degree yield a superior SC performance and those using the preventive SCRM method show greater flexibility and are better at planning safety stocks. Kern *et al.* (2012) have empirically validated the continuous impact of the three primary risk management steps, 1) risk identification, 2) risk assessment, and 3) risk mitigation on business performance. Their research demonstrates that firms with high expertise in those three SCRM phases render excellent performance concerning frequency and impact reduction of supply chain risks. Next, Wieland and Wallenburg (2012) in their empirical study where survey data from 270 industrial firms had been collected discovered that SCRM is necessary for the robustness and agility of a firm to improve performance. While agility has a significantly positive effect only on a SC customer value, robustness has a significantly positive impact on both performance measurements. Zhao *et al.* (2013) analysed both the relationship between SCRs supply chain integration (SCI) and business performance. Their results showed that SCRs have a negative impact on SCI and in turn on business performance. All in all, their findings advocate that SCRs have an undesirable impact on internal, supplier, and customer integration, pointing out that supply chain delivery risks hinder effective SCI. Chen *et al.* (2013) in their study, examined supply chain collaboration (SCC) as a risk mitigation strategy with data collected from 203 manufacturing enterprises in Australia. The study shows that SCC can significantly decrease SCRs. More precisely, their research demonstrated that process risks have the severest direct effect on SC performance, and that process hazards cause the majority of external hazards, either from the supply- or demand-side. Schmitt *et al.* (2015) proved that a decentralised design structure is ideal when supply and demand uncertainty are both existent, which balances out cost variance via risk modification effect. Finally, Nooraie and Parast (2015), revealed that increased visibility in SCs offers tremendous cost savings when SC disturbances occur. The outcomes showed that increased visibility is alluring because it builds efficiency in a SC and reduces both risks and costs.

4 DISCUSSION

4.1 Supply chain risk management definitions

From the very few definitions that exist, the results of our systematic review indicate that there is no universal and widely accepted SCRM definition in the extant literature. Given the fact that the foundation of SCM is the coordination between each entity and interface within a supply chain Thun and Hoenig (2011) correctly perceived that SCRM in opposition to traditional risk management holds a cross-company perspective while entire supply chain networks are the centre of attention. Although many authors adopt different views on SCRM, they put emphasis on the primary focus of SCRM that it extends traditional risk management approaches by integrating all partners upstream and downstream the supply chain. While there may only be slight differences between the definitions offered by the authors aforementioned, the central meaning is

apparent: Any approach to SCRM should seek to understand, identify, and reduce risks to the SC as a whole through coordination amongst partners. An in-depth analysis of the literature reveals that although there are similar definitions of SCRM in existence there is no widely and commonly one available. Considering the evolution of SCRM definitions, most of the proposals have only slightly been modified, referring to existing definitions or resulting from theory-building. A plausible explanation for the deviants in defining the elements inherent in SCRM might be that many researchers only use the SCRM definition as a basis for their research, thus, merely slightly modifying extant definitions without developing a central and unified definition. Besides, SCRM is a young cross-disciplinary research field with multiple facets; it should be borne in mind that previous definitions have primarily been developed based on conceptual views. Thus, SCRM definitions lack the empirical testing that could impede the creation of an universal definition. The conducted research further reveals that most researchers focus on defining 'supply chain risk' than on proposing a coherent definition on SCRM. Reviewing the literature it appears that the definition of "supply chain risk" is given more consideration to by authors than the definition of "supply chain risk management"(cf. Harland et al., 2003; Sinha et al., 2004; Zsidisin et al., 2004; Zsidisin and Ellram, 2003). A worthy indication of the level of maturity of a discipline is provided by the attitude of researchers concerning the definition of core concepts (Burgess et al., 2009), which suggests that definitional consensus does not exist and that SCRM is still in the evolving stage and has not yet reached maturity. We consequently anticipate that more new or altered definitions will be offered shortly. Thus, based on the findings and insights of the review, we convey an overarching definition of SCRM:

SCRM implies the identification, assessment, monitoring and evaluation of risks and potential threats within and outside supply chain networks with all members and entities involved. It supports cooperative and collaborative management of supply chain risks with the aid of adequate tools, techniques, and strategies as to mitigate or eliminate risk exposure. SCRM, therefore, aims at ensuring flexibility and agility to deliver operational excellence and to achieve superior performance and customer value.

4.2 Supply chain risk management enablers

The examination of 80 journal articles reveals that preventive and responsive methods require similar enablers to make SCRM work. Furthermore, the analysis clearly demonstrates a lack of consistency among different enablers that may hinder the ability to implement SCRM effectively. Hence, a greater consensus on particular notions and terms concerning SCRM enablers is undoubtedly required. Consequently, we grouped and synthesised the different terms into preventive and responsive SCRM methods. For the preventive approach, the strategy constitutes the enablers of visibility, relationships, collaboration, multiple sourcing, postponement, and redundancy. In most cases, late differentiation (postponement) works best in situations organisations have to face a high degree of demand-side risk, while the supply-side risks are fairly small (Manuj et al., 2014). In contrast, a responsive approach includes visibility, flexibility, multiple sourcing, redundancy, and coordination. Stank et al. (2001) also comment the benefits of collaboration to include a reduction in resource sharing, greater response to customer needs, and increased flexibility in adjusting to alterations in the marketplace. In their study, Wieland and Wallenburg (2013) demonstrate the effectiveness of preventive and responsive strategies for dealing with unexpected interruptions where they conclude that the design of the SC has a substantial influence on the suitability of the different SCRM enablers. As a result, we may assume that through combining both strategy methods organisations can exploit the advantages of both "world". This is in line with the findings made by Thun and Hoenig (2011), who found that firms applying preventive methods show higher values in terms of increased flexibility, reduced stocks, faster reactivity, and cost reduction, whereas firms adopting responsive methods show higher average values concerning the lessening of the bullwhip effect.

Several authors suggest that an organisation's ability to capture information for use in planning processes is critical to exploiting and developing adequate capabilities to deal with SCRs (Fawcett et al., 2000). Firms must possess that ability to share information to establish contingency plans, to manage planning processes, and to control daily business operations (Kaplan, 1991). Fundamental to the ability to plan is the exchange of large amounts of information within and between SC entities. Information and communication systems allow a firm to implement strategy and planning procedures by making decisions more quickly and increase inter-organisational and intra-organisational performance levels (Sanders and Premus, 2005). IT usage allows for efficient communication and information-sharing related to the allocation of resources, which, combined with adequate resource alignment allows a SC network to respond quickly and in a coordinated manner to SCRs for maximum operational benefit (Bode *et al.*, 2011; Sanders and Primus, 2005; Wakolbinger *et al.*, 2011).

4.3 Supply chain risk management and performance

The findings show a lack of empirical evidence for the linkage between SCRM and its related performance outcomes; however, there is at least fractional confirmation that SCRM and performance are positively linked to each other. Nevertheless, only 13 out of 80 journal articles conducted empirical research to quantify the impact of SCRM, for instance, on organisational performance. The analysis point to robustness measures to accommodate

sudden, unexpected events and to minimise the potential risk impact on performance. Overall, the contemporary and emerging studies show that the total SCRM effectiveness can be measured through three fundamental performance indicators (supply chain performance, financial performance and customer satisfaction), which can be used to quantify the management of SCRs. Schoenherr *et al.* (2012) emphasises that the risk topic is a field of inquiry of paramount relevance in the SCM context and despite the numerous SCRM studies, little focus on evaluating and measuring the effect of SCRM on performance. Until now, SCRM experiences the absence of reasonable and sufficient quantitative measures for SCR that considers the attributes of cutting edge supply chains. Measures principally used in finance and accounting are frequently used as mathematical methods in SCRM, too. Though, those measures regularly address the deviation from efficiency-based targets (Heckmann *et al.*, 2014). Consequently, they lack the evaluation of both operational effectiveness and essential performance indicators like product quality or customer value (Lapide, 2000). Research shows that the impact of a risk is weakened when companies implement preventive or responsive mitigation strategies (e.g. Knemeyer *et al.*, 2009, Norrman and Jansson, 2004; Thun and Hoenig, 2011). Therefore, it is favourable to make the risk probability and the risk impact comparable; thus, for the risk measurement process, two elements of a risk are pivotal: likelihood and impact (Norrman and Jansson, 2004). Under the terms of Zsidisin *et al.* (2004), risk probability measures how frequently a harmful event emerges and risk impact states the implication of that loss. In this context, Manuj and Mentzer (2008b) emphasise the importance of speed and group the speed of risk into three distinct categories:

- (a) The rate and frequency of the event that leads to loss,
- (b) the rate and frequency losses emerge, and
- (c) the rate at which the risk event is detected.

Schmitt and Singh (2012) recommend companies to focus on reducing the duration of disruptions over the frequency. Tomlin (2006, p. 640) supports the view that the nature of a disturbance, e.g. frequent but short vs. rare but long, is a crucial determinant of the optimal strategy, when studying mitigation and contingency methods. The probability of risk and its impact is thus recommended to be applied as decision criteria to select the right strategy for each particular supply chain (Wieland, 2013). Although the above-mentioned investigations clearly manifest that SCRM has a positive effect on performance and SCRs negatively impact on organisational output, the number of studies — only around 16% (13 out of 80 papers) — empirically test that relationship. While our analysis examined SCRM as the ability to avoid and reduce vulnerability to respond to uncertainties and risks as well as to analyse and mitigate potential disruptions we identified that SCRM can be quantified through three essential performance metrics that enable reporting on how severe a SCR impact is and how a firm's SCRM performs:

- (1) Supply chain performance
- (2) Financial performance and
- (3) Customer value.

5 MANAGERIAL IMPLICATIONS

The challenges of managing supply chain risks are no less than important than managing other risks faced by a company. As our world becomes more and more disordered and turbulent, the management of risks will play a greater role in both global supply chain network design and daily operating decision-making (Fawcett *et al.*, 2011). SCRM aims at providing approaches and practices for identifying, assessing, analysing and treating areas of vulnerability, disruptions and risks in supply chain networks (Neiger *et al.*, 2009; Thun and Hoenig, 2011; Jüttner *et al.*, 2003). Practical application of both of responsive and preventive strategy approaches collectively allows organisations or networks to have their resources properly allocated and positioned for maximum benefit. SCRM requires top management to take an increasingly preventive role in being well-armed for several interruptions and necessitates the same rigorous analysis and evaluation of various options and alternatives for modifying these risks (Silva and Reddy, 2011). Furthermore, measuring SCRM is a crucial managerial prerequisite that supports an organisation's knowledge and awareness of handling unexpected risk events. It also aids organisations to evaluate their SCRM, even in terms of malfunction. Corresponding firms of SCs thus need to establish a common understanding of SCRs and agree upon on a coherent risk assessment and evaluation standard, which enables to evaluate the identified risks irrespective of the company's specific preparedness to take risks. As a result, our framework with the groupings of SCRM enablers and their corresponding sub-level enablers provide an excellent managerial guideline to establish an effective SCRM. The enablers can be applied to design managerial processes to handle SCRs and to identify areas for improvement. Managers can further apply the identified SCRM enablers in this study to benchmark preventive and responsive SCRM methods. Practical application of both preventive and responsive approaches collectively allows organisations or networks to have their resources properly allocated and positioned for maximum benefit. We

should note, however, that SCRM requires top management to take an increasingly proactive role in being well-armed for several interruptions and necessitates a rigorous analysis and evaluation of various options and alternatives for mitigating risks (Silva and Reddy, 2011).

6 AVENUES FOR FUTURE RESEARCH

Hence, the challenge is first to conduct further studies on that highly relevant topic in a meaningful and practical context. Those research studies could focus attention on best practices to prevent SCRs with the aim to meet customer requirements (Lee *et al.*, 2004). Christopher and Lee (2004) prove through the “risk spiral” how the lack of information leads to a “self-perpetuating descent into chaos” (p. 389). We have reviewed research on SCRM with a focus on studies that were published in the last decade to date. Subsequent to introducing our literature review findings we created a definition for supply chain risk management. Furthermore, taking into account the findings from the literature survey, we have created a unique framework for SCRM with the focus on it building enablers. In the following we will articulate research propositions to guide future research prospect aiming at advancing current knowledge on the linkage between SCRM and performance. We will indicate the social network theory (SNT) as a potential theoretical foundation.

The collected works on social network theory (SNT) are enormous, and especially since around 2000, rising exponentially (Borgatti and Halgin, 2011); while an immense range of conceptions and methods have been created (Wynstra *et al.*, 2015). A supply chain may be seen as a value chain of social networks (Gulati, 1998; Gulati *et al.*, 2000). Social network theory is applicable for the analysis of inter-organisational relationships as firms endeavour to share data, synchronise their plans, and create products conjointly (Galaskiewicz, 2011). The SNT takes a relational perspective and highlights on the connections a firm has with different companies, and on how those relationships affect an organisation’s behaviour and performance (Dyer and Chu, 2000). The SNT views organisational outcomes as a function of the social interrelationships between firms or individual actors in a network (Jones *et al.*, 1997). A company cannot alleviate risks in isolation. They are asked to institute viable network structure of clients, suppliers, competitors, university bodies and research societies, and so forth. The SNT gives an awareness that the benefits and cooperation among firms could be to a great extent by the grant of network assets and their positionings within the network (e.g., cliques, centrality) (Chang, 2003). In light of the social network theory, we conclude SCRM is an ongoing process that implicates long-term dedication of all supply chain members involved (Giunipero and Eltantawy, 2004; Mahapatra *et al.*, 2010; Manuj and Mentzer, 2008b).

In any case, the relationship between the SCRM and SC performance has seldom been empirically confirmed (Melnik *et al.*, 2004 and Ritchie and Brindley, 2007a, respectively). Thus, Hoffmann *et al.* (2013) request for more empirical research in SCRM to explain SC performance. Firstly, we recommend researchers further to study the synthesised findings of the proposed conceptual SCRM framework in a large-scale quantitative study, in particular with the purpose to quantify the within reported enablers. The enablers may be in light of practical advancement, embraced and further developed into measurement constructs in future research. Several authors suggest that an organisation’s ability to capture information for use in planning processes is critical to exploiting and developing adequate capabilities to deal with SCRs (Fawcett *et al.*, 2000; Yu and Goh, 2014). Firms must possess that ability to share the information to establish contingency plans, to manage planning processes, and to control daily business operations (Sanders and Premus, 2005). Hence, we formulate the first proposition as follows:

P1: The higher the level of supply chain visibility, the greater the ability to mitigate supply chain risks and the higher the firm’s performance and customer value.

By achieving high levels of external integration through e.g. collaboration firms can increase their agility and are able to better respond to market uncertainty concerning customer needs and foreseen/unforeseen disruptions (Lavastre *et al.*, 2012; Sinkovics and Roath, 2004). Some researchers have included collaboration into SCRM mitigation frameworks (e.g. Christopher and Peck 2004; Chopra and Sodhi, 2004; Hallikas *et al.* 2004), but they are generally conceptually-based and provide little empirical evidence. In this context, Chen *et al.* (2013) claim that collaboration is essential to mitigate SCRs; however this linkage has not been investigated thoroughly, which leads to the second proposition:

P2: The higher the level of supply chain collaboration, the greater the ability to mitigate supply chain risks and the better the firm’s performance and customer value.

In uncertain markets, a flexible supply chain can work out its options quicker than its competitors (Manuj and Mentzer, 2008a). Zhang *et al.* (2002, 2003) examined the positive relationships between various types of flexibility in terms of increased performance. Consistent with a study by Swafford *et al.* (2006), it was established that flexibility in purchasing, production, distribution and logistics significantly contribute to the

achievement of agility. Likewise, Braunscheidel and Suresh (2009) indicate that flexibility is essential in global SCs because it plays an assisting role in the coordination process and offers a unique ability to support companies in managing the high levels of uncertainties inherent in global business operations. According to Fawcett *et al.* (1996) firms that accomplish higher levels of flexibility leave behind their less flexible competitors. Hence, we propose the following:

P3: *The higher the level of supply chain flexibility, the greater the ability to mitigate supply chain risks and the higher the firm's performance and customer value.*

Accordingly, in light of the identified SCRM performance metrics, we claim that through smooth exchange of information, higher level of collaboration, and greater flexibility firms may improve their organisational performance, and in turn achieve higher customer value. The proposed propositions are in line with suggestions made by Manuj and Mentzer (2008a) who consider among others for instance flexibility, information systems and performance metrics as key enablers in the process of risk management and mitigation. A summary of the propositions is shown in Table 4.

Table 4: Summary of research propositions.

SUMMARY OF RESEARCH PROPOSITIONS	
P1	<i>The higher the level of supply chain visibility, the greater the ability to mitigate supply chain risks and the higher the firm's performance.</i>
P2	<i>The higher the level of supply chain collaboration, the greater the ability to mitigate supply chain risks and the better the firm's performance.</i>
P3	<i>The higher the level of supply chain flexibility, the greater the ability to mitigate supply chain risks and the higher the firm's performance.</i>

Secondly, we also suggest investigating best practices for effective risk mitigation. Academics may generate qualitative and quantitative measures to analyse the effect of SCRM enablers on performance to attain new valuable insights. Therefore, several scholars advocate the application of mixed methods in SCM (Connelly *et al.*, 2013; Gammelgaard and Flint, 2012; Taylor and Taylor, 2009). Thirdly, we advise conducting longitudinal research to monitor and evaluate the long-term performance after implementing SCRM. The present study contributes to the SCRM literature in several ways. The paper at hand offers an SLR with the state-of-the-art research with extant knowledge. Its value lies in the ability to synthesise present study and aid understanding of the SCRM phenomenon to provide a solid basis for further enrichment. Hence, the findings presented in the present study reveal the potential for future research endeavours in this significant scientific discipline. We further hope that our SLR will contribute to the adoption of a standard and accepted definition of SCRM.

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