

Practices, Challenges, and Influence of Company Characteristics on Supply Chain Risk Management

A study on how organizations work to become and stay resilient

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Abstract

Background

In recent years, supply chains have faced major disruptions, including the Covid-19 pandemic, the Suez Canal blockage, and the Russia-Ukraine war, highlighting their vulnerability. As supply chains have become more global and interconnected, the complexity of supply chain networks has increased, leading to them being more exposed to risks. This has resulted in disruptions becoming more frequent and severe, reinforcing the need for stronger supply chain resilience, which can be achieved through implementation of Supply Chain Risk Management (SCRM) practices.

Problem Definition and Purpose

A structured approach to SCRM is seen as essential for building supply chain resilience, yet previous conducted studies reveal a gap between its perceived importance and actual implementation, indicating there is substantial development potential for companies to improve their SCRM efforts. The consultancy firm 4C Strategies want to expand their offering within SCRM by addressing this potential gap. Therefore, this thesis aims to explore SCRM practices, their potential challenges, and variations among different sized companies in Sweden's retail, food, and manufacturing industries. SCRM practices include proactive and reactive process activities, methods and tools, IT softwares and IT capabilities, and organizational capabilities.

Method

This thesis employed a deductive, quantitative, and cross-sectional approach using a questionnaire distributed to over 600 relevant employees at companies operating in Sweden across three industries, resulting in 72 responses. To ensure relevant and theory-grounded questions, a comprehensive literature review was conducted on SCRM practices, challenges, and industry specific characteristics. The analysis was based on 65 valid responses, using descriptive methods such as boxplots and bar charts, explanatory methods such as bubble charts to compare implementation and challenge levels, and statistical Kruskal-Wallis tests to identify significant differences between industries and company sizes. This thesis has been a complete collaboration between the two authors. Each author has been involved in every part of the process and contributed equally.

Conclusions

The results show that most organizations apply both proactive and reactive SCRM practices to a moderate or high degree, though with variation in application levels across process steps. Tools and organizational aspects have an inward focus where external collaboration is deprioritized and IT tools are highly underdeveloped. Proactive practices are generally perceived as more challenging than reactive, however higher perceived level of difficulty does not always seem to impact implementation level. While organizational challenges vary, limitations in technical resources and cultural integration emerge as key constraints to advancing organizational maturity. Clear industry differences exist, with manufacturing and food showing higher SCRM maturity than retail. Company size has a smaller impact, though larger firms tend to have more structured processes and capabilities.

Keywords

Supply Chain Risk Management, Proactive and Reactive Supply Chain Risk Management, Supply Chain Resilience, Organizational Capabilities, Supply Chain Risk Management Methods and Tools, Supply Chain Risk Management Challenges, Swedish Industries

Abbreviations

Abbreviation	Explanation
RM	Risk management
SC	Supply Chain
SCR	Supply Chain Risk
SCRM	Supply Chain Risk Management

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1. Introduction

This chapter provides context and background for supply chain risk management and explains its relevance. The problem, the research purpose, research questions, and the focus and delimitations of the thesis are stated. Finally, the structure of the thesis is presented.

1.1 Background

Over the past few years, supply chain executives have experienced numerous disruptions which have uncovered weaknesses in the supply chains of companies and, in some cases, of complete industries. In early 2020, The World Health Organization (WHO) declared the Covid-19 outbreak a pandemic, an event that was followed by years of various supply chain challenges worldwide. One major source of disruptions was the closure of borders to and from major food-exporting nations, causing food shortages in some countries. Meanwhile, other industries such as the American automobile manufacturing saw a sharp decline in demand, whereas lockdowns triggered panic buying, resulting in high and erratic demand for certain essential goods. Altogether, the pandemic revealed how sudden shifts in demand and supply could lead to widespread supply chain disruptions across multiple industries (Moosavi, Fathollahi-Fard & Dulebenets 2022). Another well-known event is the 2021 blockage of the Suez Canal. When the container ship *Ever Given* became wedged in the canal, it caused massive congestion, underscoring how localized incidents can ripple through global supply chains and highlighted the critical dependence of global trade on key infrastructure points (Wieland et al. 2023). For every day the ship remained wedged, an estimated \$9.6 billion in trade was delayed, resulting in financial losses and operational delays for countless businesses (Russon 2021). The following year, Russia's full-scale invasion of Ukraine caused not only the loss of thousands of lives (Binley & Beale 2024) but profound disruptions to global trade (WTO 2023). Western economic sanctions on Russia drove up oil and gas prices, placing significant strain on energy-intensive industries. Meanwhile, Ukraine's destroyed agricultural infrastructure and blocked trade routes led to sharp increases in food and fertilizer prices, exacerbating global shortages. Additionally, the conflict has led to a shift from rail transport to sea freight and increased one-way shipments from India. This has indirectly resulted in container shortages and port congestion, delaying shipments worldwide (GEP 2022). Concludingly, these events, though varied in nature, have all caused supply chain disruptions and collectively illustrate how vulnerable these modern networks are.

The Covid-19 pandemic, the Suez canal blockage and the Russia-Ukraine are three events that caused some of the greatest supply chain disruptions the last couple of years. However, supply chains are continually affected by a large range of risks, a result of the development of supply chains over time. In the 1980s and 1990s, the supply chains became more globalized (Norrman & Olhager 2023). By expanding operations internationally, companies have had access to configurations of global supply chains such as cheaper labor and raw materials, subsidized financing opportunities and larger markets (Manuj & Mentzer 2008). However, by outsourcing and offshoring activities to a greater degree, the supply chains have become increasingly complex, interconnected and interdependent. A company does not only often have more complex internal networks but is often also heavily influenced by factors beyond the company's realm. For example, the company Ericsson, a leading telecom company, indicated a loss of \$400 million in their annual report in 2001, as a result of a small fire at a sub supplier of a critical component in their network the previous year (Norrman & Jansson 2004). This was later called the *Albuquerque incident* and was a turning point in Ericsson's way of managing risks.

Another example is the hacker attack towards a sub-supplier of the sales system of the Swedish grocery chain COOP in 2021 which caused 800 stores to close for multiple days (Toresson 2021). In conclusion, the increasing complexity of supply chain networks has made them more exposed to disruption risks, resulting in companies facing more frequent and severe disruptions (Polyviou, Ramos & Schneller 2022). In addition to this, some risk sources are also becoming objectively more common including cyber attacks such as the one harming COOP (MSB 2024).

Despite facing increasingly severe and frequent disruptions, many companies have adopted business and supply chain strategies that make the supply chains less equipped to handle disturbances. Factors such as technological advancements, conflicting stakeholder interests, and economic pressures have, to some extent, contributed to this supply chain fragility. For instance, many companies aim to minimize inventory levels and consolidate supply and distribution centers to reduce costs and maintain low margins (Gurnani, Mehrotra & Ray 2012). Others have reduced their supplier base to achieve economies of scale or promised shorter lead times to justify higher prices (Norrman & Jansson 2004). However, such strategies can significantly disrupt supply chain operations when unforeseen disturbances occur, ultimately reducing profitability (Gurnani, Mehrotra & Ray 2012). A notable example is Ericsson which, as previously mentioned, relied on a single source for a critical component. This decision turned the component into a bottleneck, halting the complete production when a disruption arose (Norrman & Jansson 2004). Therefore, companies must recognize that their overall strategic choices play a crucial role in their ability to mitigate disruptions effectively. Even though companies have become more exposed to risk, the financial pressure often leads companies to implement strategies that may actually increase the vulnerability of the supply chain.

However, it is important to understand that even if supply chain managers try to prepare themselves as best as possible for disruptions it is impossible to achieve full control of the end-to-end supply chain as it is simply too complex and dynamic (Hoberg, Thornton & Wieland 2020). Some disruptions, such as the blockage of the Suez Canal, are simply unforeseeable. With that said, it has been observed that the extent of the negative consequences a company experiences depends largely on its ability to manage disruptions (Polyviou, Ramos & Schneller 2022). This ability to prepare for and/or respond to, and recover from disruptions is commonly referred to as *Supply Chain Resilience* (SC Resilience) (Tukamuhabwa et al. 2015). Research has shown that one of the most effective ways to strengthen resilience is through a structured and continuous approach to *Supply Chain Risk Management* (SCRM) (Fan & Stevenson 2018). Ivanov (2023) even argues that the fundamental purpose of SCRM is to build a more resilient supply chain, one that is less vulnerable to disruptions and their consequences. More specifically, the goal of SCRM is to establish a systematic process that enables companies to mitigate risks, minimize disruptions, and ultimately maintain business continuity and competitive advantage (Khojasteh, Xu & Zolfaghari 2022).

SCRM is often divided into *reactive* SCRM and *proactive* SCRM. Proactive SCRM includes working proactively with reducing the exposure to risks and the potential consequences of these, before the risks materializes (Kersten & Wentz 2012). The procedures often include detecting potential supply chain risks, estimating their probability as well as planning and activating suitable actions before a disruption occurs (Li & Barnes 2008). Reactive SCRM does instead focus on measures to reduce the consequences of an event, when it has already occurred (Kilubi 2016).

1.2 Problem Formulation

As companies have become more exposed to risks and therefore experienced a higher frequency of disruptions, the topic of SCRM and SC resilience has become of great interest. Norrman and Näslund presented in 2016 a study which showed that organizations believe SCRM to be very important. In a more recent study performed by Deloitte, the interest of increasing capabilities of handling risks in supply chains were confirmed as three of four respondents considered SC resilience as important in their company as efficiency (Deloitte 2022). However, it has been seen that there is a significant gap between the perceived need and importance of SCRM and the implemented procedures in reality. Many organizations seem to not reach the level of implementation of efforts that they consider necessary. This indicates that there is substantial development potential for companies to improve their SCRM efforts (Norrman & Näslund 2016). The relevance of SCRM and SC resilience in today's supply chain environment and the gap between the interest and implemented solutions have also been identified by 4C Strategies, which this thesis is conducted in collaboration with.

The thesis is conducted together with the consultancy company 4C Strategies, founded in Lund 2000, provides training readiness and organizational resilience solutions for public and private sectors. During their over 20 years of experience they have supported high-profile international institutions, global enterprises, and armed forces across 100 countries. The 4C Strategies platform Exonaut has simultaneously evolved into a platform of integrated solutions for Risk, Business Continuity, Crisis Management, Compliance, Training and Exercises for various industries (4C Strategies n.d). Now, 4C Strategies want to develop their offering within SCRM towards their customers, providing software solutions and support that help their customers become resilient in a SC perspective as well. However, in order to provide the right tools, 4C Strategies needs to understand more about how their potential customers work today and their expressed needs, which will be answered in this thesis.

1.3 Research Purpose and Research Questions

The aim of this master's thesis is to explore the current practices of SCRM employed by companies and to identify the key challenges companies face in their efforts that might limit effective SCRM. Furthermore, to explore whether companies should prioritize their SCRM development efforts differently, this thesis examines variations across industries and company sizes. To fulfill this purpose, the following Research Questions (RQs) are addressed:

RQ1: *What practices do organizations use to proactively and reactively manage risks in their supply chains?*

The first question explores how organizations manage SCRM, where practices refer to the key elements of SCRM. These include proactive and reactive SCRM processes, methods and tools applied in these processes, and organizational capabilities which enable effective SCRM. A literature review will be conducted in order to get an overview of the current knowledge on the subject of SCRM and comprehend what practices are available according to the literature. These findings will serve as the foundation for a questionnaire, allowing for an assessment of which practices are applied in practice and to what extent.

RQ2: *What are the greatest challenges companies face when working with SCRM and how do they seem to impact the implementation of SCRM practices?*

Secondly, identifying the key challenges companies perceive in SCRM can provide practitioners with valuable insights into where to prioritize their efforts and help explain why certain areas may be less developed. Additionally, it can guide researchers to areas of further research. RQ2 will be approached similarly to the previous question.

RQ3: *Do organizations of different industries and sizes demonstrate variations in their SCRM work?*

Lastly, the thesis aims to investigate whether company size or industry influences how organizations approach SCRM, including differences in areas such as the extent of applied practices, and the nature of the challenges they face. This will be conducted by using statistical analyses of the results obtained for RQ1 and RQ2 .

1.4 Focus and Delimitations

Figure 1.1 illustrates the scope of the thesis and the interconnections between the RQs, which have been set in collaboration with 4C Strategies. Firstly, the thesis is only including companies with a presence in the Swedish market to ensure the findings remain relevant to 4C Strategies' customers and to minimize potential sources of error related to national differences. Secondly, the study is limited to companies operating in at least one of the following industries: *retail*, *food*, and *manufacturing*. These industries align with 4C Strategies' existing customer base and each contribute with unique characteristics and SC structures, relevant for the study. Furthermore, the focus of the thesis is set by the three RQs.

RQ1, presented in blue, focuses on SCRM practices, including the proactive and reactive processes, the methods and tools used in these processes as well as organizational aspects. RQ2, presented in yellow, represents an external layer surrounding these practices, illustrating the process related and organizational challenges that may influence organizations' implementation of SCRM practices. Finally, RQ3, presented in green, builds on the insights from RQ1 and RQ2 by exploring how industries and company size influence the areas illustrated in blue and yellow.

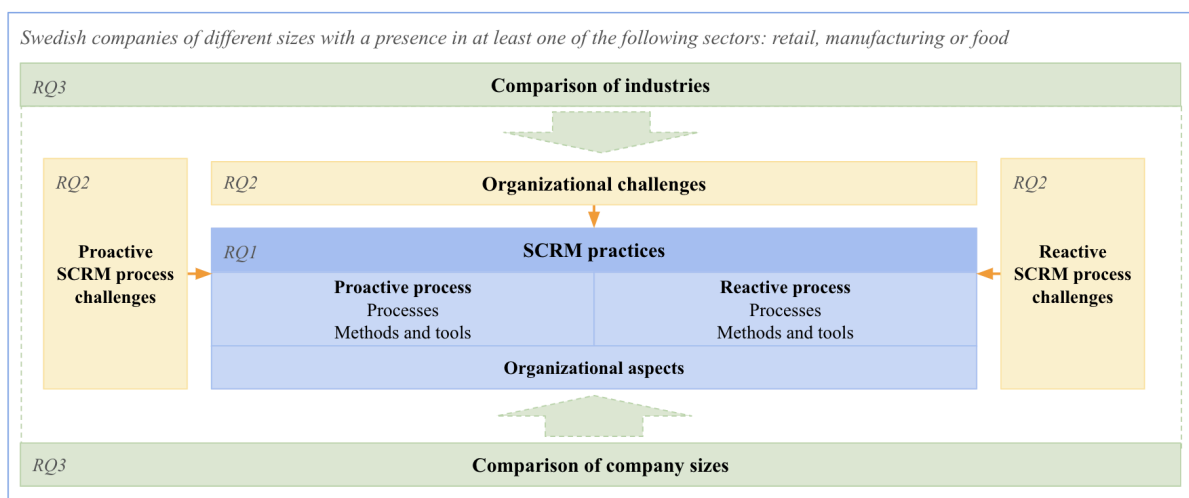


Figure 1.1: An illustration of the scope of the thesis.

1.5 Structure of Thesis

This section represents an overview of each chapter in this thesis.

Chapter 2: Literature review

The second chapter presents the literature review, establishing the theoretical foundation by defining key concepts within SCRM and SC Resilience. It then explores proactive and reactive SCRM, detailing their respective process steps. Following this, the chapter outlines various methods and tools used in SCRM. Finally, it examines the organizational aspects of SCRM, highlighting key capabilities identified in the literature as well as insights from maturity models.

Chapter 3: Industry specific characteristics

The third chapter offers an overview of the three selected industries, retail, food, and manufacturing, that are represented in the questionnaire sample. It outlines the key characteristics of each industry and highlights industry-specific challenges commonly found in their SCs.

Chapter 4: Methodology

The fourth chapter outlines the chosen research methodology and approach of the thesis. Data is collected through both a literature review and a questionnaire, with the rationale and structure of each method explained in detail. Data analysis techniques employed are described. Finally, it discusses the measures taken to ensure the quality and reliability of the study.

Chapter 5: Empirical findings related to SCRM practices

Chapter five presents the questionnaire results on the practices organizations apply in proactive and reactive SCRM activities, including methods and tools, IT systems and capabilities, and organizational capabilities. It also covers background data such as the perceived importance of SCRM, involved departments and roles, risk severity, and company and respondent characteristics. These results are then analyzed and interpreted in relation to relevant theory.

Chapter 6: Empirical findings related to challenges in SCRM

Chapter six presents the questionnaire results on the proactive, reactive, and organizational challenges faced by organizations. The reported challenge levels are compared to corresponding implementation levels to identify potential gaps. These findings are then analyzed and interpreted in relation to relevant theory.

Chapter 7: Empirical findings addressing industry and company size comparison

Chapter seven presents the questionnaire results compared across industry industries and company sizes, using both statistical tests and visual comparisons of mean values. The findings are then analyzed and interpreted in relation to relevant theory.

Chapter 8: Conclusion and Contributions

The eight and last chapter begin with presenting the finalized answers of the RQs, based on the empirical findings. Thereafter, a discussion on the generalizability of the thesis findings to other contexts and considering alternative interpretations of the results are presented, as well as theoretical and practical contributions of the research. Lastly, the delimitations of the thesis are discussed along with suggestions of future research, with the purpose of building on this research in the future.

2. Literature review

This chapter reviews existing literature based on the structure in Figure 2.1. Section 2.1 defines key concepts of SCRM and SC resilience, and their interconnection. Sections 2.2 and 2.3 outline the proactive and reactive SCRM processes, followed by section 2.4, which presents supporting methods and tools. Finally, section 2.5 identifies the organizational capabilities required for effective SCRM.

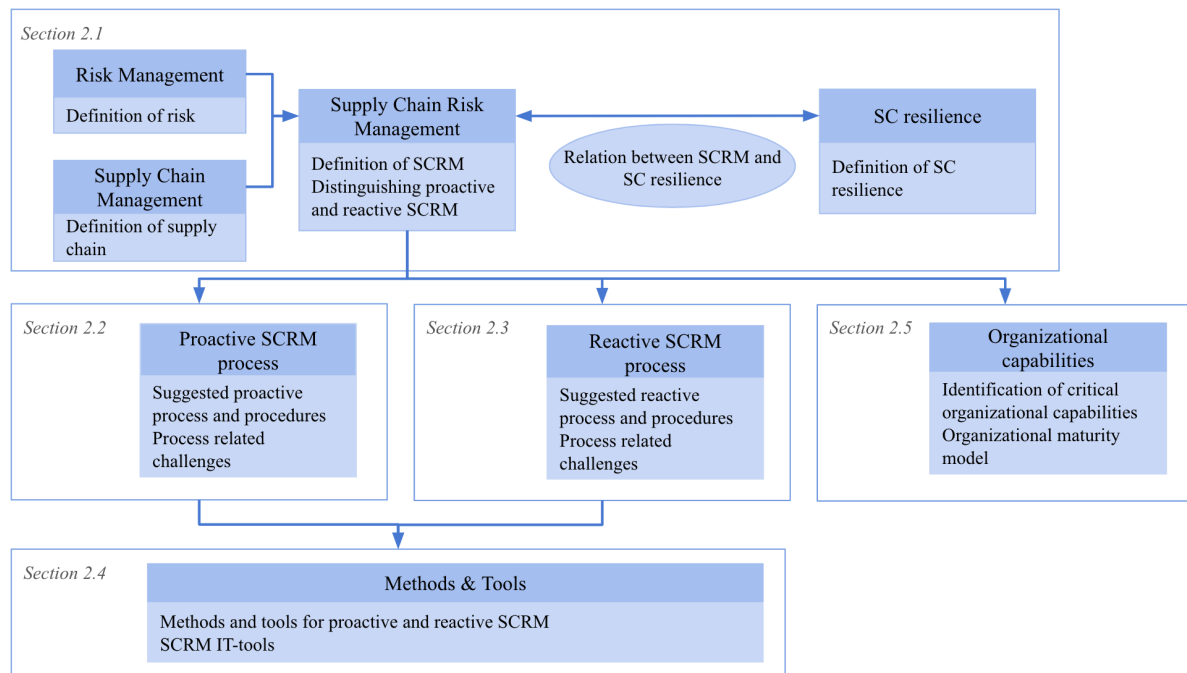


Figure 2.1: The areas which have been covered in the literature review.

2.1 Theoretical Baseline

2.1.1 Supply Chain Risk Management

In order to comprehend the area of SCRM fully, it is necessary to clearly define the areas that the term includes. Firstly, the terminology of *Risk* and *Risk Management* (RM) is discussed in general terms. This is then followed by the definitions of a *Supply Chain* (SC) and *Supply Chain Management* (SCM). Finally, the terms are connected and *Supply Chain Risk Management* (SCRM) is explained and discussed.

The term *risk* refers to a future event that can occur with a certain probability and will entail some impact on the organization (Alleman & Quigley 2024). Christopher and Peck (2004) presents various interpretations of how a risk is strictly defined but highlights that the definition often used in RM presents risk as *the multiplication of the probability of a given event and the potential impact of that event*. With that definition in mind, RM includes the decisions and implementation of processes associated with handling risks (Norrman & Jansson 2004).

A SC refers to “*the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer*” (Christopher 2011). In a definition made by Mentzer et. al (2001) it is stated that also the flows of finances and information should be taken into account

when discussing a SC. Due to the often high level of complexity, finding processes that manage issues related to SCs are necessary which is referred to as *Supply Chain Management (SCM)*. A literature review conducted by Mentzer et. al (2001) resulted in a refined definition of SCM as “*the systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole.*” Accordingly, SCM includes all measures taken to support the SC which naturally also should involve the handling of risks towards the SC, the so-called *Supply Chain Risks (SCRs)*. SCRs include all risks related to the SC network and therefore both structural elements such as key actors, stakeholder relationships and the nature of goals as well as dynamic components such as human resources, products, projects and know-how along the SC (Borghesi & Gaudenzi 2013). As the management of these risks are limited to SCRs, the handling is called SCRM.

The definition of SCRM varies somewhat in the literature, primarily in their level of detail and comprehensiveness. Some definitions are concise, leaving more room for interpretation (Norrman & Jansson 2004; Jüttner, Peck & Christopher 2003), while others provide more detailed descriptions of what SCRM entails in practice (Fan & Stevenson 2018; Ho et al. 2015). Fan and Stevenson (2018) has conducted a literature review of existing definitions of SCRM and has concluded that existing definitions include concepts which can be divided into three different elements; (1) the objective of SCRM, (2) the pathway to SCRM and (3) the process of SCRM. Regarding the objective(s) of SCRM, Fan and Stevenson address that SCRM aims to reduce costs and vulnerability while profitability and business continuity is ensured. These objectives ultimately contribute to achieving competitive advantage and long-term growth. The pathway to SCRM highlights the importance of implementing appropriate strategies, including both internal application of SCRM strategies and external collaboration and coordination with SC stakeholders. Finally, the SCRM process includes having an established structure of working with SCRM (Fan & Stevenson 2018). Fan and Stevenson (2018) have, based on the three pillars, established a comprehensive definition of SCRM which however limits the description of the SCRM process to proactive SCRM. As this thesis will include both proactive and reactive SCRM, the definition of Fan and Stevenson (2018) have therefore been somewhat altered to cover both SCRM approaches. The definition that will be used is concludingly; *Supply Chain Risk Management is the procedures of, with a structured process, and with the aid of the internal implementation of tools, techniques and strategies as well as of external coordination and collaboration with supply chain members, reduce vulnerability and ensure continuity coupled with profitability, leading to competitive advantage* (altered definition by Fan & Stevenson 2018). Thereafter, a further division of the area of SCRM, into proactive SCRM and reactive SCRM, can be done.

The fundamental difference between proactive and reactive SCRM is the timing of the efforts taken, presented in Figure 2.2. These measures cover actions to both moderate the likelihood as well as the impact of a SCR. Proactive SCRM refers to measures which aim to mitigate risks before they affect the SC. In practice, these procedures include detecting potential SCR sources, assessing the risks as well as identifying and implementing strategies to mitigate them (Kilubi 2016). Furthermore, this thesis will include the step of monitoring, to evaluate how SCRs are developing (Fan & Stevenson 2018). The monitoring step has received significantly less explicit attention in research. According to Fan and Stevenson (2018), only 10 out of 354 papers in their literature review specifically addressed monitoring.

Reactive SCRM implies that actions to minimize harm on the SC are not taken until an incident has already occurred. Therefore, reactive SCRM focuses on reducing the consequence of an already

occurred risk rather than reducing the potential impact or likelihood for an incident to occur. However, the reactive approach does contain some proactive elements in terms of arrangements and plans produced beforehand with the purpose to increase the speed in reaction in case of emergency (Kilubi 2016). Hopp, Iravani and Liu (2012) state that being more reactive by managing disruptions after they have occurred, can increase the flexibility of an organization as a crisis plan has to be applicable for any type of scenario. Meanwhile, proactive SCRM can imply investments in adjusted efforts. Nevertheless, such a crisis plan must be developed and implemented simultaneously and thus more complex to execute (Hopp, Iravani & Liu 2012). Norrman and Wieland (2020) emphasize that although companies have historically tended to adopt a more reactive approach to SCRM, an effective SCRM strategy requires both proactive and reactive processes. While proactive measures have demonstrated positive impacts on business performance, not all disruptions can be anticipated, making reactive capabilities essential for managing unforeseen events.

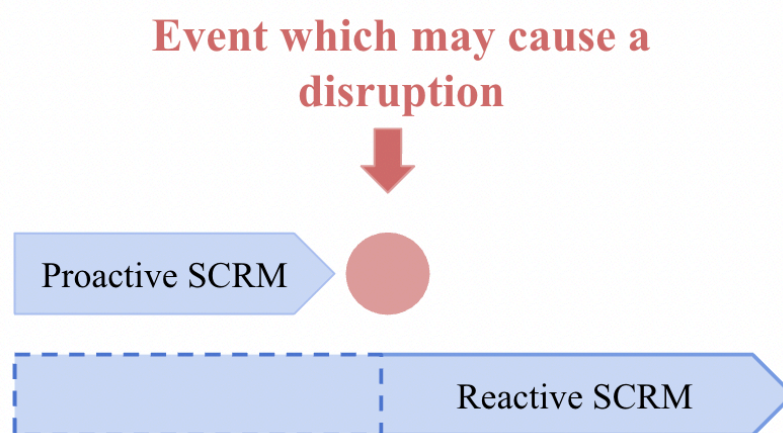


Figure 2.2: A visualization of the interconnections of proactive and reactive SCRM.

2.1.2 Supply Chain Resilience

A concept frequently discussed in relation to SCRM is SC resilience which has varying interpretations. To clarify the authors' view on the idea and its connection to SCRM, the concept is defined below.

Two suggested perspectives, *engineering resilience* (Wieland & Durach 2021) and the *stability-based view* (SBV) (Ivanov 2023), are based on the idea that a system operates in a steady, "business-as-usual" state, corresponding to a certain level of SC performance (Sheffi & Rice Jr 2005). When a disruption occurs, the system is pushed into a "disruption mode," deviating from this optimal state and should strive to return to the initial steady state (Holling 1996; Ivanov 2023).

In contrast *social-ecological resilience* (Holling 1996) and the *adaptation-based view* (ABV) (Ivanov 2023) reject the idea of defining a fixed equilibrium state. Instead, social-ecological resilience emphasizes the importance of accepting that a system will change and adapt over time in order to maintain relevance in a changing environment (Walker 1969, referenced in Holling 1996; Wieland & Durach 2021). Thus, these perspectives of resilience do not merely view resilience as the ability to "bounce back" to a previous state but also to "bounce forward" through adaptation (Wieland & Durach 2021; Ivanov 2023).

According to both Wieland and Durach (2021) and Ivanov (2023), both views on resilience are relevant. However, they suggest that the assumption of an equilibrium state (engineering resilience) is more reasonable in the short term perspective, as SC structures typically remain stable over brief periods, making it reasonable to restore operations to their prior state. However, in the long term, external conditions may change, making a return to the previous state neither feasible nor desirable. For example, economic, political, environmental, societal, or technological shifts can fundamentally reshape SC structures. Under an engineering resilience perspective, these companies should aim to restore their previous operations as soon as possible to return to the initial state. However, this might not be the optimal strategy. Consequently, in such cases, engineering resilience view can lead to the SC being rigid and an adaptations-based view may be more suitable (Wieland & Durach 2021).

Given the increasing frequency and severity of disruptions (Polyviou, Ramos & Schneller 2022) and the accelerating pace of structural SC changes, this thesis will adopt a definition of resilience that includes both recovery to an initial state and adaptation to an improved state of performance. In this context, resilience is the ability of a SC to recover and improve its SC performance following a disruption (Sheffi & Rice Jr 2005).

Furthermore, the level of resilience depends on the organization's capabilities across different disruption phases. Sheffi and Rice Jr (2005) identifies four key phases: *preparedness*, *response*, *recovery* and *growth*. The preparation phase includes activities related to attempts to foresee and prepare for different disruptions in order to minimize the effects on performance (Sheffi & Rice Jr 2005) as well as pre-design of responses (Ivanov 2023). According to Ivanov (2023), this phase plays a crucial role in determining the extent of performance degradation caused by a disruption alongside the scale of the disruption itself. If a disruptive event then occurs, the company transfers into a *response* phase. In the response phase, the company tries to control the initial situation, take actions and prevent further damage (Sheffi & Rice Jr 2005). After the initial response to the disruption, the *recovery* phase is initiated. This period includes actions taken to try to improve the performance either back to original state or to an adapted better state than before the disruption, by for example involving suppliers, redirecting resources or alternating transportation modes. During disruptive events, SC resilience capabilities should aim to minimize both the time and cost impacts on overall performance (Tukamuhabwa et al. 2015). Lastly, the long-term impact of a disruption can vary depending on its severity. In the worst cases, a company may face a lasting shortfall, never fully returning to its original levels, while in other cases, it may adapt and grow beyond its previous state (Sheffi & Rice Jr 2005). The phases of preparedness, response, and recovery directly align with proactive and reactive SCRM. Proactive SCRM as well as proactive elements of reactive SCRM, such as predesign of responses, are critical for the level of preparedness. Furthermore, reactive SCRM is crucial during response and recovery phases to minimize disruption impact.

Considering these perspectives, this thesis defines SC resilience as a SC's *adaptive capability to prepare for and respond to disruptions, recover in a timely and cost-effective manner, and ideally progress to an improved post-disruption state* (Tukamuhabwa et al. 2015). This definition acknowledges the interdependence between resilience and SCRM. A SC's ability to withstand and adapt to disruptions is fundamentally shaped by its proactive and reactive SCRM capabilities. Figure 2.3 illustrates the key elements of SC resilience, showing how the post-disruption performance is determined by capabilities across the preparedness-, response-, and recovery phases, visualizing that both proactive and reactive SCRM is critical to achieve high SC resilience.

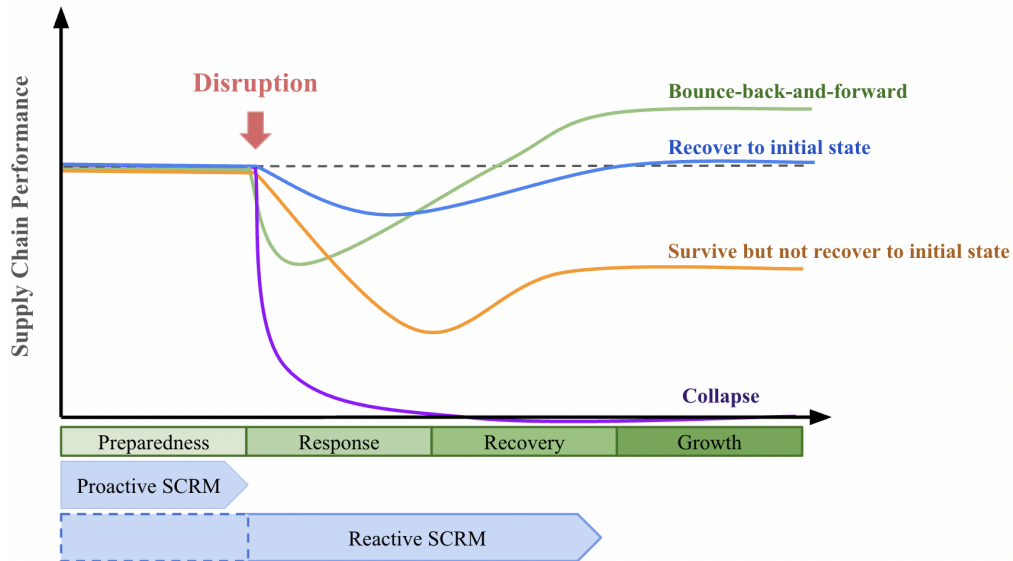


Figure 2.3: A visualization of the elements of SC resilience. (inspired by Sheffi & Rice Jr 2005).

2.1.3 Summary of Applied Definitions of Key Terminology

The applied definitions are presented in Table 2.1, along with the source of definition.

Table 2.1: Definitions of key terms establishing the theoretical foundation of the report.

Key terminology	Applied definition	Source of definition
Risk	<i>The product of the multiplication of the probability of a given event and the potential impact of that event.</i>	Christopher and Peck 2004
RM	<i>The decisions and implementation of processes associated with handling risks.</i>	Norrman and Jansson 2004
SC	<i>The network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer.</i>	Christopher 2011
SCM	<i>The systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the SC, for the purposes of improving the long-term performance of the individual companies and the SC as a whole.</i>	Mentzer et al. 2001
SCRM	<i>Supply Chain Risk Management is the procedures of, with a structured process, and with the aid of the internal implementation of tools, techniques and strategies as well as of external coordination and collaboration with SC members, reduce vulnerability and ensure continuity coupled with profitability, leading to competitive advantage.</i>	Altered definition by Fan and Stevenson 2018

Proactive SCRM	<i>A SCRM approach that aims to identify, assess, mitigate and monitor potential SCRs before they occur, reducing their likelihood and/or their impact through preventive measures.</i>	Fan and Stevenson 2018; Kilubi 2016
Reactive SCRM	<i>A SCRM approach that focuses on responding to and minimizing the consequences of disruptions after they have occurred, often relying on pre-established arrangements and plans to enable a rapid and flexible reaction.</i>	Kilubi 2016
SC Resilience	<i>The adaptive capability to prepare for and respond to disruptions, recover in a timely and cost-effective manner, and ideally progress to an improved post-disruption state.</i>	Tukamuhabwa et al. 2015

2.2 The Proactive SCRM Process

Existing literature agrees that organizations should divide their SCRM efforts into steps in order to be systematic and effective. However, how researchers divide the process differs. Fan and Stevenson conducted, in 2018, a literature review based on 354 papers regarding the topic of how the SCRM process should be defined. The concluded division consists of *identification*, *assessment*, *treatment* (also referred to as *mitigation*), and *monitoring* of SCRs (Fan & Stevenson 2018). These stages will be further explained in this section. Note that some relevant tools that support each step of the process are exemplified. However, a more detailed discussion of these and other suggested tools will be provided in Section 2.4. Figure 2.4 provides a brief overview of each step in the proactive SCRM process and outlines their specific objectives for ensuring effective implementation.

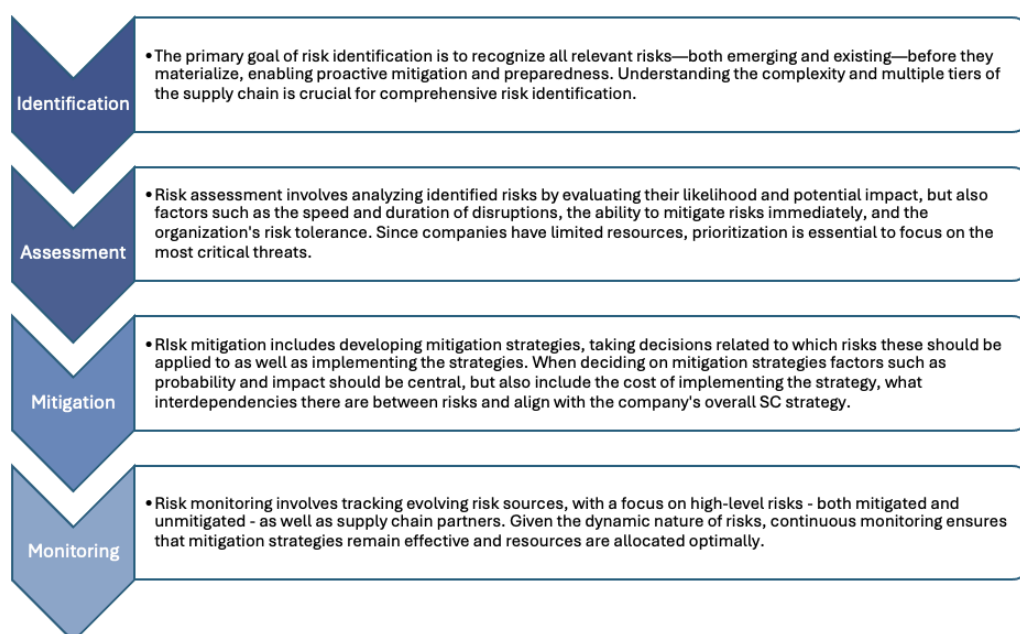


Figure 2.4: The four stages of proactive SCRM and their main objectives. Summarized by information in chapter 2.2.

2.2.1 Risk Identification

Risk identification is the first step of the proactive SCRM process. The step is essential in order for success in subsequent stages and therefore for the achievement of the SCRM objectives. If the identification of risks are not carried out thoroughly and relevant risks are overlooked, organizations can not take proactive measures to mitigate them (Kern et al. 2012). Research also shows that the later a disruption is detected or anticipated, the more severe its consequences tend to be (Kern et al. 2012). Therefore, the primary goal of risk identification is to identify all relevant risks before they materialize in order to be able to take measures to mitigate them and to be more prepared on what kind of disruptions they might be facing in the future (Fan & Stevenson 2018).

SCRs that should be identified can be of varying nature. Some risks, such as a labor strike, natural disasters or cyber attacks can disturb the material-, information- and/or the financial flow in the SC. Meanwhile, some risks such as governmental policies and environmental incidents do not affect the SC flow but rather influence the reputation of the organization and therefore indirectly have implications on the SC (Polyviou, Ramos & Schneller 2022). Norrman and Olhager (2023) present a list of risk types which are relevant for companies to cover and which will be adopted in the thesis as a foundation to understand what risks the practitioners SCRM process succeed to cover. The categorization of risks, presented in Table 2.2, includes a large range of risks and gives useful examples risk factors which to a large extent correlates with categorizations suggested by other researchers (Harland, Brenchley & Walker 2003; Manuj & Mentzer 2008; Christopher & Peck 2004; Ho et al. 2015; Tummala and Schoenherr 2011). In addition to Norrman and Olhager (2023), geopolitical risks are a relevant risk type which includes areas of political, military, economic and social due to a nation's engagement in global affairs. This risk type is also included in Table 2.2 (Geopolitical features n.d.)

Table 2.2: Summary of key supply chain risk categories.

Risk areas	Risk types	Risk factors
Macro risks	Economical	Exchange and interest rates changes
	Geopolitical	Wars, terrorism, trade wars
	Environmental	Natural disasters, pandemics
	Infrastructural	Poor infrastructure
	Social	Labor strikes, activism
	Legal/Political	Change in laws, import and export regulations
Network risks	Supply risks	Limited available suppliers and capacity
Internal risks	Cooperation risks	Cultural differences, poor communication
	Financial risks	Supplier credit risk
	Contractual risks	Contractual and legal disputes
	Logistical risks	Delivery reliability
	Operational risks	Equipment breakdowns, poor work skills
	Quality risks	Poor product quality, lack of quality control
	Security risks	Cybersecurity
	Sustainability risks	Contamination, unsafe work environment
	Technology risks	Incompatible or unreliable IT systems

In order for organizations to achieve the mission of identifying all relevant risks, it is beneficial to have a systematic and comprehensive approach. This will enable the organizations to be both resource-efficient and thorough (Fan & Stevenson 2018). Kern et al. (2012) suggests to structure the search by initially narrowing the search scope by defining observation fields that focus on known risk sources and vulnerable areas within the unique SC. These areas are often more easily pinpointed if the organization understands what drives risk in the SC. *Risk drivers* are factors that influence either the probability, impact, or both aspects of a risk. For example, companies with efficiency-focused strategies often aim to be lean by minimizing inventory, which can increase the likelihood of disruptions as late deliveries are more likely to cause stockouts (Fan & Stevenson 2018). Consequently, the executives should search for risks which can arise from the chosen SC strategy. Similarly, reducing the supplier base or centralizing production and distribution can amplify the risk impact, as potential disruptions may lead to more severe consequences. For instance, a fire in a central warehouse or bankruptcy of a critical supplier can significantly impact companies that rely entirely on those SC nodes. Other structural characteristics in modern SC, such as globalization and higher levels of outsourcing can also uncover vulnerabilities. These SC trends increase the SC complexity and increases the exposure to risk which in turn is raising the probability of disruptions (Jüttner, Peck & Christopher 2003). Other drivers of risk which highlight SCRs are lack of trust, insufficient information sharing and standardized contracts (Sinha, Whitman & Malzahn 2004). There are tools which can be used to identify these risk drivers and areas of vulnerabilities in the SC including *SC mapping* (Polyviou, Ramos & Schneller 2022) and *Check-sheets* (Tummala & Schoenherr 2011).

However, there are tools which can serve other purposes in the process of risk identification, which will be presented later in the text. As SCs have become increasingly complex and intricate, many organizations face limited visibility into risks across the SC. Different management levels perceive risks differently, and case studies show that firms often see less than 50 percent of the risks that could impact them. Additionally, as SCs become more virtual, this visibility gap is expected to widen, making the SCRM process increasingly difficult (Harland, Brenchley & Walker 2003). Therefore, companies can also need help with identifying more abnormal risks that they have not yet experienced. Then tools which focus on facilitating the process of brainstorming can be helpful. An alternative approach for identification is by using tools which focus on identifying risks by uncovering the logical relations between causes of risks and effects and consequences of these. By using visual mapping of these interconnections, SCRs can more easily be detected (Polyviou, Ramos & Schneller 2022).

2.2.2 Risk Assessment

The second step of the proactive SCRM process is risk assessment. This step aims to analyze the identified risks and evaluate the probability of occurrence as well as the impact it could have on the organization (Polyviou, Ramos & Schneller 2022). The risks are then compared based on these two factors and prioritized accordingly. The assessment is crucial as companies rarely have resources to mitigate all risks (Fan & Stevenson 2018). By systematically assessing and prioritizing risks, organizations can allocate limited resources effectively, ensuring that management focuses on the most critical threats (Norrman & Jansson 2004; Kern et. al 2012).

The initial assessment of the risks should aim to give a correct and thorough understanding of the risks that have been identified. Thus, sufficiently detailed information regarding risk type, the possible risk sources, at what stage in the life cycle the risk is likely to be realised (Harland, Brenchley & Walker 2003), its likelihood of occurrence and the potential impact should be investigated (Kern et. al

2012). This kind of information is often collected using various methods, both qualitative and quantitative, with ranging levels of formality depending on the risk (Zsidisin et al. 2004). For example, the estimation of probability and impact of a risk can be done by assessing historical data, conducting quantitative decision analysis with estimated distributions of certain outcomes, using frameworks from case studies or more perception based methods such as expert interviews or using business intelligence data and industry-experience (Mentzer et al. 2001). It is suggested that the process benefits from combining both objective data and subjective perception as this can constitute a more robust while effective construction of the risks (Tsai et. al 2008 referenced in Fan & Stevenson 2018).

However, there will always be trade-offs between the exact accuracy of the assessment and the cost efficiency and many researchers and practitioners find it difficult to achieve a balance between the two factors (Zsidisin et al. 2004). Tang (2006) emphasizes the challenge of assessing risks associated with tiers beyond the closest stakeholders of the company due to lacking visibility and control. The greater organizational distance between the organization and a risk exposure surface, the more impractical and expensive it is to analyze (Tang 2006). Another perspective of the cost-effectiveness trade-off was experienced by Ericsson. The company experienced that it was difficult to internally communicate the meaning of impact and therefore achieve change within the organization. As a result, they simplified the measure of impact to a KPI only by focusing on financial impact, more specifically the *Business Interruption Value* (BIV) (Norrman & Jansson 2004).

Furthermore, another issue which can be experienced in the assessment stage is the lack of data which probability and impact estimates can be based upon. For some risks it is easy to find information both regarding the likelihood and the impact, either because the event has occurred previously or because the information is easily accessed externally. However, some risks are more difficult to quantify or have unavailable data. An example is trade compliance risks where penalties and other legal cases can be assessed, but where export administration might not want to share the probability of being penalised (Jones 2017). Additionally, the organizational level responsible for risk assessment can play a crucial role in determining the quality of the assessment. If the assessment is conducted in isolation rather than from a holistic perspective, significant risks may be overlooked. For instance, an event deemed unlikely at a local level could pose a serious threat when considering its cumulative probability across the entire global network (Harland, Brenchley & Walker 2003).

The next step of the risk assessment is prioritization of the risks (Fan & Stevenson 2018). This prioritization can be conducted by using suggested methods and tools in Section 2.4.2 and should be based on the estimated probability and impact (Fan & Stevenson 2018). However, the prioritization of SCRs should also take other factors into account. Such factors may be how fast a disruption can unfold, the duration of a potential disruption (Kern et al. 2012) if there is an opportunity to mitigate the risk immediately (Sinha, Whitman & Malzahn 2004) and the organization's risk tolerance (Polyviou, Ramos & Schneller 2022) Some organizations may be more willing to accept uncertainty in their decision making process than others. Lastly, the SCR inter-relationships should affect the prioritization (Fan & Stevenson 2018).

In order to achieve an effective prioritization it is important to understand the relationships between different risks. SC inter-relationships means that an impact of a risk often affects other risk-scenarios in a SC (Fan & Stevenson 2018). Sarker et al. (2016) highlight that mitigating one risk can, in some cases, increase other risks or even create new ones (negative dependencies). For example, a sourcing director at the divisional level may choose to reduce cost-related risks by replacing certain suppliers

with cheaper alternatives. However, this decision could simultaneously introduce new risks, such as compromised quality or misalignment with the company's vision of innovation, ultimately increasing innovation risks and jeopardizing the company's ability to remain competitive. On the other hand, some risks have positive interdependencies, meaning that mitigating one risk can simultaneously reduce others. To be effective and resource-efficient in the SCRM process, it is therefore favorable to prioritize risks that may result in reduced risks from other sources (Venkatesh, Rathi & Patwa 2015). The tools used in SCRM often evaluate each risk isolated and therefore does not take the complete risk situation into account. However, with technology development tools, such as Monte Carlo simulations, these more complex interdependencies can be simulated (Polyviou, Ramos & Schneller 2022).

2.2.3 Risk Mitigation

The third step of the proactive SCRM process is risk mitigation which includes developing mitigation strategies, taking decisions related to which risks these should be applied to as well as implementing the strategies. According to Tang (2006) few organizations actually take proactive measures to preclude disruptions. Few organizations want to invest money in actions that prevent a disruption that might not even happen (Tang 2006). It has also been shown that the manager's own perception of risk tends to shape the risk behavior of decision-makers (Jüttner, Peck & Christopher 2003). This subjectivity in the choice process of mitigation strategies can therefore also lead to inconsistent risk responses, where some risks may be underestimated or overlooked, making mitigation efforts less effective (Polyviou, Ramos & Schneller 2022). In order to confront this issue, decision-aiding tools can be used to choose suitable strategies. Examples of such tools are an elaborated version of the *Risk-Impact-Matrix* and *Portfolio Analysis* which are further explained in Section 2.4.1.

When making decisions on how to mitigate a risk, the risk assessment, including the probability and impact, should be central but there are also other factors that should be taken into account. Firstly, the choice of mitigation strategy is highly dependent on the financial constraints within the organization. There is a trade-off decision between the costs associated with mitigating the risk and the value it brings and it is impossible to take costly actions on all risks (Tummala & Schoenherr 2011). Additionally, it is important that mitigation efforts take the interconnections between risks, which have been identified in the stage of assessment, into account. Mitigation strategies should preferably target risks with positive dependencies in order to direct the efforts towards areas where they will be most effective (Fan & Stevenson 2018). Furthermore, the SCRM strategies must align with the overall SC strategy which in turn should fit with the corporate strategy (Manuj & Mentzer 2008). For example, industries like automotive manufacturing, which rely on just-in-time (JIT) manufacturing and delivery, have strategically minimized their inventories. These companies must prioritize mitigating the risks associated with low buffer stocks while ensuring their approach aligns with their overall strategy. Examples of measures are standardization of sourced parts, asking suppliers of critical parts to increase their inventory levels and make procurement across geographic regions independent to avoid that multiple partners are affected by for example natural disasters simultaneously (Polyviou, Ramos & Schneller 2022).

Lastly, an important consideration when selecting risk mitigation strategies is the need to tailor them to the specific characteristics of the supply chain. Jüttner, Peck, and Christopher (2003) highlight that decision-makers must understand the trade-offs involved. These include repeatability versus unpredictability, where efficient, repeatable processes may reduce flexibility; cost versus reliability, when choosing between low-cost suppliers and established ones; and centralized versus decentralized

decision-making, balancing control with responsiveness. Collaboration and information sharing can improve risk management but may weaken bargaining power or deter customers. Finally, the trade-off between redundancy and efficiency involves choosing between flexible excess capacity and lean operations that are more vulnerable to disruptions (Sheffi 2001).

2.2.3.1 Categorization of SCRM Mitigation Strategies

According to Norrman and Jansson (2004), mitigation strategies can be divided into groups according to the objective of the strategy. An organization could either choose to accept a risk or implement strategies with the aim to either avoid, transfer, share or reduce the risk (Norrman & Jansson 2004).

Risk acceptance means a company chooses not to avoid a risk but accepts its potential impact. The acceptable risk level depends on the organization's risk behavior and the risk context (Fan & Stevenson 2018). However, accepted risks should still be monitored to ensure they do not escalate beyond acceptable limits (Aqlan & Lam 2015). In that case they might reevaluate the type of chosen strategy (Polyviou, Ramos & Schneller 2022).

In contrast, *risk avoidance* involves eliminating the root cause of a risk to prevent disruptions (Ritchie and Brindley 2007), *risk transfer* aims to hand over the risk to another party, *risk sharing* involves distributing risk between parties, often through contracts or relationship development (Fan & Stevenson 2018) and *risk reduction* aims to lower risk to an acceptable level by decreasing its likelihood, impact, or both. Mitigation strategies can be implemented in multiple parts of the organization. Consequently, a good cross-functional collaboration is crucial (Polyviou, Ramos & Schneller 2022).

This categorization of risks is further complemented by a categorization based on *type of action*, suggested by Norrman and Olhager (2023) as it covers a broad range of strategies named by other authors (Kilubi 2016; Manuj & Mentzer 2008; Polyviou, Ramos & Schneller (2022) meanwhile providing clear practical examples, enhancing clarity on how to implement strategies in practice to achieve the intended objectives of the original categorization. This is presented in Table 2.3.

Table 2.3: Categorization and examples of SCRM mitigation strategies (adopted by Norrman and Olhager 2023), connected to overarching risk strategies. The connection between the two categorization has been made by using the examples given by Fan & Stevenson (2018), Jüttner, Peck & Christopher (2003), Manuj & Mentzer (2008), Norrman & Jansson (2004), and Polyviou, Ramos & Schneller (2022).

Risk mitigation strategy	Example	Explanations	Overarching strategy
Buffering	Increase inventory levels	Increase inventory levels, such as the safety stock, to minimize the risk of stock shortages	Risk reduction
	Increase capacity in e.g. production, storage, transports	Expand capacity in production, warehousing, handling, and transportation to enhance flexibility in case of unexpected disruptions	Risk reduction
Network design	Use multiple sourcing	Utilize multiple suppliers to mitigate SCRs associated with the performance of any single supplier	Risk reduction

	Use a geographically diversified sourcing network	Establish a geographically diverse supplier network to reduce exposure to location-specific risks	Risk reduction
	Use local sourcing	Opt for local suppliers to shorten lead times and minimize related uncertainties	Risk avoidance
	Outsource non-critical activities	Outsource non-essential operations to shift risk to external SC partners	Risk transfer
	Source from creditworthy suppliers	Partner with financially stable suppliers to safeguard against disruptions caused by supplier's liquidity issues	Risk reduction
	Insource as a result from make-or-buy decisions	Secure direct control over key suppliers or critical activities to manage associated risks more effectively	Risk reduction
	Select strategic stocking locations	Strategically position inventory to balance cost efficiency with high service levels	Risk reduction
	Use multiple transportation modes and routes	Develop a flexible transportation system by incorporating different modes, carriers, and routes to prevent disruptions tied to specific options	Risk reduction
Planning	Use postponement in e.g. production and payments	Postpone resource allocation and financial commitments where possible to maintain adaptability	Risk transfer
	Improve forecasting techniques	Enhance forecasting methods to improve decision-making accuracy	Risk reduction
	Use pricing and promotion to steer customer demand	Encourage customers to modify purchasing behaviors through pricing strategies and promotions to mitigate supply risks for specific components and products	Risk reduction
	Limit and/or adjust assortment	Consider supply constraints when making assortment decisions to minimize risks related to certain components and products	Risk avoidance
Standardization	Standardize processes, products and/or components	Streamline processes to reduce complexity and increase operational flexibility; similarly, standardize products and components to enhance adaptability	Risk reduction
Security	Improve data security	Strengthen data security measures to safeguard against external threats, such as cyber risks	Risk reduction
Collaboration	Information-sharing with SC partners	Share critical information with SC partners to improve visibility and facilitate more efficient decision-making	Risk sharing
	Invest in SC partner development for critical suppliers	Invest in the development of critical suppliers/components to enhance performance in these areas	Risk reduction
	Include SC partners earlier in product development	Involve suppliers early in the product development cycle to prevent issues later in the process	Risk reduction/risk sharing
	Use SC partners audits and scorecards to monitor performance	Implement supplier audits and performance scorecards to assess and track supplier progress	Risk reduction
	Coordinate decisions and actions with SC partners	Align decisions and actions across SC entities to optimize overall performance	Risk reduction

	Develop joint SC strategies with SC partners to ensure alignment	Collaborate with SC partners to develop coordinated risk mitigation strategies	Risk sharing
Contracts	Transfer risks through contracts, e.g. insurances and agreements	Utilize insurance policies to transfer a portion of the risk to insurers	Risk transfer
	Share risk with SC partners through contracts	Adapt contracts to reflect changes in the external environment and the actions of involved parties, ensuring risk is shared with SC partners	Risk sharing

2.2.4 Risk Monitoring

The last step of the proactive SCRM process is risk monitoring. The purpose of this stage is to track changes which affect identified risks (Polyviou, Ramos & Schneller 2022) and supervision of the SC partner performance in comparison to the commitments that have been made (Norrman & Jansson 2004). Polyviou, Ramos & Schneller (2022) further suggest that the monitoring phase should include evaluation and improvement of the SCRM process. However, these activities will be separated from monitoring and rather included in the organizational capability of *performance measurement* in Section 2.5.1.

In a constantly evolving risk environment, previously conducted risk assessments can quickly become obsolete. To ensure the risk register remains up to date, a structured monitoring process is essential (Fan & Stevenson 2018). This process should focus on high-level risks, including both mitigated and non-mitigated risks (Norrman & Jansson 2004). For non-mitigated risks, it is crucial to track potential changes in for example risk sources, probability, and impact to determine whether mitigation measures need to be implemented. Meanwhile, for mitigated high level risks, the monitoring process should verify whether the applied mitigation efforts have successfully reduced the risk to an acceptable level (Norrman & Jansson 2004). If the risk remains unacceptably high, organizations should refine their existing strategies or consider adopting entirely new approaches (Fan & Stevenson 2018).

To support risk monitoring, organizations can implement systems with a feature of *early warning signals*, which detect deviations in performance. When performance deviations are identified, these systems trigger alerts, implying that further investigation and potential corrective actions has to be made. The effectiveness of the risk mitigation efforts can be measured by using *KPIs and metrics* (Polyviou, Ramos & Schneller 2022).

The final aspect of monitoring involves tracking SC partners to monitor their developments against their commitments. At Ericsson, the process of supplier monitoring has been structured by using *the Spider-web* tool, which takes several development factors and time perspectives into account in order to get a complete view of the supplier situation (Norrman & Jansson 2004). This is particularly crucial for suppliers that provide sole-sourced or single-sourced materials, as they pose a significant risk of supply disruptions. For such suppliers, it is also essential to extend monitoring beyond the first-tier and assess risks further upstream in the SC (Polyviou, Ramos & Schneller 2022).

2.3 The Reactive SCRM process

As previously stated, SC managers will never achieve complete control of their SCs, regardless of how well prepared they are (Hoberg, Thornton & Wieland 2020). In order to handle risks that are impossible to predict or not prioritized for mitigation in the proactive SCRM process, it is essential for companies to have a reactive approach alongside their proactive efforts (Norrman & Wieland 2020). The goal of this reactive process is to enable early detection and a fast response to unforeseen disruptions, ensuring that normal operations can resume as quickly as possible. This approach helps minimize losses associated with disruptions and, in some cases, can provide the organization with a competitive advantage. A clear example of this can be seen in the previously described Albuquerque incident, where a small fire at a sub supplier of a critical component in their network led to large financial loss, where both Nokia and Ericsson relied on the same supplier. Nokia quickly reacted to the missing supplies and acted fast, detecting and responding to the disruption faster than Ericsson. Even before having complete information, Nokia had reached out to alternative suppliers, securing available backup supply. Meanwhile, Ericsson faced severe production disruptions due to a delayed response. Competitive advantages obtained during disruptions can be exploited in order to achieve increased market shares and hence have long term consequences for the late adopters. Therefore, it is also crucial that measures are taken fast once a disruption is discovered (Hopp, Iravani & Liu 2012). The Albuquerque incident triggered Ericsson to implement a reactive SCRM approach to enhance response speed and strengthen its ability to react effectively to disruptions (Norrman & Wieland 2020).

Hopp, Iravani and Liu (2012) suggests a reactive SCRM process of five steps including (1) *recognizing and initiating a response*, (2) *creating a disruption management team*, (3) *development of an initial plan*, (4) *revising the initial plan with consideration of new information* and (5) *evaluation and analysis of the reactive work in order to improve for future disruptions* (Hopp, Iravani & Liu 2012). These steps are illustrated in Figure 2.5.



Figure 2.5: A visualization of the reactive SCRM process.

According to Hopp, Iravani and Liu (2012), the first step in the reactive SCRM process involves recognizing a disruption and initiating an appropriate response. This initial response might for example include analyzing the number of suppliers and sub-suppliers in the affected area, evaluating manufacturing sites, and assessing the potential financial impact on sold products (Norrman & Wieland 2020). According to Sheffi (2015) it is often the more operational staff, handling day-to-day operations, which typically are the first to detect disruptions such as issues with material flows, unexpected components shortages or accidents.

However, detecting disruptions can be challenging due to the complexity and global dispersion of SCs. The authors specify three key factors that make disruptions difficult to detect. First, distinguishing a true disruption from normal SC variations can be difficult. For example, many organizations frequently experience late, damaged, or incomplete deliveries, but the majority of these deviations are day-to-day issues and not effects of disruptions upstreams. As a result, investigating

every minor deviation immediately is rarely cost-efficient. Instead, companies can benefit from monitoring key metrics and comparing them to predefined "normal" thresholds, allowing them to focus investigations only on significant deviations (Hopp, Iravani & Liu 2012). Additionally, proactive relationship building with SC partners and setting guidelines can incentivize SC partners to report incidents to a greater extent (Norrman & Jansson 2004). Secondly, understanding the root cause of a deviation is another challenge. Without thorough data collection on the origin of the variation, it can be difficult to determine whether the issue will resolve quickly or escalate into a major disruption. A late delivery, for instance, can originate from multiple causes, and SC visibility is often limited. However, proactive mapping of cause-and-effect relationships can help narrow down potential explanations and facilitate quicker decision-making. Lastly, ensuring that critical disruption-related information reaches the right person within the organization is essential. Without clear communication channels or a culture that encourages action, important variations may go unnoticed (Hopp, Iravani & Liu 2012). At Ericsson, the development of a reactive SCRM process has led to clearly defined roles, supported by structured tools and processes, where for example it is known who conducts an initial analysis to determine whether a response should be activated (Norrman & Wieland 2020).

The second step of the process involves assembling a cross-functional disruption management team. This team may also include representatives from external parties, such as suppliers, customers, and third-party logistics providers (3PLs), to ensure that all relevant stakeholders are involved (Hopp, Iravani & Liu 2012). At Ericsson, this so-called task force consists of members with clearly defined roles who can be activated on very short notice (Norrman & Wieland 2020).

The third step of the process includes that once the team is assembled, an initial response plan should be developed quickly. This plan may include, for example, reaching out to suppliers who could potentially provide backup supply if needed. The plan should then be continuously refined as new information becomes available, which is the fourth step of the reactive process. For instance, suppliers initially considered viable alternatives may turn out to lack the necessary capacity or be unsuitable for other reasons. This emphasizes the importance of flexibility in the plan of response. Organizations can improve their flexibility by conducting crisis simulations, allowing teams to practice decision-making under pressure. Furthermore, even if the most critical factor is having a well-structured approach in place to effectively manage and respond to such incidents, the process can benefit from proactive measures, such as strengthening relationships with SC partners to foster transparency and collaboration during disruptions (Hopp, Iravani & Liu 2012). Clear and effective communication to affected stakeholders in this stage is also a crucial aspect of reactive SCRM in order to protect the company's reputation (Norrman & Wieland 2020).

The final step of the reactive SCRM process is evaluation and learning for future improvement. The organization should systematically analyze the course of events related to a disruption to improve skills for future incidents (Hopp, Iravani & Liu 2012). At Ericsson, this has been formalized through structured "lessons learned" sessions, where disruptions are thoroughly analyzed and documented. The insights gained are then incorporated into proactive SCRM strategies. Additionally, Ericsson conducts regular cross-functional training sessions at multiple organizational levels to further strengthen its capabilities (Norrman & Wieland 2020).

2.4 Methods and Tools for SCRM

One of the critical factors in achieving the objectives of SCRM, reducing vulnerability, ensuring continuity, and maintaining profitability for a competitive advantage, is the internal implementation of

SCRM methods and tools. These methods and tools should aim to facilitate the proactive and reactive SCRM processes by providing structure and giving decision support. However, Fan and Stevenson (2018) suggest that a gap may exist between the more advanced methods developed in research and the simpler, well-established tools that practitioners tend to use. This hypothesis is supported by Norrman and Näslunds questionnaire (2016) as 48 percent of the respondents, Swedish company representatives, did not work with SC mapping at all, even if this is a frequently mentioned tool in literature (Polyviou, Ramos & Schneller 2022; Knemeyer, Zinn & Eroglu 2009; Norrman & Jansson 2004; Tummala & Schoenherr 2011; Harland, Brenchley & Walker 2003). Therefore, to build upon their research, this thesis will aim to cover a broad range of methods and tools, providing a theoretical basis for the outlook towards the industry. First, methods and tools used in either or both proactive and reactive SCRM will be presented. To collect the list of these tools, the primary sources that have been used are Polyviou, Ramos and Schneller (2022), Mitroff and Alpaslan (2003), Tummala and Schoenherr (2011) and Knemeyer, Zinn and Eroglu (2009). A summary of the tools and in which steps they are typically used is presented in Table 2.4. Furthermore, this will be followed by Section 2.4.4 which presents commonly used categories of SCRM IT softwares/platforms which provides a digitized version of some of the previously presented tools.

2.4.1 Methods and Tools for Proactive SCRM

SC mapping is a commonly mentioned tool in the step of risk identification in the proactive SCRM process (Polyviou, Ramos & Schneller 2022; Knemeyer, Zinn & Eroglu 2009; Norrman & Jansson 2004; Tummala & Schoenherr 2011; Harland, Brenchley & Walker 2003). It can help the organization to understand the division of responsibility and facilitate the identification of critical components, processes and nodes which ultimately will help with the identification of SCRs, specific for their SC (Polyviou, Ramos & Schneller 2022). A SC map should visualize the complete SC network and information regarding the flow of goods as well as financial and information flows (Tummala & Schoenherr 2011). This may include the suppliers and customers alongside their respective locations, transport modes and routes as well as 3PL providers (Polyviou, Ramos & Schneller 2022). Additionally, a map can entail key measures such as number of shipments and performance metrics (Harland, Brenchley & Walker 2003). An example of a SC map is presented in Figure 2.6.

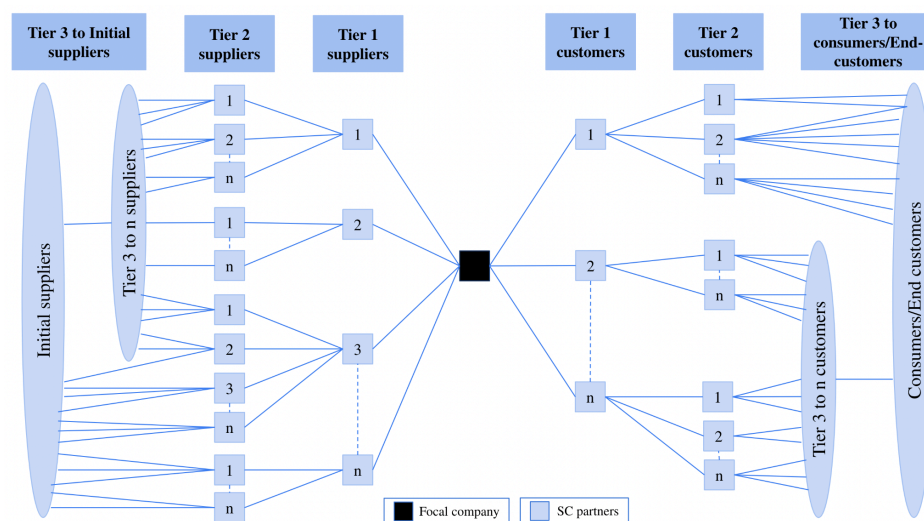


Figure 2.6: An illustrating example of how a SC map can look (Gardner & Cooper 2003, p.49).

Check-sheets is another tool which uses collected data, more specifically metrics, to identify

weaknesses in the SC and identify SCRs (Polivou et al. 2022; Tummala & Schoenherr 2011). A check-sheet tracks key metrics across the SC, helping the company identify problem areas and potentially pinpoint the root cause of risks, depending on which part of the SC the data relates to. For example, an organization can track late deliveries from suppliers in order to identify if there is a risk of late deliveries and/or if this risk is associated with certain suppliers (Tummala & Schoenherr 2011). Following up on KPIs can also be used for monitoring changes in behavior and therefore changes in risks as well as detection of disruptions in reactive SCRM. The collected data can also be used to create histograms to derive the distributions related to certain events. Thereby it can also be a useful tool for the assessment process (Polyviou, Ramos & Schneller 2022).

To make sure that commonly experienced SCRs are not overlooked in the identification process, *Check-lists* can be used as a safety measure (Polyviou, Ramos & Schneller 2022). A check-list is an internally produced compilation of SCRs that have been identified or experienced in previous projects or past risk identification processes. Utilizing such a list helps organizations share knowledge and experience both internally and across divisions. However, a checklist should not be used until the later stages of the risk identification process. Relying on it too early in the identification process may lead teams to focus only on known risks, potentially overlooking emerging risks or project-specific SCRs that require attention but which cannot be discovered in the historical collection of risks (Minnesota department of Transportation n.d).

Another tool which can be used to come up with relevant risks is *externally produced risk lists*. Such a list is often based on some kind of *risk categorization* with given examples which can serve as a structure which facilitates the risk identification and risk assessment processes. This thesis has adopted one way of categorizing risks in Section 2.2.1 Risk identification, but there is currently no research which has established which categorization approach is most effective. Some authors focus on identifying an extensive list of specific risk types and linking them to relevant examples and/or sources (Chopra & Sodhi 2004; Norrman & Olhager 2023; Tummala & Schoenherr 2011), while the other takes a broader perspective with less detail (Ritchie & Brindley 2007; Jüttner, Peck & Christopher 2003). Different categorization frameworks may be relevant for different companies as varying risk types are especially relevant for different companies (Fan & Stevenson 2018). However, as companies should aim to capture all relevant risks (Kern et al. 2012), their categorization framework should be designed to identify risks throughout the entire value chain, addressing both supply and demand aspects. Different categorization frameworks may suit different companies, but to ensure comprehensive coverage, companies should ensure to capture risks across the entire value chain, addressing both supply and demand dimensions (Kern et al. 2012).

To identify emerging project-specific risks and abnormal risks that organizations typically overlook (Tang 2006), tools that facilitate brainstorming can be helpful (Mitroff & Alpaslan 2003). Examples of such tools are *The Wheel of Crisis* (Mitroff & Alpaslan 2003; Knemeyer, Zinn & Eroglu 2009), and *Role play* (Mitroff & Alpaslan 2003). *The Wheel of Crisis* uses a setup similar to a conventional spinning wheel with seven sections, all representing a risk category which should be considered. The sections suggested are *personal crises*, *physical crises*, *economic crises*, *natural disasters*, *criminal crises*, *information crises* and *reputation crises*. It is used by a group where one person at the time spins the wheel. As the pin stops in one section, all possible risks within that category are discussed. Thereafter, the group decides on two abnormal crises which create a more improbable combination of crises. This is done with the purpose to make executives realize that abnormal crisis can often have a large impact. This can also help executives to link crises to the company or industry that they believed was very absent (Mitroff & Alpaslan 2003). An illustration of how a Wheel of Crisis can look is

presented in Figure 2.7. *Role play* involves employees being assigned the task to think as “internal assassins” and thereby use their internal knowledge of products, systems or processes in order to identify ways these can be harmed or destroyed. For example, employees can be asked to walk around on a production site after work hours to identify security risks. The change of attitude has shown to make a big difference to cover intentional man-made disasters (Mitroff & Alpaslan 2003).

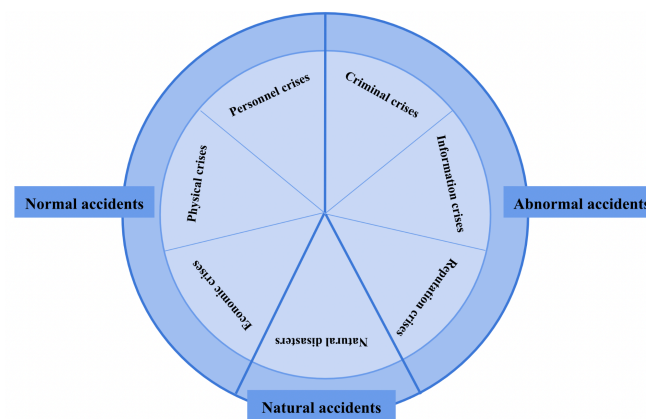


Figure 2.7: An illustration of a *Wheel of Crisis* (adapted by Mitroff & Alpaslan 2003, p.10).

The *Delphi method* is another method which can be used in teams. It is a meeting structure which can be used both in the step of identifying the most relevant SCRs (Polyviou, Ramos & Schneller 2022) and/or derivation of probabilities for certain risks in the stage of assessment (Knemeyer, Zinn & Eroglu 2009). The approach is based on a multi-round process where an expert group responds to a survey anonymously. Once answers are collected, the group receives all participants' answers and is then asked to answer the same survey again with this information in mind. The process is repeated until consensus is reached within the group.

Another suggested approach is to collect insights through *interviews* and *surveys* with external experts. The external input can complement as well as fill in gaps of knowledge regarding risks outside the organization's area of competencies. The collected information can regard all kinds of information including information on what SCRs are relevant or what likelihood and potential impact which should be assigned to certain risks. Therefore it is a relevant tool for both identification and assessment of SCRs (Polyviou, Ramos & Schneller 2022).

An alternative set of tools that can be used are methods which identify risks by understanding the logical relations between causes of risks and the effects and consequences of these. The literature suggests various tools to do this, including *Fault Tree Analysis (FTA)*, *Event Tree Analysis (ETA)* (Polyviou, Ramos & Schneller 2022; Tummala & Schoenherr 2011; Norrman & Jansson 2004) *the Bow-tie analysis* (Sphera 2023) and the *Ishikawa diagram* (also called *Fishbone diagram*) (Fan & Stevenson 2018; Poliyu et al. 2022; Paredes 2024). By using visual mapping of these interconnections, SCRs can more easily be detected. However, it must be taken into account that various factors often interact more than the diagram suggests due to its simplified and organized representation of complex information (Paredes 2024).

The *Fault Tree Analysis (FTA)* and the *Event Tree Analysis (ETA)* are similar in the way that both tools provide a graphical presentation of the interrelations between risks and their potential unwanted outcomes (Tummala & Schoenherr 2011). However, they are also in a way opposite to one another. The FTA is conducted by a deductive approach, meaning that the team first comes up with the

unwanted outcomes and thereafter works “backwards”, trying to understand potential causes. The aim is to examine the logic relationships between events and find all events and contributing factors which can cause the final outcome, see Figure 2.8. Meanwhile, the ETA is instead created with an inductive approach meaning that starts by stating potential initiating events and thereafter examines logical consequences. Then the focus is on identifying all potential disruptions that one risk can cause, see Figure 2.8 (Polyviou, Ramos & Schneller 2022). *The bow-tie analysis* combines the FTA and the ETA by connecting both potential causes and consequences to each event. It is constructed as a bow-tie, with the event in the middle, connected with potential causes to the left and consequences to the right (Sphera 2023), see Figure 2.9. Additionally, all three types of diagrams can be enriched by quantitative data of, for example, probabilities for certain events in order to estimate the probability of the final outcome, making them relevant for the assessment stage as well (Norrman & Jansson 2004). They can also include measures that the organization is already taking to manage the risks (Polyviou, Ramos & Schneller 2022).

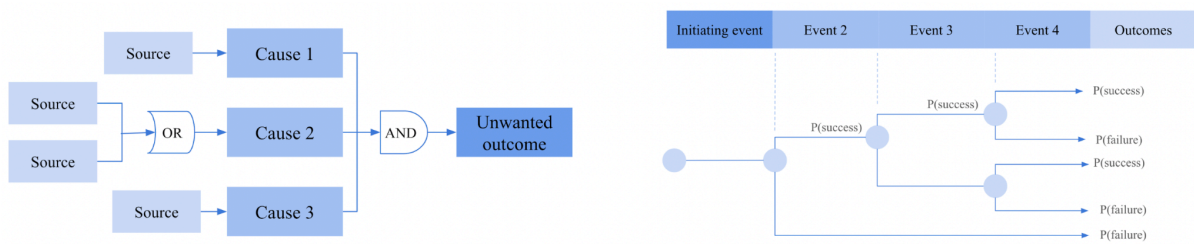


Figure 2.8: To the left, an illustration of a Fault Tree Analysis (FTA). To the right, an illustration of an Event Tree Analysis (ETA).

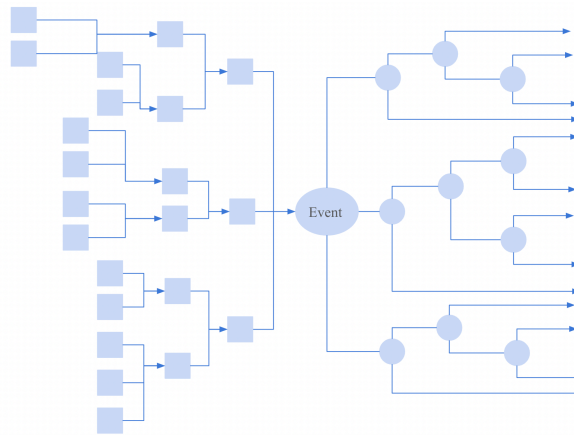


Figure 2.9: An illustration of a Bow-Tie Analysis.

The Ishikawa diagram, also known as the *Fishbone diagram*, is according to Fan and Stevenson (2018) commonly used by practitioners. It is another tool which connects potential causes to different events of SCRs. However, the Ishikawa diagram provides a somewhat more structured approach than the FTA, as the sources are linked to categories of risks. A common set of categories used is known as the 6Ms; Methods, Machines, People, Materials, Measurements, and Mother nature (the Environment). Thereafter, a team should brainstorm possible causes and impacting factors within each category (Paredes 2024). During the assessment phase, the possible causes can also be prioritized based on the assessment. However, the estimation of probability and impact is often conducted separately (Polyviou, Ramos & Schneller 2022).

Hazard and operability study (HAZOP) is another tool which investigates the cause-and-effect relationships to identify and assess risks, but with a more narrow scope of focus. A HAZOP is primarily used to assess risks related to industrial processes and facilities. The approach is divided into several steps which starts with identifying appropriate nodes in the *Piping and Instrumentation diagram* (P&ID Diagram) of the process (Bogdanovska & Pavlickova 2016). A P&ID is a detailed drawing of a processing plant, showing the pipes, equipment, instruments, and control systems involved in the process flow (EdrawMax n.d.). For each node, parameters such as flow, temperature and pressure can be identified. Thereafter, so called *guide-words* are coupled with each parameter, making up possible deviations. For example, the parameter flow can potentially be coupled with the guide words “no, more, less, reverse” resulting in four deviations that should be investigated. For each identified deviation, potential causes and consequences are then analyzed. Once all guide-words have been considered, the next parameter at the node is considered before moving to the next node in the system (Bogdanovska & Pavlickova 2016).

Lastly, risks can be identified with the help of *Failure mode and effect analysis (FMEA)* (Tummala & Schoenherr 2011). Failure mode and effect analysis (FMEA) is a tool mostly used to identify potential risks in manufacturing and in the customer usage-phase as the product is still in the design stage (Tummala & Schoenherr 2011). The method identifies both possible courses to failure for the product or process and the corresponding effects. The failures can thereafter be ranked according to frequency, severity and detectability (Polyviou, Ramos & Schneller 2022).

As previously stated, the step of assessment can be divided into two main parts; evaluation of the identified SCRs and prioritization of risks. The evaluation of SCRs is suggested to include estimation of the probability and impact of a risk (Fan & Stevenson 2018). Several of the presented tools for risk identification can, as described, also be used for assessment but these will be complemented by other relevant below.

Firstly, if data is available to estimate probability distributions for a parameter, for example, using *Check-sheets* or *KPIs*, Bayesian analysis is an effective approach for probability estimation (Polyviou, Ramos & Schneller 2022). If estimating probability distributions is not possible, research on historical events can still be useful. For example, the probability and impact of previous strikes and aircraft accidents can be investigated by looking back (Knemeyer, Zinn & Eroglu 2009). The historical assessments can thereafter be complemented by expert opinions on factors that might increase or reduce those numbers in the future. Another approach to integrate historical data with expert opinions is to have a group of experts estimate the frequency of an event over a past time period, as well as their projections for future occurrences. Once collected, the past estimates can be compared with actual historical data to identify any bias. This identified bias is then assumed to remain consistent for future predictions and is used to adjust the experts' estimates accordingly (Knemeyer, Zinn & Eroglu 2009).

Estimating the probabilities of intentional crime such as terrorism is often an issue for organizations as it includes rivaling actors which aim to either cause or prevent an event. Therefore, it is often quite different from the situation of estimating probabilities of accidents. For such situations, the tool of *game theory* can be useful in order to estimate the likelihood of an occurrence. This means that a “game” between the potential terrorist and the defender is created. The attacker will be making decisions based on the payoff and risk of an attack meanwhile the defender will try to hinder such an attack, but both parties are limited by budget constraints. By formulating objective functions for both

parties, the optimal strategy for each player can be identified which in turn can support an estimation of probability and impact of such an attack (Knemeyer, Zinn & Eroglu 2009).

Furthermore, Petronijevic, Etienne & Siadat (2022) states that it is the aggregated risk exposure of an organization that will be decisive regarding how well an organization will cope with risks. In turn, this aggregated risk exposure is determined by the interdependencies of risks (Sarker et al. 2016), highlighted in Section 2.2. To capture this aspect, scenario analysis such as *Monte Carlo Simulation* can be used. By using this method, the aggregated variation in a system can be determined. This variation is caused by the variations in the system for various inputs. Every input variable has a defined distribution, and has established relationships to the output variables (Polyviou, Ramos & Schneller 2022).

However, in the case that there is no historical data available to a SCR or challenging to assign a risk a specific absolute value of probability and/or impact, one suggested approach is to *combine expert judgements with the decision-maker's perspective* (Knemeyer, Zinn & Eroglu 2009). The method is based on the idea to break down an event into multiple contributing factors, making it easier to assess the likelihood of each factor individually. These probabilities are then aggregated into an overall risk estimate. By involving multiple experts in this process, a range of probability estimates will emerge, reflecting differences in opinion. The decision-maker then modifies their own initial assessment by selecting a probability within this range, but one that remains closest to their initial judgment (Knemeyer, Zinn & Eroglu 2009).

Another suggested approach is to implement a ranking system (Tummala & Schoenherr 2011; Norrman & Jansson 2004; Knemeyer, Zinn & Eroglu 2009). A *ranking system* can be used to assess and prioritize risks, based on categorizing risks according to predetermined ranges of frequency and impact-levels (Tummala & Schoenherr 2011). Examples of predetermined levels are presented in Figure 2.10. Each level is accompanied by a qualitative description that helps assess how frequently a risk is expected to occur. For instance, a risk can be considered to occur *often* if it is assessed to occur once a week. Based on this classification, the risk is assigned one probability index and one consequence index, each between one and four. The overall *risk exposure value* is then determined by multiplying the probability index and the consequence index. This method allows organizations to prioritize risks more effectively, ensuring that those with the highest exposure values receive the most attention, while lower-scoring risks may be seen as more acceptable (Tummala & Schoenherr 2011).

Impact severity level	Qualitative description	Risk consequence level	Probability categories	Qualitative description <i>The identified risk factor could occur on an average of...</i>	Risk consequence level
Catastrophic	Plant shut down for more than a month due to lack of components with zero safety stock levels	4	Often	...once per week	4
Critical	Slow down of process or plant shut down for one week due to lack of components with zero safety stock levels	3	Infrequent	...once per month	3
Marginal	Decreased service levels with depleting safety stocks	2	Rare	...once per year	2
Negligible	Service levels not impacted due to sufficient safety stock levels	1	Extremely rare	...once per decade	1

Impact severity level	Probability			
	Often (Index=4)	Infrequent (Index=3)	Rare (Index=2)	Extremely rare (Index=1)
Catastrophic (Index=4)	16	12	8	4
Critical (Index=3)	12	9	6	3
Marginal (Index=2)	8	6	4	2
Negligible (Index=1)	4	3	2	1

Figure 2.10: An illustration of a two-dimensional ranking system without requirement of information of absolute values (Tummala & Schoenherr 2011, p.478-479).

The last steps of the ranking procedure, when the risks are compared based on both measured variables in a two-dimensional matrix, is very similar to an *Impact-Probability matrix*, illustrated in Figure 2.11. The *Impact-Probability matrix* is one of the most commonly referred to RM tools, used for prioritization of risks, regardless if the two dimensions are based on absolute values or on relative comparisons (Polyviou, Ramos & Schneller 2022). The x-axis represents the impact of a risk and the y-axis represents the probability of the risk.

An extended version of the probability-impact matrix, also seen in Figure 2.11, includes decision-support on what mitigation strategies should be applied to what risks, depending on their respective probability and impact (Fan & Stevenson 2018). According to Aqlan and Lam (2015), risk acceptance is suitable for risks with low probability and low impact. Such types of risks can for example be malfunctioning of non-critical equipment or port congestion (Polyviou, Ramos & Schneller 2022). Risk avoiding strategies should be applied for risks with a high probability and high impact, as these kinds of risks can justify substantial investments (Fan & Stevenson 2022; Manuj & Mentzer 2008; Polivou et al. 2022). For risks that appear to have a low probability but a high impact, such as natural disasters or terrorist attacks, risk transfer or risk sharing are often appropriate treatment types (Aqlan & Lam 2015). Risk sharing is often conducted with the aim to reduce cost meanwhile attaining higher customer service levels (Fan & Stevenson 2018). Lastly, Aqlan and Lam (2015) highlights that risk reduction is especially appropriate for operational risks with high probability but low impact as it can make a great difference over time.

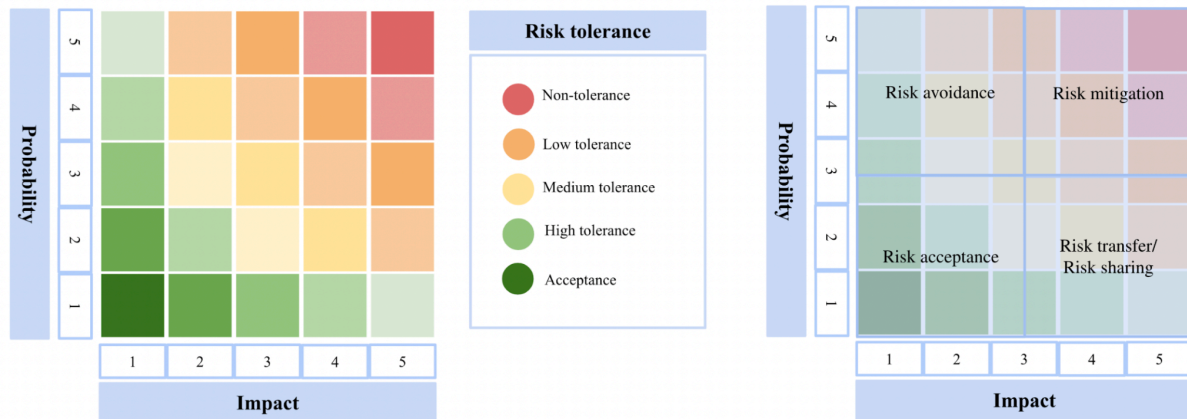


Figure 2.11: To the left, an illustration of the Probability-Impact matrix (Polyviou, Ramos & Schneller 2022, p.39). To the right, an illustration of the extended Probability-Impact matrix (Fan & Stevenson 2018, p.217).

Other prioritization tools are *Analytical hierarchy process (AHP)* (Zahra et al. 2024), *Hazard Totem Pole analysis (HTP)* (Tummala & Schoenherr 2011) and the *Spider web tool* (Norrman & Jansson 2004). Furthermore, *Portfolio analysis* (Polyviou, Ramos & Schneller 2022) can be used for both prioritization and for decision support of mitigation strategy.

The *Analytic Hierarchy Process (AHP)* is a decision-making tool used to prioritize and evaluate complex problems by structuring them into a hierarchy of criteria and alternatives. Its main purpose is to provide a systematic approach for decision-makers to weigh different factors, particularly when both verbal qualitative judgements and quantitative aspects must be considered. In the SCRM process such criterias that should be taken into account may include probability, impact, detection severity etc. These criterias are then pairwise compared using a relative scale (1-9) to determine each criteria's relative importance and giving each criteria a numerical weight-factor. Different risks are then assigned values for each criteria and a final score taking the criteria weights can be calculated. This final score will then help the organizations rank and prioritize their risks (Zahra et al. 2024).

A *Hazard Totem Pole analysis (HTP)*, presented in Figure 2.12, similar to the AHP, takes several factors into account when prioritizing risks. In addition to the impact and probability, the implementation cost of mitigation is taken into account in order to support the decision on what risks that should be prioritized. The idea of HTP is an extension of the previously mentioned ranking system, where an aggregated risk exposure score will be complemented by a letter code, where each letter entails information of the included probability, impact and implementing cost. The system is based on the idea that in addition to a number index of one to four, a risk is assigned a letter corresponding to each category it is placed into. Then, a diagram including the sum of the three indexes, the risk factor code and the cumulative implementation cost is included. The mitigation efforts can then be directed towards risks with high scores with regard to available resources. If one risk is associated with significant costs which exceed the budget constraints, other less likely or less severe risks might be prioritized instead (Tummala & Schoenherr 2011).

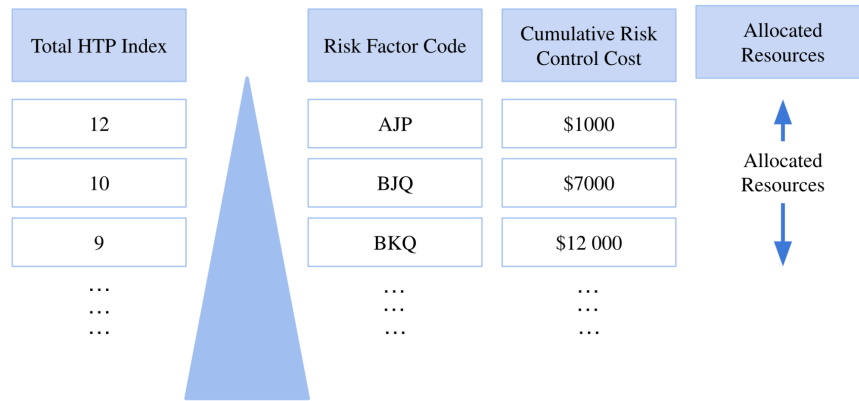


Figure 2.12: An illustration of how HTP analysis can be used for assessment of which risks to prioritize and mitigate (adapted by Tummala & Schoenherr 2011, p.481).

In a *spider web diagram*, visualized in Figure 2.13, multiple parameters can be assessed and summarized alongside different time horizons which imply that also the forecasted development can be captured. This makes the tool particularly useful for summarizing complex information, such as monitoring supplier performance against their commitments (Norrman & Jansson 2004) or risk assessments that consider multiple factors.

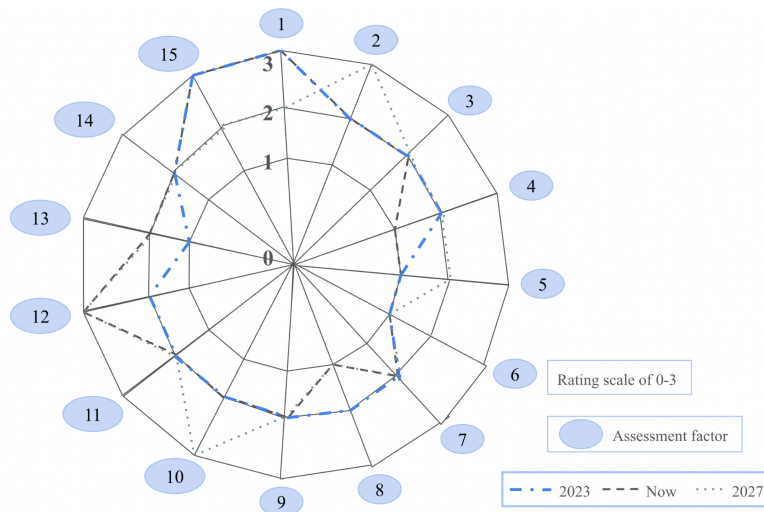


Figure 2.13: An illustration of a spider web tool (adapted by Norrman & Jansson 2004, p.447).

A *Portfolio analysis* is a tool for prioritisation and choice of mitigation strategy more specifically used for segmentation of specific sourced items (Kraljic 1983). Organizations can in addition to certain risks identify certain suppliers and customers which the organization should prioritize to direct their efforts towards. This can be done by conducting a portfolio analysis which evaluates goods and services (Polyviou, Ramos & Schneller 2022). The portfolio analysis matrix, suggested by Kraljic (1983) sorts goods and services with regard to their “profit impact” and “sourcing complexity”. The “profit impact” can be evaluated by using metrics such as relative spend, its impact on product quality or its impact on business growth to name a few. The “sourcing complexity” can be evaluated by looking at factors including available suppliers in the market, substitution possibilities, complexity of material requirements, geographical locations of suppliers etc (Kraljic 1983; (Polyviou, Ramos & Schneller 2022). The goods and services are thereafter placed into the matrix according to the assessment and will depending on this be grouped into one of the four categories “leverage items”,

“strategic items”, “non-critical items” and “bottleneck items” (Kraljic 1983). For each category of goods, certain generic strategies have been identified which are presented in Figure 2.14. Therefore, the tool can facilitate both identification, assessment and mitigation practices.

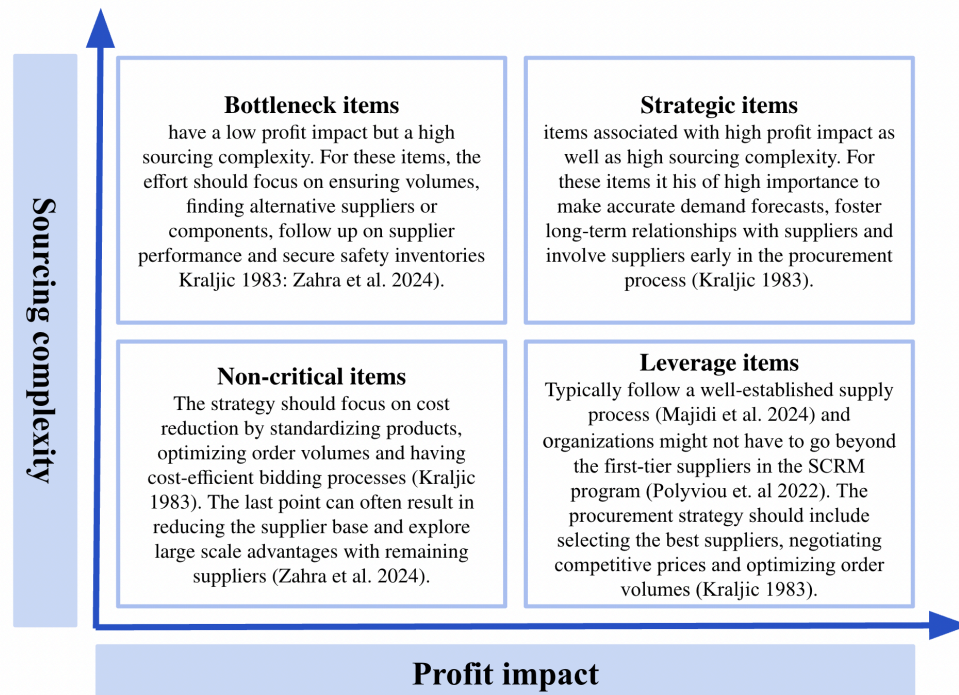


Figure 2.14: An illustration of a Portfolio analysis (Kraljic 1983, p.111 with included information from Kraljic 1983, Zahra et al. 2024 and Polyviou, Ramos & Schneller 2022).

An organization can also set up indicators which detect certain metrics which represent a certain risk, so called *Early warning signals*. Then, if a SCR is deviating from accepted levels, notifications can be sent in order to inform the organization of the need to investigate the causes. For example, one can use product complaints as an indicator of issues (Polyviou, Ramos & Schneller 2022).

2.4.2 Methods and Tools for Reactive SCRM

Since reactive SCRM focuses on responding to incidents after they occur, the need for tools is more limited compared to proactive SCRM. However, given that the success of the reactive approach heavily depends on the speed of response, certain proactive measures can significantly enhance its effectiveness (Hopp, Iravani & Liu 2012).

For instance, companies can use various methods to increase their ability to detect disruptions. Sheffi (2015) suggests six data sources which can help discover disruptions in an early stage. Firstly, monitoring of weather data can help anticipate natural disasters and severe storms that could impact operations. Secondly, tracking news and incident monitoring services may keep companies informed of fires, civil unrest, infrastructure issues, and geopolitical events that may disrupt SC. This can further be enhanced by monitoring of social media platforms which can provide real-time updates and crowd-sourced information about emerging disruptions or crises in specific locations. Additionally, tracking of regulatory developments and government policy changes can increase the ability to quickly respond to new tariffs, restrictions, or compliance requirements which can affect sourcing, production, and deliveries. Furthermore, tracking of sensor data of own assets, such as in-store sensors, GPS trackers on vehicles and containers, and shipment monitors, can help detect blackouts, delays, theft, or other anomalies in real time. And lastly, direct communication with suppliers,

including monitoring for financial and operational warning signs and conducting regular site visits, can help companies identify early risks and maintain strong supplier relationships (Sheffi 2015). In order to use the gathered information from these data sources, companies can implement tools which analyze the detection related data.

Once a disruption is identified, gathering critical information, such as affected SC partners and potential financial impact, is crucial for assessing its severity. Pre-established evaluations, such as *SC mapping* and *cause-effect diagrams*, can streamline this process (Hopp, Iravani & Liu 2012). This can for example be seen through an online tool, which integrates tools like SC mapping with Google Earth and links to sourcing's risk database, enabling quick access to relevant information (Norrman & Jansson 2004). Furthermore, pre-assessed SC partner evaluations, such as *Portfolio Analysis*, can provide valuable insights when for example quickly trying to identify potential backup-suppliers (Norrman & Wieland 2020).

A key aspect of reactive SCRM is ensuring that the organization is prepared to mobilize quickly and that responsibilities are clearly defined. While rapid decision-making is essential, making the wrong decisions can be costly. Therefore, regular *training and simulations* can strengthen response capabilities (Hopp, Iravani & Liu 2012). Norrman and Wieland (2020) also highlight that training and scenario analysis play a key role in maintaining a strong risk culture. These efforts help foster an organization that remains alert and proactive in identifying and responding to potential risks. Meanwhile Ericsson develops training material internally (Norrman & Wieland 2020), there are companies such as 4C Strategies which offer crisis management training. Mitroff and Alpaslan (2003) further suggest involving external parties, such as journalists, lawyers, or consumer affairs experts, to stage hypothetical crises. This approach helps employees identify weaknesses, test response strategies, and gain a deeper understanding of potential crisis scenarios. They claim that external parties provide an unbiased perspective, allowing executives to better anticipate and prepare for real-world disruptions (Mitroff & Alpaslan 2003).

2.4.3 Summary of Proactive and Reactive Methods and Tools

Table 2.4 presents a summary of all the methods and tools described.

Table 2.4: Overview of available SCRM methods and tools, including their areas of application.

Method & Tool	Proactive				Reactive
	Ident.	Assess.	Mit.	Mon.	
SC mapping					
Check-sheets diagram					
Check-list					
Wheel of crisis					
Role play					
Risk categorization					
Delphi method					
Interviews & surveys with external experts					
Fault Tree Analysis (FTA)					
Event Tree Analysis (ETA)					
Bow Tie Analysis					
Ishikawa diagram (Fishbone diagram)					
HAZOP					
FMEA					
KPIs					
Bayesian Analysis					
Basic analysis of historical data					
Game Theory					
Monte Carlo Simulation					
Ranking systems					
Analytical hierarchy process (AHP)					
Hazard Totem Pole (HTP)					
Spider Web Tool					
Probability-Impact Analysis					
Portfolio Analysis					
Early warning signals					
Training & Simulation practice					

2.4.4 SCRM IT-tools

Most of the tools presented in the previous section can be used independently of specific software or IT platforms. However, integrating a dedicated platform or software into the SCRM process can significantly enhance efficiency by simplifying team coordination, streamlining data management, and providing structured workflows. Additionally, systems often offer features and integration of systems impossible to achieve without digitalization¹.

The SCRM Software Market is expected to grow significantly in the coming years, driven by increasing demand for risk mitigation and business continuity solutions. The primary growth drivers for software solutions in particular are the adoption of AI and machine learning, the integration of SCRM software with existing ERP systems and the availability of cloud-based solutions, mobile applications and real-time data analytics (Market Research Focus 2025). For example, AI can be used to collect relevant data from open media sources in order to support the monitoring of risks (Everstream Analytics n.d.). The monitoring process can also be facilitated by seamlessly incorporating information regarding supplier performance data which often is collected in the Enterprise Resource Planning (ERP) systems into RM platforms (Sphera n.d.). Some platforms also provide digitalized SC mapping, or geomapping (Kodiak Hub n.d.), which can connect real time supplier data to specific coordinates. Mobile applications can for example be used to reach a team with incident alerts and facilitate reactive incident responses and documentation of reporting (Sphera n.d.). A summary of the mentioned features are presented in Table 2.5.

The features mentioned above are only examples of what platforms used in SCRM processes can include. Moreover, different categories of platforms exist, each with its own primary focus and area of application. Some examples are platforms focused on *Governance, Risk and Compliance (GRC)*, *Risk Management (RM)*, *Business Continuity Management (BCM)*, *SC Planning*, *Supplier Risk Management (SRM)* and/or *Resilience*².

Table 2.5: Summary of key IT platform features that support SCRM activities.

Features in IT-platforms which can facilitate the SCRM work
Integration of the SCRM IT system with other enterprise systems (e.g., ERP systems)
Automated monitoring of open-source media which can affect risks and/or cause disruptions
Real-time incident alerts and early warning notifications
Functionality to document reports and SCRM-related communication
SC mapping and geolocation tools linking supplier data to specific geographic coordinates
Real-time data tracking of SC data

¹ Ansgar Toscha, Principal Consultant, 4C Strategies. Interview 2025-02-26.

² Ansgar Toscha, Principal Consultant, 4C Strategies. Interview 2025-02-26.

2.5 The Organizational Aspect of SCRM

2.5.1 Key Factors in Ensuring an Effective SCRM Process

A broad literature review on SCRM papers conducted by Guerra et al. (2024) identified eight key factors that organizations must address to ensure an effective SCRM process. These factors relate to the characteristics, capabilities, and procedures essential for successful implementation. While they are crucial for strengthening SCRM, they also present significant challenges that organizations can find particularly difficult to overcome (Guerra et al. 2024).

The first factor is *formalization*, which is described as that the SCRM process needs to be structured and formalized effectively, by defining steps, roles, objectives and responsibilities (Guerra et al. 2024). Initially, it is important to assign roles, and can be beneficial to have a cross-functional team addressing SCRM. According to Van den Adel, De Vries and Van Donk (2023) cross-functional teams serve as an effective mechanism for facilitating information scouting, managing SC disruptions, and enhancing organizational resilience. The teams may consist of coworkers from departments such as quality, logistics, operations, supply management, finance, legal, engineering, or market managers. This team should then be the ones to identify, own, and manage risks that are affecting the company, as well as decide the scope of SCRM (Polyviou, Ramos & Schneller 2022).

Other key aspects of formalization can include establishing clear and efficient stakeholder communication and implementing scheduled SCRM activities (Polyviou, Ramos & Schneller 2022). Norrman and Wieland (2020) highlight the need for prompt, structured communication once a risk is identified. Thereafter, the frequency of certain actions can be important (Polyviou, Ramos & Schneller 2022), where SCRM activities can be conducted at regular intervals, such as annually, bi-annually, or quarterly, depending on the scope and risk level of the assessment (Norrman & Wieland 2020).

The second factor that is fundamental for implementing an effective SCRM process is *resources*. Adopting SCRM requires significant resources, in the form of human, technical, and financial ones. Human resources include allocating people experienced with working with RM and preferably having different backgrounds. Technical resources can include information systems, databases and tools. Financial resources refers to the need for an allocated budget for the RM process (Guerra et al. 2024). For example, it is of high relevance what the budget is for an organization to decide what type of risk strategies to adopt. For a firm with a relatively strict budget and limited resources, it is of extra importance for them to understand what strategies the resources can be deployed the best (Fan & Stevenson 2018).

Thirdly, *scope* is a key enabler of SCRM, as different risks can impact various parts of a company. To ensure effective SCRM, it must be integrated across the entire organization. Achieving this requires a holistic view of risks, with responsibilities and tasks distributed throughout the company (Guerra et al. 2024).

The fourth important enabler is *learning and culture*, focusing on that SCRM processes are not solely about tools and resources, but needs to be integrated into the company's core capabilities and culture. This can be obtained through developing skills and competencies for employees and fostering a SCRM culture (Guerra et al. 2024). One example highlighting this is Ericsson, where their SCRM has evolved through major disruptions, with events like the 2000 Albuquerque fire and the 2011

Fukushima disaster driving improvements. However, during stable periods, focus on SCRM has waned. This highlights the need to embed SCRM into corporate culture, ensuring continuous learning, training, and monitoring beyond crisis responses (Norrman & Wieland 2020).

Additionally, the fifth enabler focuses on *emphasis* on the SCRM, which can be perceived as challenging as it requires integration across all hierarchical levels of an organization. Companies can drive engagement through incentives and by recognizing SCRM as a value-generating strategy rather than just cost reduction. A holistic approach ensures its benefits are fully realized. Important actions that need to be taken are to define strategic goals and incentives connected to the process and need for participation on different hierarchical levels (Guerra et al. 2024).

Thereafter, the sixth enabler is *leadership support* is crucial for SCRM success, acting as a catalyst for implementation. Top management engagement ensures SCRM is prioritized, enabling better SCRM outcomes and long-term commitment (Guerra et al. 2024). Furthermore, effective SCRM requires top-down decision-making, as many risk mitigation measures, such as global information systems, cross-functional risk strategies, and SC restructuring, cannot be implemented at an individual or unit level (Norrman & Wieland 2020).

A seventh enabler is *involvement*, highlighting that SCRM is not solely about a single company, but the entire SC. Therefore, these parties need to be involved in the process of SCRM that affects both parties. Actions enabling this can include alignment of strategies, information sharing, and risk sharing with other parties (Guerra et al. 2024).

A final important aspect that companies can struggle to implement is *governance*. SCRM governance involves not only strengthening a company's own SCRM but also enhancing supplier capabilities through collaboration, certification, training, contractual requirements, and shared tools. Companies may use direct or indirect mechanisms such as joint performance metrics, financial support, and supplier development to improve overall SC resilience (Guerra et al. 2024).

Beyond these key areas described by Guerra et al. (2024), which are both critical and challenging for many organizations, implementing a ninth enabler, *performance measurement*, is crucial for assessing SCRM effectiveness and driving continuous improvement through targeted incentives (Polyviou, Ramos & Schneller 2022). Ericsson offers an illustrative example from their experience with the Japanese earthquake and tsunami. The company recorded its reactive mitigation activities, and analyzed them afterward for internal learning. This reflection identified opportunities for improvement in proactive measures, including processes, competencies, and organizational interfaces. As a result, previously overlooked areas were integrated into their SCRM framework. Additionally, they recognized the need for more effective tools to address disruptions involving multiple suppliers and identified gaps in customer communication strategies (Norrman & Wieland 2020). Concludingly, this aspect of monitoring gives an indication of the looping process of SCRM, where the results of the mitigation will give feedback to the previous steps in the process (Manuj & Mentzer 2008).

2.5.2 Maturity Model

Building a structured and effective SCRM approach requires organizations to assess their current capabilities and identify areas for improvement. To address this need, various methods for measuring a company's SCRM maturity have been developed, leading to extensive research on maturity models. These models can be considered as powerful tools, in order to understand where a company is in the

evolving process of SCRM, make comparisons and see next steps to improve (Guerra et al. 2024). What the maturity model shows is that when moving from a low maturity level to a higher level, the impact on business value increases when policies and procedures become implemented, defined, documented and assessed. An example of a maturity model can be seen in Figure 2.15 (Proença et al. 2017).

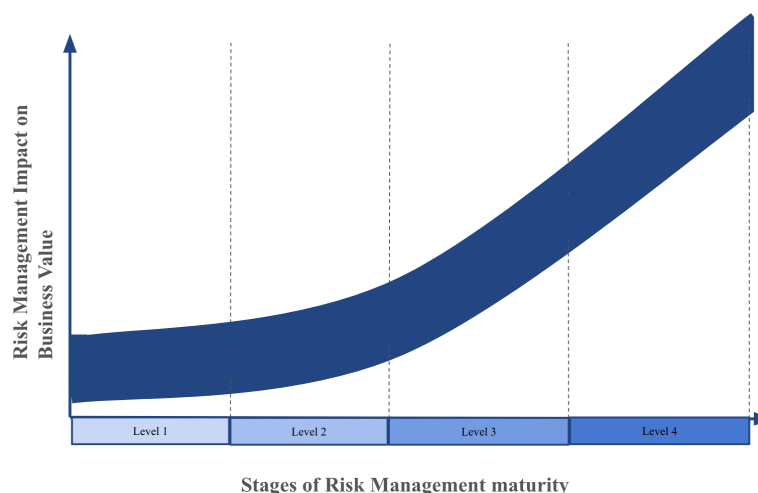


Figure 2.15: SCRM Maturity Model. Adapted from Proença et al. (2017, p. 105) and modified to reflect the four maturity levels defined by Guerra et al. (2024), as described below.

However, some models outline maturity levels without defining specific criteria, making it difficult for organizations to accurately assess their own maturity. To address this, Guerra et al. (2024) developed a maturity model incorporating eight critical SCRM factors from the previous section and established clear criteria for its four levels. Table 2.6 illustrates these criteria, providing a structured framework for assessment. Note that the ninth enabler, performance measurement, is not included in this since that was taken from another source which had not described it into four levels as Guerra et al. (2024) did.

Table 2.6: Framework for assessing an organization's position in the maturity model (Guerra et al 2024).

Risk areas	Level 1	Level 2	Level 3	Level 4
Formalization	There are no structured ways for processes, procedures, roles or responsibilities, and actions are reactive and improvised once a risk occurs. Documents, reports, tools, and indicators are either missing or not utilized	Some structured elements emerge, but practices remain inconsistent and largely influenced by past experiences rather than a disciplined approach	The RM starts to occur more consistently and routinely, with still room for improvement of the structure	RM actions are sufficiently and broadly formalized, with clear procedures, structured processes and given responsibilities declared even before a risk emerges, while still remaining adaptable to changes
Resources	Resources, whether human, technical, or financial, are scarce or entirely absent, resulting in that organization must improvise and reactively allocate resources at the timing when a risk appears	Resources are more available, but they may still be insufficient to meet even the lowest level of operational needs	The allocation of resources is sufficient for most of the needs of the organization	There are enough resources to fully meet the needs of the organization, and the changes in demand needs are reviewed periodically

Scope	The scope of the SCRM is extremely limited, focusing only on reactive and immediate responses after a risk has emerged	SCRM expands to include a small selection of areas, and only a few people are included. Several critical areas that impact the organization may still be overlooked	SCRM starts to become more decentralized, expanding to include more areas and a larger part of risk types are included in the process	SCRM is deeply embedded and institutionalized across all areas, ensuring a comprehensive and proactive approach
Learning and culture	There are no formal efforts to develop a RM learning and culture, such as fostering or improving the skills associated with RM	Some training sessions are initiated, but there might still be a lack of attendees or areas covered. As a result, there are still too few fully trained individuals qualified to carry out SCRM actions	The training sessions have developed and include broader aspects including people, risk areas, and hierarchical levels. The training sessions are better planned to fully incorporate necessary skills and competencies requirements, and are executed regularly	A strong SCRM culture is embedded across the organization, both horizontally and vertically, shaping itself to the organization's environment and focus
Emphasis	Emphasis describes how the organization commonly sees SCRM solely as an expense, there are no goals connected to RM, and the few actions taken are usually isolated and only connected to the operational level	A few benefits of executing SCRM are identified, but mostly towards reducing costs. With this, some coordination and goals can be identified, but the RM process is still strongly associated with one hierarchical level, commonly the operational level	The organization begins to see benefits beyond reducing costs, and how the process can improve processes and products. Actions begin to be taken on different hierarchical levels. Some goals are connected to the process	The organization instead sees SCRM as a strategic tool that can generate value and a competitive advantage, and the process is not installed only to manage risks but to take advantage of the opportunities they can become
Leadership support	There is no sort of support when it comes to encouraging SCRM actions for the employees. The leadership believes that themselves can solve the potential risks when they emerge, mainly by improvised actions	Leadership involvement is minimal, providing only restricted commitment that falls short of the organization's basic needs for effective SCRM	Leadership demonstrates a reasonable level of commitment, meeting most of the organization's SCRM needs but leaving some areas for improvement	The leadership provides strong and comprehensive support, fully meeting the organization's SCRM needs
Involvement	At the lowest level, there is no involvement of the other members of the organization's SC into their SCRM actions	Other SC members are engaged only in critical or highly specific situations	Some collaboration occurs, such as information sharing or involving partners in certain steps, but not consistently — making it still limited.	A broad and effective collaboration is in place, where the collaboration is routinely checked with the SC members, closely becoming a shared process
Governance	The organization is not encouraging or supporting their SC members to improve their SCRM process. Instead, they only look at their own organizations' processes	The organization begins to support or encourage their SC members to improve their SCRM processes in critical and specific areas	The organization routinely tries to support and encourage their SC members to improve their RM processes by indirect actions	Governance is done with a proactive approach taking both direct and indirect actions to improve the RM process outside the organization's boundaries

2.6 Concluding Conceptual Theoretical Framework

Based on findings from the literature, a conceptual framework and summary of important findings was developed to guide the focus of the research. This framework is presented across two Figures, Figure 2.16 and 2.17, each structured according to its intended purpose within the study.

Figure 2.16 outlines the key elements of SCRM practices to handle risks and reach resilience; the proactive SCRM process, the reactive SCRM process, relevant methods and tools used in these processes, and nine critical organizational aspects of SCRM, eight from Guerra et al. (2024), and with performance measurement added from Polyviou, Ramos and Schneller (2022). Each of these elements has been investigated to ensure a good theoretical foundation for the following empirical research.

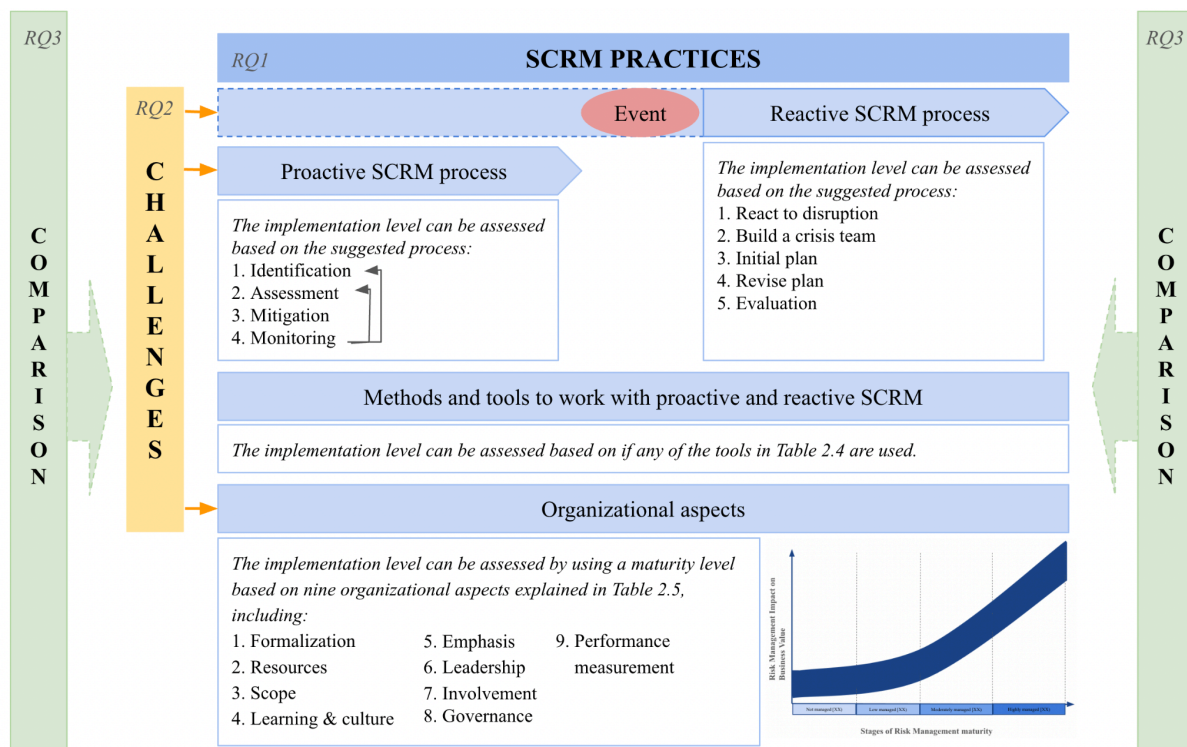


Figure 2.16: A conceptual framework of the theory used to develop empirical research for RQ1.

Figure 2.17 summarizes the relevant identified challenges which will be explored in the empirical research to answer RQ2. The challenges include challenges identified in the literature and categorizes them based on the area to which each challenge appears to relate. In addition, challenges related to each process steps, based on the researchers' insights from the literature, have been added in the *Reactive- and Proactive SCRM process challenges*.

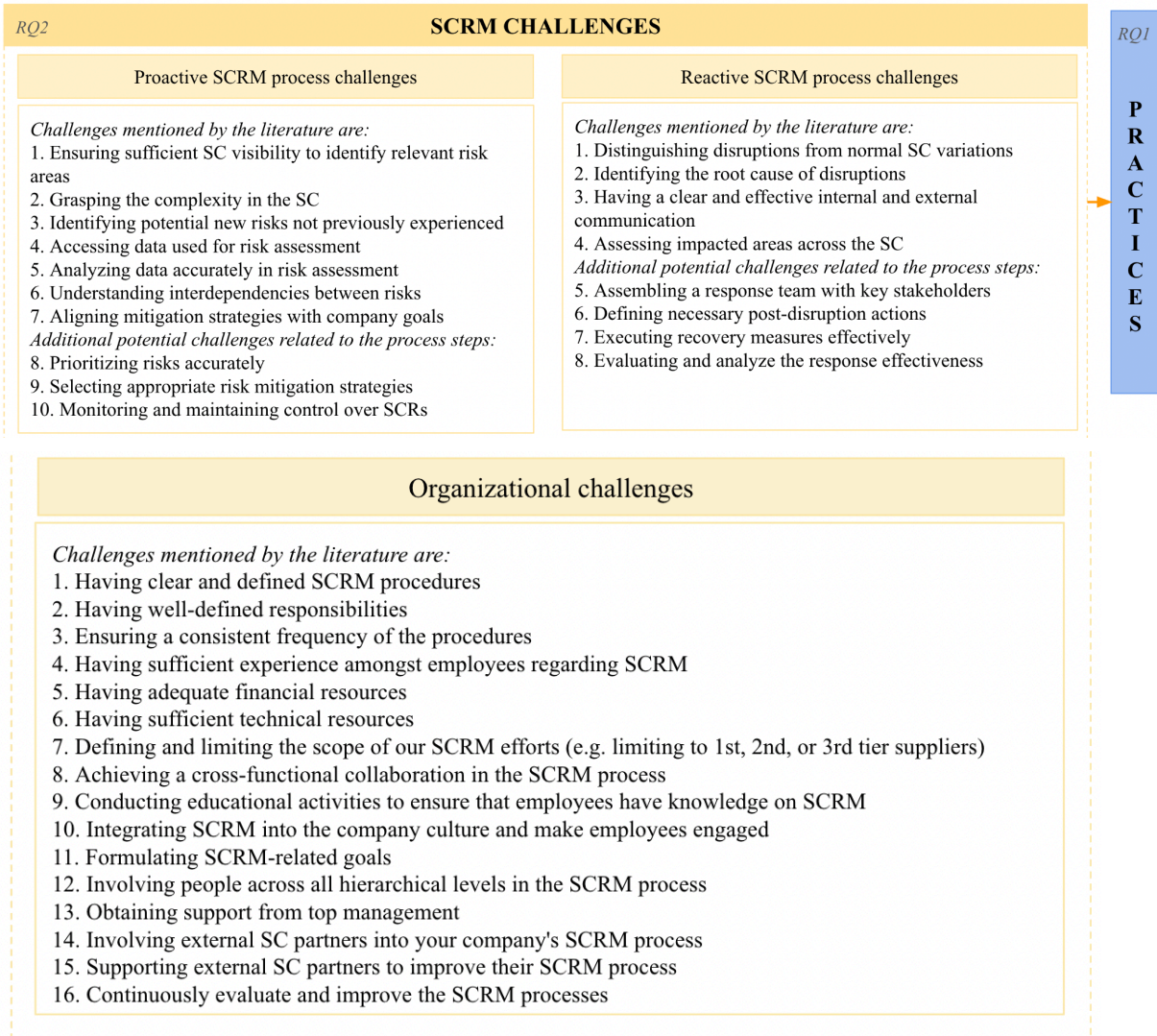


Figure 2.17: A summary of the challenges which will be explored in the empirical research to answer RQ2.

3. Industry Specific Characteristics

This chapter introduces the three industries analyzed, retail (section 3.1), food (section 3.2), and manufacturing (section 3.3), by outlining their key characteristics and challenges to support interpretation of differences in the comparative analysis.

3.1 Retail Industry

The retail industry serves as the final link between producers and consumers and the SC typically consists of four components: wholesaler or vendors, warehouses, stores and customers. Retailers can satisfy customers in different ways, either by shipping from stores, from warehouses or even directly from the suppliers (Ge, Pan & Shen 2019). Due to the wide ranges of delivering their products, retail companies are closely interconnected with importers, packaging, transportation and logistics service providers, postal and courier service providers (European Commission n.d.). Furthermore, retail companies can be divided into *grocery retail* and *durable goods retail*. Grocery retail refers to stores that primarily sell fast-moving consumer goods, such as food, beverages, personal care products, and household essentials. These products are purchased frequently and have a relatively short consumption cycle. Durable goods retail includes stores that sell products purchased less frequently, often with a higher price point and longer lifespan. This category covers items such as clothing, cars, as well as home goods and leisure products such as furniture and refrigerators (Nationalencyklopedin n.d.). On average, consumers allocate roughly one-third of their household spending to retail purchases (European Commission n.d.).

The main challenges of retail SCs are often related to short product life-cycles and high SC downward complexity. Rapid shifts in consumer preferences and market trends push companies to accelerate product launches and shorten life cycles, making it challenging for producers to keep pace. Growing global competition and ever-evolving fashion trends further pressure businesses to introduce new products more frequently while upholding high service standards. However, traditional SC structures and long lead times can hinder responsiveness, especially as global sourcing and offshoring introduce additional complexities and risks (Khan, Christopher & Burnes 2009).

Additionally, retail SCs easily become very complex when they have multiple store locations/customer locations, and a great number of *stock keeping units* (SKUs) and suppliers (Oke & Gopalakrishnan 2009). Furthermore, the increase in omni-channel retail and pick-up options have added to the complexity and put pressure on SCs to adapt and be responsive to the change in needs of the customers (Myerson 2021). These structures make it difficult to forecast the demand, including how much inventory to hold and where to allocate it (Oke & Gopalakrishnan 2009). Consequently, it puts higher requirements on data collection, analytics capabilities, SC visibility, network design and reverse logistics (Myerson 2021).

3.2 Food Industry

The food industry encompasses all activities involved in the production, processing, distribution, and retailing of food products, serving both consumers and businesses. It includes a diverse range of players, from agricultural producers and food manufacturers to wholesalers, retailers, and restaurants. (Lindow 2012). The food industry is considered to be one of the most vital societal functions and critical infrastructures by the US and the EU, together with e.g. medicine, energy and transportation. Therefore, when a disruption occurs in a food SC it can lead to severe negative consequences on

societal functions and the welfare of citizens. For instance, the Russian-Ukrainian war caused shortages of cereals, fertilizers, and vegetable oils, as these products were previously heavily produced in the region. This also serves as an example of how the food industry is highly dependent on inter-organizational and international SCs and cannot be managed by a single entity. Additionally, the industry comprises both public and private actors, further complicating coordination and SCRM efforts. However, while collaboration is essential, SCs are often competitive with limited transparency and unclear responsibilities. The interconnected SC can have especially critical consequences for the food industry due to the unique characteristics of the products (Norrman & Eriksson Ahre 2024).

The food SC presents several industry-specific challenges due to the unique characteristics of food products. One of the primary challenges is perishability, which complicates logistics and necessitates strict monitoring to prevent food safety and quality issues. Given food's short lifespan, it requires precise control over temperature, humidity, and protection from contaminants throughout processing, transportation, and storage (Oliveira et al. 2023). Therefore, shelf life prolonging measures become critical. While maintaining cold chain logistics it is also a necessity not just to maintain an adequate temperature, but also to try and reduce the number of transfers and the total amount of time in transportation to ensure food safety (Zhao 2024). Additionally, the global nature of food SCs further enhances these challenges by reducing visibility and limiting control over various stages of the process, thereby increasing the risk of food safety incidents. In recent years, there has been a notable rise in food recalls and safety violations, posing serious risks to human health, brand reputations and highlighting the critical need for robust RM procedures in the industry (Oliveira et al. 2023).

Concludingly, to handle the challenges within the food industry, some key measures are food safety standards, regulatory frameworks, and policies that enforce strict food safety controls. Additionally, regular quality inspections, import and export controls, continuous risk monitoring, and effective crisis response strategies play a vital role in mitigating food safety risks (Oliveira et al. 2023).

3.3 Manufacturing Industry

The manufacturing industry is responsible for transforming raw materials into finished products, through organized processes utilizing manual work, tools, chemical processes, machines or a combination of these. Manufacturing includes multiple industries such as automotive, aerospace, electronics, textiles, and many others. Additionally, the industry includes both companies supplying goods aimed for the end customers and companies further upstreams in the SC, supplying to other industries (Skyplanner n.d.).

The greatest SC related challenges manufacturing companies experience are material scarcity and price fluctuations. Firstly, some industries use raw material or components, such as specific metals or semiconductors, which can be difficult to source. The causes for low supply are different but can for example include strikes in heavily human dependent mining, government closures or countries trying to control the supply and increase the prices. If materials are critical or of high demand such delays can halt production. An additional aspect of the risk of material scarcity is the trend in the last decades to have lean- and just-in-time inventory management, with the aim to reduce costs and increase efficiency, which have made manufacturing SCs increasingly vulnerable. Another challenge experienced are the price fluctuations in raw materials which can have large impacts on the price of more refined products which can also change demand-patterns (Harris 2024).

Additionally, manufacturing companies face increasing urgency to decarbonize, as global production activities account for around 20 percent of carbon emissions and more than half of the world's energy use. This growing pressure is driven by rising awareness in society and heightened expectations from consumers, investors, and regulatory bodies (World Economic Forum 2022).

3.4. Size Comparison

SC complexity often correlates with company size. Smaller, local businesses typically rely on a limited number of suppliers, operate a single production facility, and distribute directly to customers. As companies grow into midsize operations, they must coordinate with a wider variety of suppliers, manage regional distribution centers, and serve both wholesale and retail channels. The largest enterprises face the highest levels of complexity, overseeing vast global networks of suppliers, manufacturing sites, distribution hubs, and market channels. Global SCs introduce additional challenges, including complex logistics, customs regulations, currency fluctuations, trade disputes, and regulatory requirements. The more components and suppliers involved, the more difficult coordination becomes, especially across dispersed geographic regions and under varying regulatory environments (Schwarz 2024).

4. Methodology

This chapter outlines the methodology. Section 4.1 presents the research purpose and approach and section 4.2 the research design process. Section 4.3 details data collection procedures, while Sections 4.4 and 4.5 cover data analysis and measures to ensure research quality.

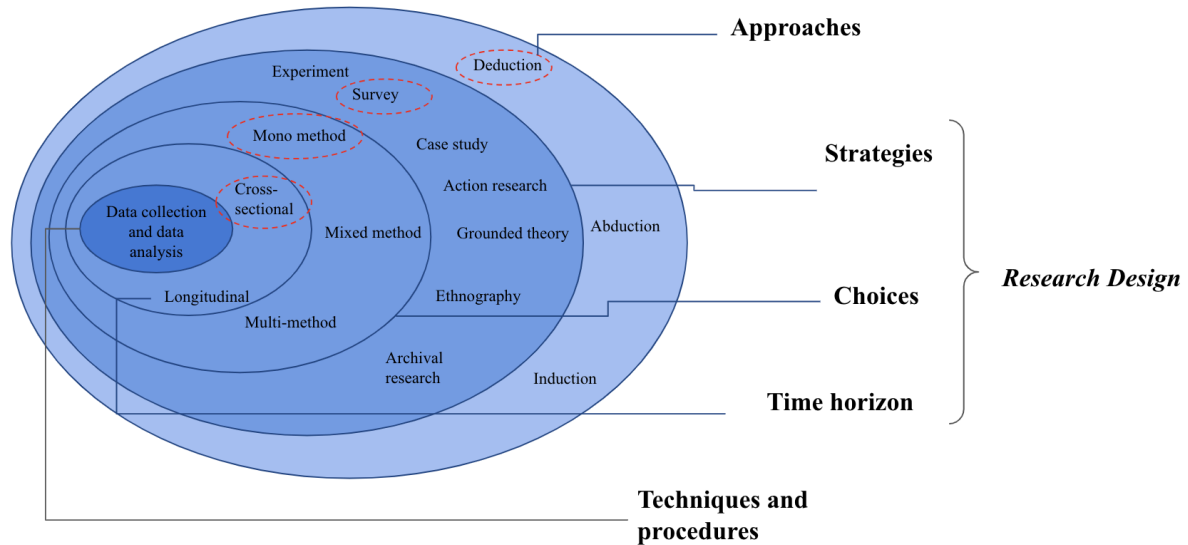


Figure 4.1: Research onion with the elements circled that align with the methodological aspects of the thesis (adopted from Saunders, Lewis & Thornhill 2006, p.102).

4.1 Research Purpose and Research Approach

According to Saunders, Lewis, and Thornhill (2006), the formulation of research questions (RQs) influences the study's objectives and methodological choices. Each RQ can typically be categorized as exploratory, descriptive, or explanatory. Exploratory research examines a phenomenon in order to enhance the understanding of a problem through methods such as literature reviews or expert interviews, while descriptive research aims to accurately portray a phenomenon. Explanatory research, in contrast, investigates relationships between variables using statistical methods. In this thesis, RQ1 and the first part of RQ2 are descriptive, aiming to clarify the SCRM practices companies use and the challenges they face. The second part of RQ2 and RQ3 take an explanatory approach, as they explore how challenges influence implementation and examine differences between industries and company sizes.

Additionally, the research onion, addressed in this thesis, concerns how theories are developed. The approach can be either deductive, inductive, or abductive. A deductive approach starts with existing theories, formulates hypotheses, and tests them through data collection. Induction begins with data collection to build new theory, while abduction combines both, iteratively refining theory and data (Saunders, Lewis & Thornhill 2006). This thesis adopts a deductive approach, first exploring established SCRM theory and then systematically collecting quantitative data to examine its application in practice. This structured method enhances reliability, replicability, and generalizability. However, it also requires an adequately sized sample to draw meaningful inferences for larger populations (Saunders, Lewis & Thornhill 2006). By analyzing a representative dataset, the study seeks to offer insights applicable to a broader context and to explain causal relationships between key variables.

4.2 Research Design Process

The next three layers of the research onion regard research strategies, research choices, and time horizons and together form the research design process. This process involves transforming the RQs into a structured research project and is a general plan of how the authors of this thesis will proceed in order to answer the RQs.

Among the most common research strategies are experiment, survey, case study, action research, grounded theory, ethnography, and archival research. The survey strategy is particularly well-suited for answering questions such as what, who, how much, where, and how many, as well as for exploring potential relationships between variables, making it appropriate for both descriptive and explanatory research. Its ability to generate large volumes of quantitative data in a cost-efficient manner further supports its relevance for this study (Saunders, Lewis & Thornhill 2006). Therefore, the survey strategy was chosen as the most appropriate method for this thesis.

The next layer defines the data collection and analysis methods. Quantitative research focuses on numerical data and larger samples for generalizable results, while qualitative research uses words or visuals with smaller samples for deeper insights. As the aim is to generate generalizable results to answer the RQs, such as measuring the prevalence of tools and identifying key challenges across a broad set of companies, a quantitative mono-method approach was considered most suitable (Denscombe 2017). Although some qualitative input was gathered through optional open-ended responses, the primary data collection relied on quantitative answers from the questionnaire, consistent with the survey strategy, and was analyzed using statistical tests and graphical tools.

Lastly, survey research can follow two main designs, cross-sectional and longitudinal. A cross-sectional design captures data at a single point in time, while a longitudinal design collects data at multiple intervals to track changes over time (Leavy 2017). Since this study will only be performed during a short period of time, a cross-sectional study will be performed.

4.3 Data collection

The final layer of the research onion concerns data collection techniques. In line with the deductive approach, this study begins with a literature review to establish a thorough understanding of the topic, forming the foundation for the empirical research. Furthermore, to achieve the research objectives, a questionnaire has been selected for empirical data collection, aligning with the study's survey based research strategy and the quantitative methodology (Saunders, Lewis & Thornhill 2006). A questionnaire enables standardized data collection from a large sample while minimizing the need for personal interaction, increasing the replicability and generalizability of the results. Since the study primarily captures respondents' perceptions, experiences, and self-reported practices, a questionnaire is particularly effective, as the information sought is straightforward and concise. Furthermore, anonymity of responses and the non-sensitive nature of the questions ensures that participants can answer honestly and accurately, fostering reliable data collection (Denscombe 2017).

4.3.1 Literature review

The literature review aims to present the current state of knowledge within the area of interest. This includes establishing a foundation of theoretical concepts and terminology and identifying how the research will contribute to and support the field (Rowley & Slack 2004). More specifically, the

literature review of this thesis has identified and covered relevant topics to address the RQs and help shape the questionnaire by providing the conceptual framework.

The review has followed the approach outlined in Figure 4.2. It is based on the stages proposed by Rowley and Slack (2004), with the added step of *Document Search and Retrieval*, which is essential for ensuring the quality and relevance of the literature review. The iterative loop between step three and step one is added as sources partly have been extracted by using a *Citation Pearl Growing search strategy*, implying that relevant sources have been used for extracting suitable terms which thereafter have been used as key words in the search base to find further relevant sources on a certain topic (Rowley & Slack 2004).

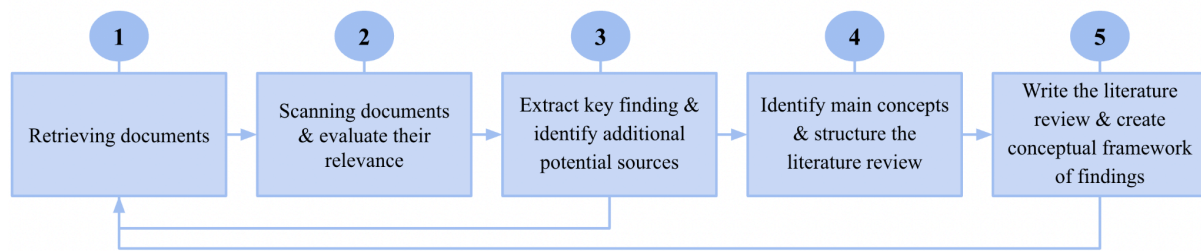


Figure 4.2: An illustration of a modified version of Rowley and Slack's suggested structure of a literature review (2004).

The first step of the literature review process is *Document Search and Retrieval*. To find relevant articles, the primary search engine which has been used is LufSearch. LufSearch is a library web page which provides tools for simple keyword-based searches and directions to online-databases where complete documents can be accessed (Hansson n.d.). Further, to ensure quality of the review, some requirements have been set for the retrieved documents, which will be further discussed in Section 4.6.

Articles were selected based on peer-reviewed sources and recommendations from the thesis supervisor, complemented by an initial review of key themes to ensure their relevance. In addition, the Citation Pearl Growing strategy was applied to expand the scope of relevant literature. Finding relevant, additional literature was made in the third step.

In the third step, key findings from the identified articles were extracted, and notes were taken to outline the key findings. This step also prompted further literature searches, as key references and keywords from the initial articles were used to identify additional relevant sources. Further documents were retrieved by both *backward- and forward citation searching*, meaning finding both references cited in previously used sources to find foundational research as well as sources which have cited our used sources (Rowley & Slack 2004). The key sources in the thesis are presented in Table 4.1. Each of these sources have been considered to have a thorough coverage of its specific topic which have resulted in it being frequently referenced in the thesis.

The fourth step involved organizing the concepts and documents according to their key themes and their contribution to the literature review (Rowley & Slack 2004). Based on this, an initial structure for the literature review was established. The final step was writing the literature review, where articles gathered for each topic were used to provide a comprehensive discussion within the structured framework. Based on feedback from the supervisor of the thesis, the included content was iteratively

refined, some sections being expanded to cover additional critical topics and others being streamlined to improve focus and clarity. Once this process was completed, the literature review was summarized, highlighting key concepts and visualizing their interconnections in a framework. This framework was then used as a basis for the questionnaire and used to support the analysis of empirical data.

Table 4.1: Summary of the most referenced sources and their applications in the literature review.

Key references	Used for
Fan & Stevenson 2018	Defining SCRM, Proactive SCRM content
Guerra et al. 2024	Organizational aspects
Holling 1996	Defining resilience
Hopp, Iravani & Liu 2012	Reactive SCRM content
Ivanov 2023	Defining resilience
Kilubi 2016	Proactive SCRM content, Reactive SCRM content
Knemeyer, Zinn & Eroglu 2009	Tools content
Norrman & Jansson 2004	Proactive SCRM content
Norrman & Olhager 2023	Risk categorization
Norrman & Wieland 2020	Reactive SCRM content, Organizational aspect
Polyviou, Ramos & Schneller 2022	Proactive SCRM content, Tools content
Tukamuhabwa et al. 2015	Defining resilience
Tummala & Schoenherr 2011	Tools content
Wieland & Durach 2021	Defining resilience

4.3.2 Questionnaire

The objective of the questionnaire was to collect reliable and meaningful data, from relevant participants, and to do analysis on. In order to achieve this, the target group has been carefully selected through a sampling procedure and the questions have been formulated in a well-structured manner by following the step-by-step guide, presented in Figure 4.3, derived from Stone (1993). Furthermore, the questionnaire was web-based which streamlines the data analysis since responses can be automatically transferred to an Excel file and thereafter uploaded into SPSS, a data analysis program (Denscombe 2017).

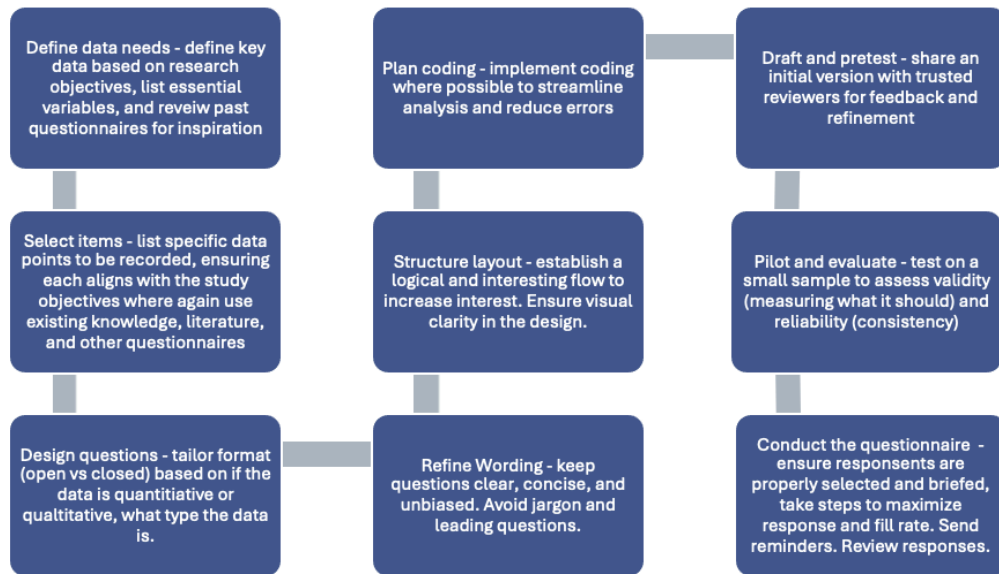


Figure 4.3: An illustration of a step-by-step guide for designing a questionnaire (Stone 1993).

4.3.2.1 Sampling

When conducting a survey, it is essential to define a relevant study population—i.e., the group from which meaningful data can be collected (Denscombe 2017). While studying the full population is ideal, time and budget constraints often require researchers to select a sample (Saunders et al. 2006). The goal of sampling is to gather insights that reflect the characteristics of the entire population (Merriam-Webster n.d.).

In this study, the target population was defined together with 4C Strategies as companies with supply chains and a presence in the Swedish market. Based on this, 4C provided a list of relevant firms from different industries, including past clients and companies from Sweden's top 100 list (Bolagsfakta 2025). The list was further supplemented by companies within the FORCE network³, and additional firms identified by the researchers. Three industries—retail, food, and manufacturing—were selected due to their strong representation and relevance to 4C Strategies. The resulting study population consisted of companies within these industries operating in Sweden with a SC.

Based on provided information by Descombe (2017), the sampling procedure was structured in three layers of selection. First, an *exploratory sampling* approach was chosen over a representative one, prioritizing insight from relevant respondents rather than aiming for perfect population proportionality (Dencombe 2017). The choice was made as attaining a perfect population would have required extensive resources and time to gather. Secondly, the study applied *non-probability sampling* over probability-based methods, as the researchers lacked access to a complete population list and instead built the sample using existing contacts, online research, and known firms. Thirdly, the thesis combined *quota sampling*, to ensure that enough number of responses were gathered to achieve a reliable statistical analysis, and *subjective sampling*, by targeting individuals with relevant job titles likely to provide valuable insight for the study's purpose (Dencombe 2017).

³ FORCE is a knowledge center with researchers from Lund University, the Swedish University of Agricultural Sciences, the Royal Institute of Technology and the AgriFood Economic Center.

To ensure reliable industry comparisons, a minimum of 30 responses per industry was targeted, following the central limit theorem and best practices in small-scale research (Saunders et al. 2006; Denscombe 2017). Based on expected response rates of 20–25 percent from similar studies (Olhager & Selldin 2004; Wieland & Wallenburg 2012), approximately 150 companies per industry needed to be contacted. Since this number could not be reached, 1–5 relevant individuals within each company were instead approached to increase the likelihood of obtaining at least one response per company. In total, 248 people from 97 manufacturing companies, 174 from 78 retail companies, and 201 from 74 food companies received the questionnaire.

Since the research focuses on company practices, the sample consists of companies represented by individuals with relevant SCRM expertise. A structured search was conducted on LinkedIn to identify key participants, first prioritizing senior roles (e.g., Vice Presidents, Heads of Departments), then professionals in Risk, followed by those in Supply Chain, Logistics, and Purchasing. These job titles have been identified, in a similar questionnaire, as the titles most frequently engaged in SCRM (Norrman & Näslund 2016). Email addresses were obtained using Hunter (Hunter. n.d.) and RocketReach (RocketReach n.d). If no email was found, general company-specific email formats were identified and adapted to the respondent's name in an attempt to reach the correct contact.

4.3.2.2 Defining Data Needs and Select Items

The first two steps of creating a questionnaire is to *define the required data* and *select the specific data points* which have to be recorded. A key part of these steps are ensuring that the questions in the questionnaire accurately reflect the concepts being measured, in order to answer the RQs (Leavy 2017). To define the data required for this study, it was essential to identify key variables, or constructs, that align with the RQs (Stone 1993). Constructs represent underlying concepts that are measured to analyze the research objectives and answer the study's RQs (Leavy 2017). The constructs are based on the theoretical framework presented in the concluding theoretical frameworks in Section 2.6.

To address the RQs, firstly, four second-order constructs were defined for RQ1 based on the conceptual framework in Figure 2.16; *Proactive SCRM Process*, *Reactive SCRM Process*, *Methods and Tools*, and *Organizational Practices*. To provide detailed analysis, these second-order constructs were divided into first-order constructs reflecting specific process steps or organizational dimensions. For example, the construct *Proactive SCRM Process* was divided into four first-order constructs, and *Organizational practices* was divided into nine, based on the identified critical capabilities in the literature review. Furthermore, to answer RQ2, an additional second-order construct, *Challenges*, was included. This construct captures the challenges from literature, structured around the constructs defined for RQ1, divided into Proactive SCRM, Reactive SCRM and Organizational challenges. All constructs used to answer RQ1 are presented in Figure 4.4 and highlighted in blue, and the constructs for RQ2 highlighted in yellow.

Finally, to ensure that the correct data is collected a group of control questions and background questions are included in the questionnaire in order to validate which companies that are participating and achieving an understanding of the interest of SCRM in practice. Some of these control questions, which industry the company belongs to and its size, will be used in the statistical analyses, used to answer RQ3.

Second-order constructs	First-order constructs										Items	
Control questions and background											...	
Proactive SCRM Process	Identification		Assessment		Mitigation		Mitigation strategies		Monitoring	Frequency	...	
Reactive SCRM Process	Step 1	Step 2	Step 3	Step 4	Step 5						...	
Methods & Tools	SCRM Methods & Tools			Disruption detection			IT Methods & Tools					...
Organizational practices	Formalization		Resources		Scope		Learning & Culture		Emphasis	Leadership support		...
	Involvement		Governance		Performance measurment							
Challenges	Proactive SCRM process challenges				Reactive SCRM process challenges				Organizational challenges			...

Figure 4.4: Overview of Second- and First-Order Constructs Used in Empirical Research.
The blue boxes represent the constructs used to answer RQ1, and the yellow boxes to address RQ2.

According to Forza (2002), a construct can be multidimensional, meaning that several factors should be taken into account in order to capture all dimensions of the construct. To capture these dimensions each first-order construct has been further operationalized into observable and measurable *items/indicators*. Each item is linked to a question in the questionnaire which measures an important aspect of the construct (Forza 2002). These questions have either been newly developed, based on theory from the literature review, or adapted from existing questionnaires (Leavy 2017). An example of how a construct was operationalised into clearly defined items, by using both theory presented in the literature review and conducted questionnaires, is presented in Table 4.2. Questions derived from “literature review” have foundation and support in Chapter 2. If additional sources are given, the questions are also inspired by questions which have been used in questionnaires used in previous research. The complete set up of the established *measurement theory* (how questions are connected to items and ultimately which construct they relate to) along with derivation of each question is presented in Appendix A.

Table 4.2: Example of the operationalization of constructs, presenting how the construct SC Resilience was measured in the questionnaire.

Q nr. 27: How well do you perceive that your company's SCRM efforts contribute to the following outcomes?	Item	The question is derived from...
We are able to maintain high situational awareness and effectively control our SC and its external environment	SCResAwareness	Literature review, (El Baz & Ruel 2021), (Um & Han 2021), (Eryarsoy et al. 2021)
We are able to anticipate and prepare for potential disruptions	SCResPrepare	Literature review
We provide a quick response to disruptions	SCResQuickResponse	(El Baz & Ruel 2021), (Um & Han 2021), (Eryarsoy et al. 2021)
We are able to initiate an appropriate response to disruption	SCResInitiate	(Manuj, Herburger & Adana 2024)
We can quickly recover from disruptions	SCResQuickRecover	Literature review, (Eryarsoy et al. 2021)
We can recover from a disruption with minimal financial impact	SCResCost	Literature review, (Manuj, Herburger & Adana 2024)
We have the capability to not only recover to the initial state after a disruption but to emerge in an improved state	SCResEmerge	Literature review

4.3.2.3 Design Questions, Structure Layout, Refine Wording, and Plan Coding

After identifying the constructs and items to include in the questionnaire, the step was to design the actual questions, refine their wording, and structure the layout. Question design involves selecting the appropriate format, such as having open or closed questions and single or multiple choice questions. These choices depend on if the data is qualitative or quantitative and its *classification* (e.g., ordinal or nominal). Wording refinement ensures that questions are clear, concise, and unbiased, avoiding leading or ambiguous phrasing. Layout structuring focuses on organizing the questionnaire in a logical and engaging flow to maintain respondent interest and encourage completion (Stone 1993). The questionnaire has been developed in accordance with these principles and recommendations of Descombe (2017), presented in Table 4.3 which outlines the specific actions taken.

In the questionnaire, different types of questions were used. Open-ended questions were limitedly used in multiple choice questions when listing all possible options was impractical, such as for methods or departments, allowing respondents to add additional options, or when requesting specific details like email addresses or company names. Most of the questions were structured as rating scale questions, assessing how challenging, applicable, or important various aspects are. The rating was always done on a 7-point scale to avoid the extremes being underused in a more limited scale, or the choices losing significance in a larger scale (Descombe 2017). Single-choice questions were used for areas with one clear answer, such as revenue or company size. Multiple-choice questions were included where multiple departments or methods could apply. All questions required answers, except the first one, which offered the option to receive a summary report in exchange for an email address. An 'I don't know' option was provided for all questions except background information of the respondent and a few clear company-related questions.

Table 4.3: Steps taken to develop the questionnaire, including question clarity, refined wording, and structured design (Denscombe 2017).

Area		Actions taken by the researchers in this study
Design	the questions	Ensured that response options were mutually exclusive and collectively exhaustive Incorporated a variety of question formats to maintain engagement, such as - Rating scale questions with predefined options - Multiple-choice selections when multiple answers could apply - Fixed-choice questions for uncomplex questions Maintained a consistent 7-point scale for readability and ease of understanding
Refine wording		Avoided leading questions that could influence responses. Used neutral language to prevent unintended bias. Avoided terminology or complex terms that could be offensive or difficult for respondents to understand.
Structure	the layout	Started with simpler questions to ease respondents into the survey. Ensured a user-friendly design by using Google Forms, which offers easy navigation. Included an indicator to inform respondents of the estimated length remaining. Provided clear instructions for each question type to minimize confusion.

Additionally, the coding procedures, though typically linked to data analysis, was considered early, as careful preparation was considered crucial. Coding involves assigning numerical or standardized values to responses, making data analysis more efficient. For example, Yes = 1, No = 0, or for a satisfaction scale: Very satisfied = 5, Satisfied = 4, ..., Very dissatisfied = 1. In the questionnaire,

coding was implemented by writing scale descriptions directly in the questions, ensuring that response options were purely numerical. This way, when exporting the results, answers were automatically in numerical form (e.g., "4 - Moderately applicable" became just "4"). For questions with word or sentence-based responses, a categorization table was created to specify how each answer should be re-coded for analysis. This table made it easy to determine which responses corresponded to each number. By planning coding in advance, valuable time and effort could be saved during the analysis phase.

4.3.2.4 Draft, Pretest and Evaluate

After drafting the initial questionnaire, the researchers needed to pretest and evaluate it. An iterative review process was conducted to ensure clarity, relevance, and efficiency in accordance with recommendations by Forza (2002). The first review, performed by two peers, focused on grammar, question clarity, consistency, and estimated completion time. The test respondents, who were observed while completing the questionnaire, provided real-time feedback and highlighted unclear instructions, or confusing questions and response options. The initial completion time of around 30 minutes was deemed too long.

While there are no strict guidelines of a questionnaire's length (Denscombe 2017), the researchers were determined to aim for 20-25 minutes completion time, taking into account how long it can take before potential respondents lose interest while still covering all relevant areas. To reduce the initial response time, questions that were repetitive or not essential to addressing the RQs were removed, and response options were refined and made more concise without compromising the validity of the data. The revised version was then reviewed by the academic supervisor, ensuring the questionnaire's alignment with the RQs, while the supervisors at 4C Strategies provided feedback on content relevance. Another professor at Lund University, experienced in statistical analysis, provided insights on correctly linking the questionnaire to the constructs to ensure it effectively addressed the RQs. The professor also highlighted common pitfalls to avoid, such as including a question that addresses two topics connected by 'and' or 'or,' as it becomes unclear which part the respondent is actually referring to in their answer.

After addressing the second round feedback, a final test involved both researchers and two additional peers. The time of completion of the survey was then on average 24 minutes. The finalized questionnaire was thereafter sent to the academic and company supervisors for final approval before it was distributed.

4.3.2.5 Conduct the Survey

As the final step, the questionnaire was sent out in accordance with recommended actions for maximizing both the *response-* and *fill rate* (Stone 1993), as well as ensuring the *validity of the answers* (Denscombe 2017). A high response rate indicates that a large proportion of the contacted people submitted completed questionnaires, while a high fill rate refers to the completeness of each respondent's submission. Both these aspects are essential for obtaining a sufficient amount of data to enable a meaningful analysis. Additionally, the validity of responses concerns the honesty and accuracy of the answers provided. Low validity can lead to distorted findings, potentially rendering the results more misleading than having no data at all (Denscombe 2017).

To improve the response rate, the researchers ensured that respondents were provided with clear and relevant information. This was communicated both in the emails and through a brief introduction at

the beginning of the questionnaire. The information included background details about the master's thesis, such as the collaboration with 4C Strategies and the FORCE research network, the purpose of the study, how confidentiality would be maintained, a statement emphasizing voluntary participation, and an expression of gratitude for their potential contribution (Denscombe 2017). After receiving concerns about IT security and a reluctance to click on external links, an additional section was included in the communication, providing contact details for the supervisor at LTH. This allowed recipients to verify the legitimacy of the research if needed. Another measure taken to increase the reliability towards the respondents was to send out the questionnaire from university verified email-addresses. This was done after several respondents followed up and stated that the email had been flagged as spam or trash. Additionally, information about the collaboration with FORCE was removed from emails sent to companies within the manufacturing and retail industry, as it appeared to create confusion about the study's relevance to industries outside of the food industry. To encourage a high fill rate, the provided information also included an estimate of the expected completion time for the questionnaire. However, following feedback from the initial respondents regarding its length, this estimate was adjusted from 20 to 25 minutes in the sent out reminders.

Another measure taken to increase the response rate was personalization of the emails. Initially, the questionnaire was distributed via bulk emails, with up to 50 contacts per message. All recipients were blind carbon copied (bcc) to maintain confidentiality and prevent respondents from viewing each other's email addresses. However, due to a low response rate, personalised follow-up reminders were subsequently sent to each recipient, addressing them by name and referencing their respective companies. In total, three reminders were sent, each spaced one week apart. Additional actions taken by the researchers to increase response- and fill rate as well as high validity of answers are outlined in Table 4.4.

Table 4.4: Steps to ensure high response rates, fill rates and validity of answers are outlined, including details on survey length and relevant information (Denscombe 2017).

Area	Actions taken by the researchers in this study
Response rate	Provided clear communication including - The purpose and objectives of the research - The significance of the topic and its potential impact on respondents - Assurance of confidentiality of answers - Statements to increase IT security reliability Encouraged the respondents by specifying that they would receive a summarized report of the results including industry benchmarks and best practices. Sent emails from University verified email addresses to not get flagged by IT-security filters Sent three personalized reminders including the contact person's name and company Posted two LinkedIn posts at 4C Strategies page with information about the master thesis and the link to the questionnaire One of the supervisors at 4C Strategies reached out to personal contacts, encouraging them to participate in the study Ensured questions were relevant to respondents' ability to answer.
Fill rate	Designed the questionnaire to be simple and easy to understand, avoiding unnecessary complexity. Minimized the response burden by keeping the questionnaire as short as possible meanwhile covering all necessary areas Included a progress indicator in the questionnaire to inform respondents of their advancement. Ensured the questionnaire was user-friendly to facilitate engagement by using well-known and easily navigated Google Forms.
Validity of answers	Formulated questions in a clear, unambiguous manner to prevent misinterpretation. Clearly defined the estimated completion time to set expectations. Explained how confidentiality would be maintained and provided a statement regarding voluntary participation to promote honest responses

To provide an example of how the questionnaire appeared to respondents, Figure 4.5 illustrates a typical question, which required participants to respond on a 7-point scale accompanied by explanatory labels for each point, along with an option to select "I don't know."

6. To what degree do you consider that proactive and reactive Supply Chain Risk Management (SCRM) is **important** for your company's success? *

[7-point scale: 1) Not important at all – 4) Moderately important – 7) Highly important]

	1	2	3	4	5	6	7	I don't know
Proactive SCRM	☐	☐	☐	☐	☐	☐	☐	☐
Reactive SCRM	☐	☐	☐	☐	☐	☐	☐	☐

Figure 4.5: A screenshot of a question from the questionnaire.

4.5 Data Analysis

After closing the questionnaire after four weeks there were 72 submitted responses, including 66 unique companies. This corresponds to a response rate of 11.55 percent based on the total number of individuals contacted, and 26.50 percent when calculated as unique companies responding relative to the total number of companies approached. This data was thereafter analyzed according to five steps presented by Descombe (2017), as shown in Table 4.5.

Quantitative data can be analyzed through advanced statistical tests, as well as straightforward descriptive statistics (Denscombe 2017). For the conducted analyses, IBM SPSS Statistics were used. SPSS Statistics is a software which facilitates data management, statistical modeling, and research without extensive programming knowledge. Additionally, SPSS provides tools for data visualization, allowing for the exploration of insights, hypothesis formulation, identification of variable relationships, trend analysis, and prediction-making based on survey data (IBM n.d.). This formed the basis for most of the analyses conducted in the thesis, with Excel additionally used to visualize trends for RQ3.

Table 4.5: Overview of the quantitative data analysis process (Dencombe 2017).

Chapter	Quantitative data
1. Data preparation	Control and categorization of data
2. Initial exploration of data	Search for trends or relationships
3. Analysis of data	Use statistical tests and connect to research questions
4. Generation and presentation of data	Use tables, Figures and written interpretation of the statistical findings
5. Validation of data	External standards Compare to other explanations

4.5.1 Data Preparation

Before analysis, the data first had to be reviewed and categorized. The review involved identifying missing values and detecting outliers, both of which are crucial steps to ensure the accuracy of the results. Unaddressed outliers can distort statistical relationships, while missing data can introduce bias into correlations between variables. Categorization involved determining the type of data collected and converting qualitative responses into numerical values for compatibility with SPSS (Hair et al 2014).

4.5.1.1 Missing data

The first step in data preparation involves assessing missing data, since there may be distortions caused by missing data if there is a significant difference between those who respond and those who do not fill in the questionnaire. Missing responses can result from either lack of contact with a certain group or from a group refusing to participate. When conducting a survey, it is therefore essential to investigate the missing answers, and identify if there are common characteristics for those compared to the ones that answer. If a distortion is present, one solution is to weigh the findings, but this is more common in large-scale surveys than in small-scale research. However, even if this adjustment is not

made, it is important to recognize the missing responses when discussing the results (Denscombe 2017).

In the questionnaire, all missing data resulted from respondents actively selecting 'I don't know', as all questions were mandatory and could not be skipped, except for one question, which allowed participants to optionally enter their email address. There can also be missing data due to certain groups of companies not answering the questionnaire, which is further discussed in Chapter 8 Conclusion and Discussion.

The extent of missing data was firstly analyzed by case and by variable. As a general guideline, missing data below 10 percent per respondent is acceptable, and up to 20 percent if missing at random. If missingness is concentrated in a few variables or cases, these can be excluded to maintain overall data quality (Hair et al. 2014).

The authors reviewed the number and percentage of unanswered responses across 28 main questions and 167 sub-questions. Among the 72 respondents, 56 had less than 10 percent missing data, 10 had 11–20 percent, 3 had 21–30 percent, 1 had 31–40 percent, and 2 exceeded 41 percent. The six respondents with the highest missingness were reviewed in detail. One of the latter, who consistently answered 'I don't know', was excluded for limited data reliability. The other, who cited time constraints but provided high-quality responses in the completed sections, was retained. For others with over 20 percent missing data, the missingness was isolated to a few descriptive questions, likely unrelated to their job roles, and thus these responses were also kept. Missingness was also evaluated by question. Of 163 sub-questions with 'I don't know' responses, 144 had less than 10 percent missing data, 17 had 11–20 percent, and 2 had 21–30 percent. Most missingness above 10 percent was found in questions 13, 14 (risk mitigation strategies) and 22 (IT capabilities), and primarily from the same few respondents with high missing data. Since these questions are used descriptively, they were included in the final analysis.

To assess whether missing data occurred completely at random, Little's MCAR (Missing Completely at Random) test was conducted using SPSS's Missing Value Analysis tool. The test evaluates the null hypothesis that missingness is random and unrelated to other variables. A non-significant result ($p > .05$) indicates MCAR, allowing for less intrusive handling without introducing bias. The test, applied to all variables with missing data and all respondents, confirmed that the dataset was MCAR, justifying continued use without major bias risk (Hair et al. 2014). Given the low extent of missingness and confirmation that the data were missing completely at random (MCAR), the all-available data approach was applied using pairwise deletion. In SPSS, pairwise deletion excludes only the missing values for specific variables in each analysis, as opposed to listwise deletion, which omits entire cases if any value is missing. Pairwise deletion therefore maximizes the use of available data without imputing values, making it particularly suitable for smaller datasets with limited missingness. As it retains more information than listwise deletion, pairwise deletion was deemed the most appropriate approach for this study (Hair et al. 2014).

4.5.1.2 Outliers

Outliers are observations that deviate markedly from the rest of the data, either through extreme values on a single variable or unusual combinations across multiple variables. They can affect statistical results by skewing analyses but may also reveal valuable insights about unique segments of the population. Practically, outliers should first be assessed for their impact on analysis. An outlier

may be relevant if it represents a legitimate part of the population, but problematic if it distorts results without broader relevance. Analysts must decide whether to retain, adjust, or remove outliers based on their significance and influence on the analysis (Hair et al. 2014). In SPSS, outliers are detected using boxplots. Values beyond 1.5 standard deviations from the box are marked as circles (potential outliers), and those beyond 3 standard deviations as crosses (extreme outliers).

In total, 73 outliers were identified, but they were spread across many sub-questions and respondents, indicating almost no consistent pattern. Three respondents stood out, company 39 had 11 outliers, company 2 had 7, and company 40 had 6. Upon review, these correspond to two retail companies that overall engage minimally with SCRM and a manufacturing company involved in raw material extraction. These cases were deemed representative of their business contexts rather than inaccurate responses and were therefore retained in the analysis without further adjustment.

4.5.1.3 Duplicate Answers From the Same Company

Furthermore, there were several duplicate responses from the same company. To avoid biasing the results by including multiple entries from a single organization, the authors retained only the response deemed most reliable. To determine the most trustworthy response, several factors were considered. First, responses that contained a high number of 'I don't know' answers or repeated the same numerical value across many consecutive items were considered less reliable, as they indicated either limited awareness of internal processes or a lack of thoughtful engagement with the questionnaire. Second, the respondent's role was taken into account; individuals working directly with SC, purchasing, or SCRM were considered more qualified to provide informed responses. In some cases, respondents explicitly stated that their submission was the result of a collaborative effort involving multiple colleagues, which was deemed more credible than individual submissions. All of these aspects were evaluated when deciding which response to keep. Based on this assessment, five duplicate responses were removed. The finalized data, uploaded into SPSS, included 65 submitted answers.

4.5.1.4. Categorization of Data

If a response was deemed valid, the data had to be categorized. The majority of the questionnaire consisted of ordinal data, as most questions used 7-point scales to measure perceptions of applicability or levels of challenge. Ordinal data ranks items but does not assume equal distance between points (Denscombe 2017). An example is the scale used to assess how well a company applies different SCRM practices. Nominal data, which groups responses into numbers representing categories without any ranking (Denscombe 2017), was also present, for instance in the question asking to which industry a company belongs, where each industry was assigned a number. Calculating means for nominal data is not meaningful, as the numbers only represent categories (Denscombe 2017). Interval and ratio data were not used in this questionnaire. In SPSS, each variable was accordingly defined as ordinal or nominal to ensure correct analysis.

Secondly, before importing the data into a computer programme, some adjustments were necessary. Categorization was required for questions where respondents could provide additional answers and for single-choice questions with text-based options. For instance, in questions about company size, industry, revenue, and job titles, responses were converted into numerical categories (e.g., 1 = less than 10 million SEK, 2 = 10–49 million SEK, etc.). Variable names were defined to prevent long question texts from being imported as the variable name. All 'I don't know' responses were replaced with 99, which was then designated as a missing value in SPSS. Additionally, the company name and

email of the respondents columns were removed, as it was not needed for the analysis, but saved in the original response file.

Thirdly, for multiple-choice questions, such as which methods are used or how disruptions are detected, respondents could select more than one option. In Google Forms, all selected answers were stored as a single string within one variable, with semicolons separating the chosen options. To enable analyzing the frequency of data, the responses were transformed by creating a new binary variable for each possible option. Each of these variables was then recoded: 1 indicating that the option was selected, and 0 indicating that it was not. Then these could be analyzed by frequencies and illustrated in bar chart graphs. This was done for five variables.

Fourthly, two scope variables, *number of well-implemented mitigation strategies* and *number of departments involved in SCRM*, were transformed to align with the 7-point scale used throughout the study. Originally, these variables were based on questions where respondents indicated if they apply certain strategies and which departments were involved in SCRM work. However, to ensure comparability and integration into the broader scope construct, they needed to be scaled consistently with the rest of the dataset. For mitigation strategies, a strategy rated ≥ 4 was considered well-implemented. Then each variable was transformed as can be seen in Table 4.6 into two new variables.

Table 4.6: The categorization of the variables number of well-implemented mitigation strategies and number of departments involved in SCRM.

Original Value	Recoded 7-Scale
0–3 strategies / 0–1 departments	1
4–6 strategies / 2 departments	2
7–10 strategies / 3 departments	3
11–13 strategies / 4 departments	4
14–17 strategies / 5 departments	5
18–20 strategies / 6 departments	6
21–24 strategies / 7+ departments	7

Fifthly, for calculating maturity model levels, several items were used to measure each capability. For example, the "resources" dimension was captured through three items: human resources, financial resources, and technical resources. To obtain an overall maturity level for "resources," these three items were averaged. To transform the results into the four levels of the maturity model, thresholds were then defined as follows, Level 1 represents an average between 1 and 2.5, Level 2 covers averages between 2.5 and 4, Level 3 includes averages between 4 and 5.5, and Level 4 corresponds to averages between 5.5 and 7.

4.5.1.5. Size and Industry Categorization

To be able to answer RQ3, the companies needed to be categorized into size and industries correctly and are presented in table 4.7. The mapping of the represented companies was measured based on the annual revenue. Regarding annual revenue, six respondents selected 'I don't know' when asked about their company's revenue. Public data from Allabolag.se was used to manually classify four of these, while two remained unclassified due to lack of information. Based on the available data, seven companies were categorized as *small revenue companies* (0–499 million SEK), 14 as *lower mid revenue companies* (500 million–2.49 billion SEK), 18 as *upper mid revenue companies* (2.5–9.99 billion SEK), and 26 as *large revenue companies* (10–100 billion SEK).

To compare differences based on firm size, organizations were grouped into four revenue-based categories (Size 1-4). Originally, firms reported their revenue by entering one of the eight options that was including revenues from 'Less than 100 million SEK' to 'Greater than 100 billion SEK'. However, to achieve a more balanced distribution and sufficient sample sizes within each group, the categories were consolidated: sizes 1-2 were merged into Size 1, 3-4 into Size 2, 5-6 into Size 3, and 7-8 into Size 4. This resulted in group sizes of 7 organizations in Size 1, 14 in Size 2, 18 in Size 3, and 26 in Size 4.

Regarding industry classification, some companies provided more specific industry descriptions than the predefined categories in the questionnaire. In these cases, the researchers assigned them to the closest predefined category based on the definitions in Chapter 3 Industry Specific Characteristics. Eight companies identified with two industries and two companies identified with all three. Most companies (n=55) clearly identified with a single industry. The eight dual-industry companies all included food, typically combined with packaging or non-food items, and were classified under food as their core business. The two companies that selected all three industries were excluded from the analysis answering RQ3 on industry comparison due to the absence of a clear primary industry, and would not be applicable to compare between industries if they operate in all, these are therefore included in a separate column in the table.

Table 4.7: The categorization of the respondents divided into sizes and industry.

	Retail	Manufacturing	Food	Operating in all three industries	Total
Size 1	1	3	3		7
Size 2	4	4	6		14
Size 3	5	4	8	1	18
Size 4	9	12	4	1	26
Total	19	23	21	2	

4.5.2 Initial Exploration, Analysis of Data, and Graphical Representation

This thesis analyzed both individual variables and relationships between two or more variables.

4.5.2.1 Descriptive Statistics

For univariate analysis in this thesis was mostly analyzed by visualizing the data using simple bar charts, stacked relative bar charts or into boxplots, see Figure 4.6. For more statistical information, the mean, median, range, frequencies, was found with the help from SPSS. Important to remember is that the mean can greatly vary if there are outliers and might need to be removed to get a favorable picture, therefore the distribution of data is also important to consider (Denscombe 2017).

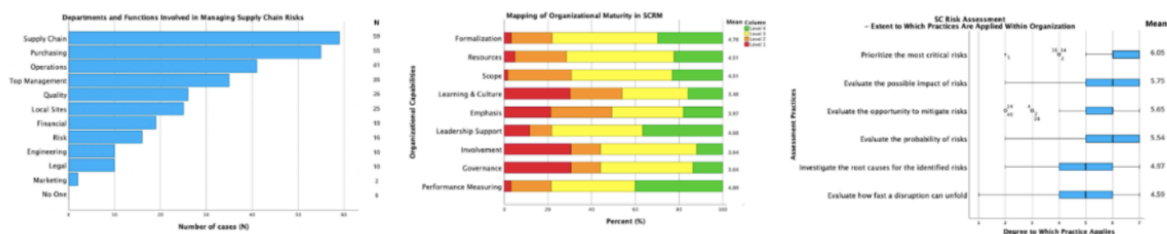


Figure 4.6: Examples of different plots that were used, with a simple bar chart to the left, a stacked relative bar chart in the middle and a boxplot to the right.

Bar charts were used to present descriptive statistics for multiple-choice questions, showing how frequently each option was selected by respondents. This allowed for a clear overview of the most to least popular choices in descending order. In one case, stacked relative bar charts were employed. These made it easy to assess the distribution of perceptions, whether they skewed toward higher values (right side) or lower values (left side). Stacked bar charts were particularly useful when comparing two or more variables side by side, highlighting similarities or differences in response patterns.

The boxplot is a way to visualize data where one can understand the shape and dispersion of a distribution. The box comprises the middle 50 percent of observations, with the median in the box. Thereafter, there are two whiskers extended downwards to the lowest value in the distribution and upwards to the largest value, excluding outliers, which are separated from the box and instead marked as a circle if 1.5-3 standard deviations away from the mean or as a cross if more than 3 standard deviations away. This way, outliers could be identified as well as to see if the majority was centralized around one number or if the responses had a wide range. In addition to this, the boxplot diagrams included the mean value to the right in all plots to get further insights into the distribution.

4.5.2.2 Explanatory Gap Analysis

To address RQ3, the descriptive analysis was complemented with a comparison between respondents' perceived difficulty of each practice and their corresponding level of implementation. This was visualized using Bubble Diagrams in Excel, where perceived difficulty was plotted on the x-axis and implementation level on the y-axis. The size of each bubble represented the number of respondents selecting a given combination of ratings. This approach allowed for the identification of potential patterns in the relationship between the two measured variables. An example of a bubble diagram is shown in Figure 4.7.

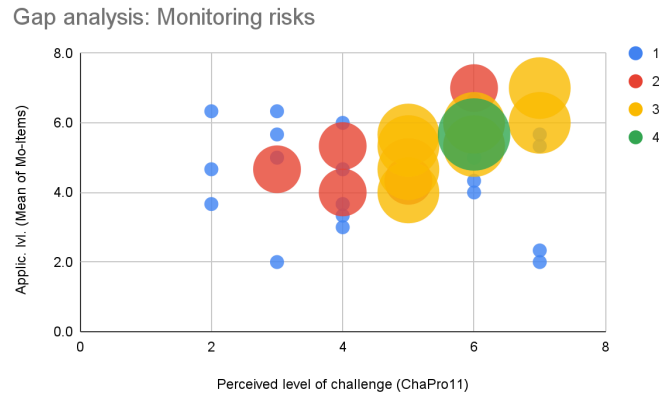


Figure 4.7: An example of a bubble diagram, comparing the variable values of perceived level of difficulty of a practice and the corresponding implementation level of the practice.

In most comparisons, there were matching items used to measure both the level of application and the perceived challenges. For example, the challenge of securing adequate financial resources was compared to how often companies reported having sufficient financial resources in place. However, in some cases, there was no single item that directly corresponded to the challenge. One such example is the challenge of maintaining a consistent frequency of procedures, which was instead compared to the average implementation score across four related items: identifying risks-, assessing risks-, mitigating risks-, and evaluating the effectiveness of mitigation strategies at planned occasions at least annually. Full details of how items were paired for comparison can be found in the Figure captions in Appendix B (proactive practices), Appendix C (reactive practices), and Appendix D (organizational aspects).

4.5.2.3 Statistical Differences

In addition to descriptive statistics, one of the research questions, RQ3, examines if there are differences between industries or sizes. This will be examined through The Kruskal-Wallis test, which is a non-parametric statistical test used to determine if there are significant differences between three or more independent groups. It is applied when the data are ordinal or when continuous data do not meet the assumptions of normal distribution. The test ranks all data across groups and compares the sum of ranks for each group. The null hypothesis states that all groups have the same mean rank. A p-value below the significance threshold (e.g. 0.05 or 0.1) leads to rejecting the null hypothesis, indicating that at least one group differs significantly from the others (DataTab Team 2025). Each group should consist of a sample size of at least five (Lomuscio 2021).

For both industry and size comparisons, the mean was calculated for each group, either industry or company size, and was visualized in bar charts alongside the Kruskal-Wallis test to illustrate average group responses. This approach helped identify the sources of significant differences and also allowed for discussion of general trends where differences were not statistically significant.

4.6 Quality of Research

To ensure a good quality of research, some requirements were set for the documents included in the literature review. Primarily, the sources needed to be research articles or published books. While the name of the journal or publisher was not strictly limiting, it was considered when evaluating the document's relevance. Similarly, publication date was not a strict criterion but was considered in relation to the specific information used from each source. However, exceptions regarding the

formality of the references were made for sources offering practical perspectives, where more informal web-based materials were included to complement the knowledge base. These practical contributions included for example news articles covering the consequences of experienced cyber-attacks, descriptions and instructions on how to perform statistical tests, as well as the collection of available methods and tools. In these cases, the source's informal character and their connection to practice does rather seem to complement the literature review than harming its credibility.

To ensure the trustworthiness of the empirical research, it is necessary to minimize the risk of obtaining poor-quality answers or unreliable results, which requires a strong focus on both reliability and validity (Denscombe 2017). The description as well as actions to enhance each criteria can be seen in Table 4.7.

Table 4.7: Actions taken to ensure validity and reliability in the thesis.

	Definition	How is it obtained in the thesis?
Validity	Validity refers to the extent to which a measure accurately assesses what it intends to measure.	- Have non-experts review the measure to see if it makes sense intuitively (Leavy 2017) - Consult experts in the field to confirm the measure is appropriate (Leavy 2017) - Clearly define concepts using precise operational definitions (Leavy 2017) - Use appropriate statistical methods and verify that conclusions align with statistical laws (Leavy 2017) - Compare to additional studies with different populations and settings to confirm the broader applicability of the results (Leavy 2017) - Conduct pre tests to measure effect (Leavy 2017) - Conduct research with diverse populations to check if findings generalize beyond the tested group (Leavy 2017) - Systematically review responses – Eliminate answers that are clearly contradictory or random (Denscombe 2017)
Reliability	Reliability refers to how consistent the research findings are when the research process is repeated under similar circumstances with the same or similar instruments and the same phenomenon. To ensure reliability it is of relevance to ensure traceability and that no alternations in methodology is done (Saunders, Lewis & Thornhill 2006)	- Include several related questions or measures for a single variable to check for consistency across responses. If responses vary significantly, review and refine the inconsistent items (Leavy 2017) - Provide all participants with identical and clear instructions to ensure consistency in test administration, scoring, and interpretation (Hassan 2024) - Conduct pilot studies to identify and revise ambiguous or poorly worded survey questions (Hassan 2024)

5. Empirical findings related to SCRM practices

This chapter presents and analyzes the empirical results, where Section 5.1 covers background data and Section 5.2 addresses SCRM practices (RQ1)

Note that the results sometimes refer to low, moderate or high ratings. Low ratings include all scores of 1, 2 and 3, moderate ratings include 4 and 5, and high ratings include the ratings of 6 and 7.

5.1 Background

5.1.1 Background Results

The questionnaire responses provided background information to better understand the sample's characteristics, such as the respondents' job titles, and number of employees, annual revenue and industry of the companies they represent, presented in Table 5.1. The results and analysis are based on data from 65 completed questionnaires. Among these respondents, 32 respondents were employees working within *SCM* or *logistics*, followed by the second most represented department *purchasing* (11 respondents). For both departments, both *directors*, *managers*, and *team members* were represented in the respondent groups. In terms of hierarchical level, directors constituted the largest group of respondents, followed by managers and then team members. The mapping of participating companies was based on annual revenue, number of employees, and industry affiliation. The gray areas in the revenue chart indicate the transformed company size categories, where the original eight options were consolidated into four distinct size groups.

Table 5.1: Demographics of the research participants.

	n (65)	%
Job title		
CEO/CFO	0	
Vice President (Supply Chain Management, Operations, Purchasing, Risk)	3	4.6
Supply Chain Management Director / Head of Supply Chain / Logistics	16	24.6
Operations Director / Head of Operations	4	6.2
Purchasing Director / Head of Purchasing	5	7.7
Risk Director / Head of Risk	2	3.1
Supply Chain / Logistics Manager	11	16.9
Operations Manager	0	0
Purchasing Manager	3	4.6
Risk Manager	6	9.2
Supply Chain / Logistics Team member	5	7.7
Purchasing Team Member	3	4.6
Other	7	10.8
Number of employees		
Less than 100 employees	4	6.2
Between 100 and 499 employees	17	26.2
Between 500 and 999 employees	4	6.2
Between 1000 and 4999 employees	17	26.2
Between 5000 and 9999 employees	7	10.8
More than 10000 employees	16	24.6
Annual revenue		
Less than 100 million SEK	2	3.1
Between 100 and 499 million SEK	5	7.7
Between 500 and 999 million SEK	2	3.1
Between 1 and 2.49 billion SEK	12	20
Between 2.5 and 4.99 billion SEK	7	10.7
Between 5 and 9.99 billion SEK	11	16.9
Between 10 and 99 billion SEK	17	26.2
Greater than 100 billion SEK	6	9.2
Uncertain	2	3.1
Industry*		
Retail	25	38.5
Food	22	33.8
Manufacturing	30	46.2

* - the frequencies and percentages exceed 65 and 100 percent respectively as there are 10 companies which have been identified to fit into more than one industry.

The questionnaire also showed that for both proactive and reactive SCRM, the most common approach is to assign responsibility to a *team of employees from different departments*, presented in Figure 5.1. This is particularly evident in reactive SCRM, where approximately 68 percent (44 cases) follow this approach, compared to approximately 60 percent (39 cases) for proactive SCRM. Other response alternatives are considerably less common. For proactive SCRM, the second most chosen alternative is *top management* (17 cases), followed by *teams of employees from the same department* (7 cases). For reactive SCRM there is a similar pattern, though *top management* is selected in only 7 cases, while *same-department teams* are noted in 11. No respondent selected “No one” or “One individual.”

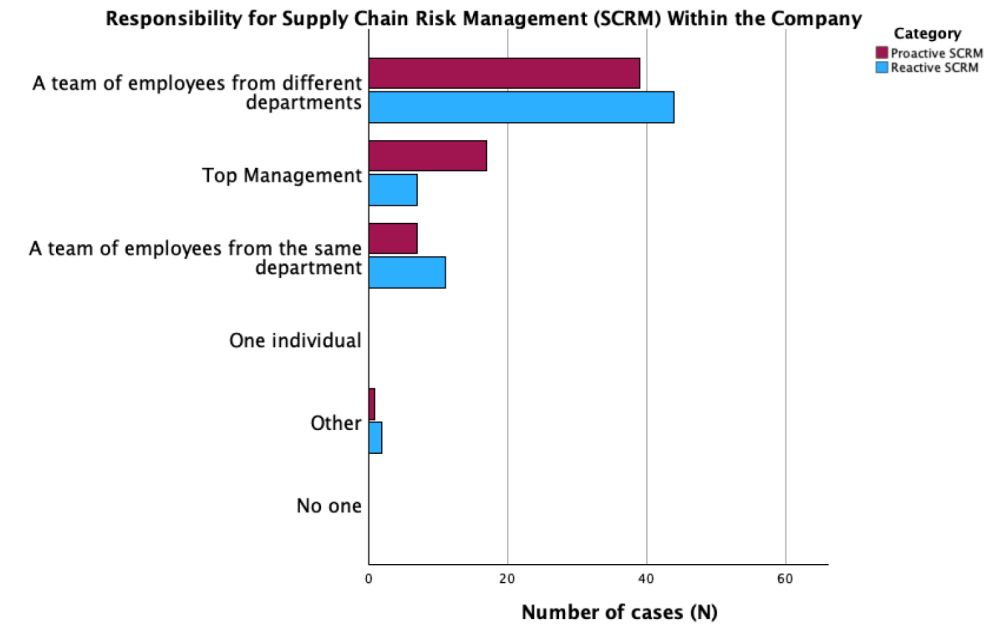


Figure 5.1: The responsibility allocation for SCRM in companies.

Furthermore, the most frequently involved departments/functions in managing SCRM are *supply chain* and *purchasing*, followed by *operations* and *top management*, presented in Figure 5.2. Mid-level involvement is seen from *quality*, *local sites*, *financial* and *risk*. Meanwhile, the least involved are *engineering*, *legal*, and *marketing*. When observing the underlying data, it is calculated that the mean number of departments/functions included in SCRM is 4.6 departments/functions, showing a general cross-functional focus.

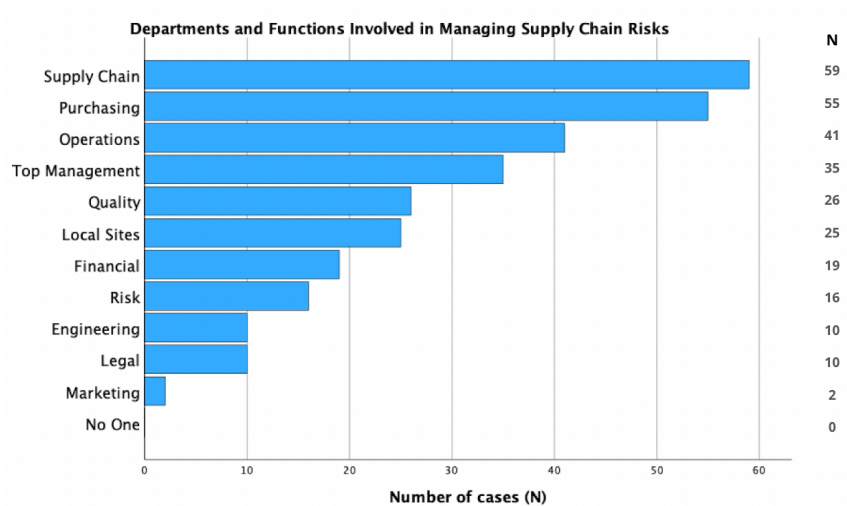


Figure 5.2: Departmental and functional involvement in SCRM.

To investigate the perceived relevance of SCRM in practice, the respondents were asked questions regarding how serious they perceived different SCR types to be, categorized into *macro risks*, *network risks*, and *internal risks*, as well as the importance of SCRM. Respondents rated both aspects on a 1–7 scale, where higher values indicate greater perceived seriousness and importance respectively.

Based on the mean values, in Figure 5.3, the highest perceived risk category is *geopolitical risks* (e.g. wars, terrorism, trade wars), closely followed by *supply risks* (e.g. limited available suppliers and capacity), *logistical risks* (e.g. delivery reliability), and *environmental risks* (e.g. natural disasters, pandemics). Contrary, the lowest perceived risks are *corporate risks* (e.g. cultural differences, poor communication) and *contractual risks* (e.g. contractual and legal disputes).

The overall results indicate a wide variety in perceived seriousness of the SCR types. While 50 percent of respondents typically fall within a three-point range for most risks, the full spectrum ranges from 1 to 7 for most SCR types. However, *logistical risks* and *supply risks* diverge from this trend, exhibiting a narrower range and a higher degree of consensus. With the exception of a few outliers, presented as circles and stars in the diagram, all respondents rated these risks as moderate or high. On the contrary, there is less consensus regarding the perceived seriousness of *quality risks* (e.g., poor product quality, lack of quality control), *operational risks* (e.g., equipment breakdowns, poor work skills), and *corporate risks*, as the spread within the central 50 percent is wider compared to other risk categories.

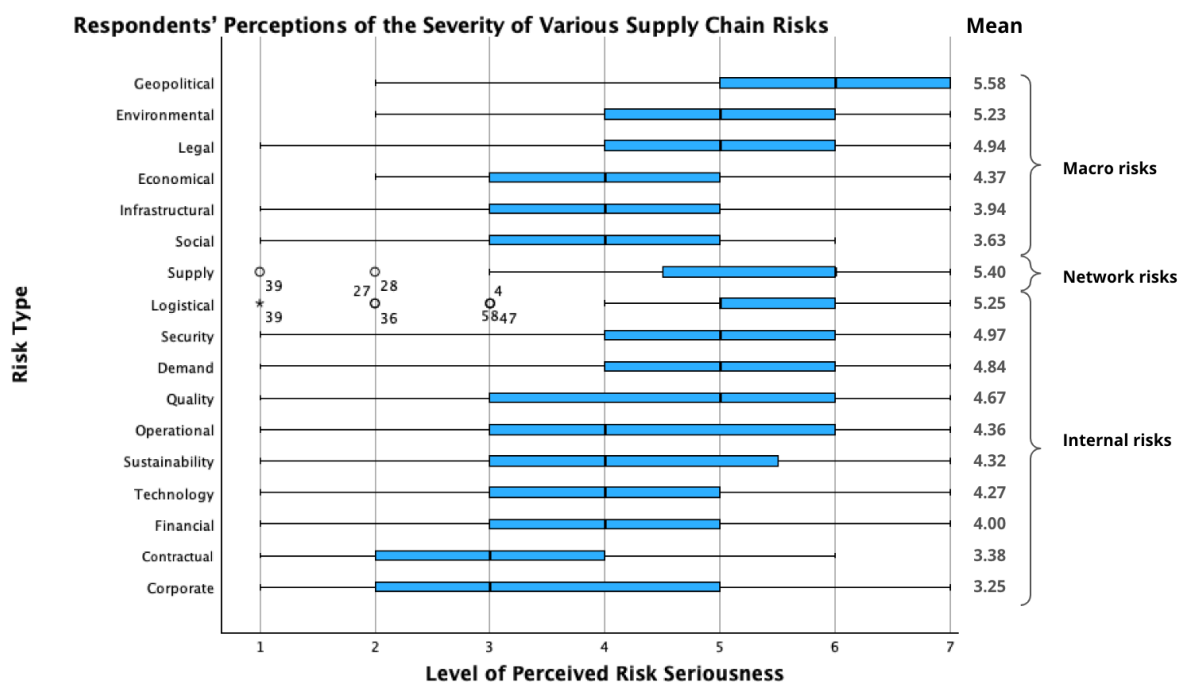


Figure 5.3: The extent to which respondents perceive the seriousness of different risk types.

Both *proactive SCRM* and *reactive SCRM* are perceived as important for company success, according to Figure 5.4. All respondents rated proactive SCRM as at least moderately important (scores of 4-7), with approximately 80 percent considering it highly important. In contrast, perceptions of the importance of reactive SCRM were somewhat more varied as approximately 70 percent rated it as highly important, 25 percent as moderately important, and around 5 percent as of low importance (score of 3).

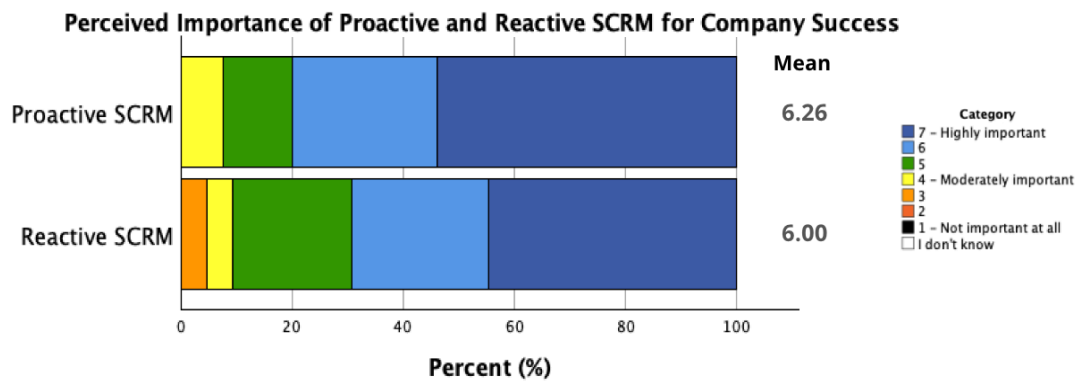


Figure 5.4: The perceived importance of Reactive and Proactive SCRM.

5.1.2 Background Analysis

The results in Figure 5.1 show a clear organizational preference for managing SCRM through cross-functional teams, indicating it is increasingly seen as a shared responsibility rather than the domain of a single individual or department. Compared to Norrman and Näslund's (2016) finding that fewer than 10 percent of companies shared responsibility across departments, this reflects a notable increase in cross-functional collaboration over the past nine years. This trend likely reflects a growing recognition among companies of the complexities involved in managing SCRs and SC disruptions, along with the advantages of involving multiple business areas covered in the literature, such as facilitating knowledge- and information sharing (Van den Adel, de Vries and Van Donk 2023) which in turn can enable swift, coordinated action. The absence of "No one" responses further highlights that most companies now assign structured responsibility, underscoring SCRM's rising organizational importance.

Furthermore, according to Figure 5.1, *top management* is more commonly responsible for proactive SCRM than for reactive SCRM, which may reflect a greater need for involvement of top management in proactive SCRM initiatives. On the contrary, disruptions are often identified and addressed at the operational level (Sheffi 2015), making reactive SCRM more reliant on operational staff for quick and coordinated actions, rather than top management.

By looking at the results from Figure 5.2, it is further confirmed that many organizations have a structured cross-functional collaboration by the mean number of involved departments/functions (mean of 4.6). As noted in the literature review, Harland, Brenchley, and Walker (2003) highlight the importance of adopting a holistic approach to SCRM, rather than operating in silos, to reduce the risk of overlooking critical SCRs. The findings in Figure 5.2 regarding the departments most commonly involved further indicates that organizations prioritize including employees who are closely connected to day-to-day disruptions and possess deep SC knowledge. Top management as the fourth most commonly involved function further ensures that SCRM receives prioritization (Guerra et al. 2024). According to Norrman and Wieland (2020), such support is essential for improving SCRM outcomes, fostering long-term commitment, and enabling the implementation of large-scale, cross-functional strategies that are critical for proactive SCRM, such as investments in forecasting, product standardization, or structural changes to the SC.

On the other hand, functions such as *quality*, *finance*, and *local sites* tend to play more supportive roles, while departments like *risk*, *legal*, *engineering*, and *marketing* are less frequently involved. This

could suggest a gap in cross-functional integration, potentially overlooking critical perspectives like legal compliance or product design vulnerabilities. However, it is important to consider that not all respondents may have all these functions established within their organizations.

Differences depending on individual characteristics of companies may also affect what SCR types that are considered most serious as the wide boxplot ranges in Figure 5.3 indicate that companies do face varying levels of risk exposure. However, the data reveal that the four most highly perceived risks are *geopolitical*, followed closely by *supply*, *logistical*, and *environmental risks*. When comparing these results with Norrman and Näslund's (2016) study, which investigated the frequency of disruptions caused by various risk categories, it is not surprising that *supply*- and *logistical risks* are ranked at the top. Their findings revealed that nearly 70 percent of respondents had encountered disruptions in the past 12 months related to *supplier production capabilities* and *transportation issues*, risks that closely align those identified in this thesis. While Norrman and Näslund's study did not assess the aspect of risk impact when asking about the risks, the high regular occurrence of disruptions suggests that these risks remain serious concerns for many companies, even nine years later. Furthermore, these risks appear to be relevant to a broader group, as indicated by the narrower range of the boxplot, which is concentrated towards the higher scores.

However, when comparing the results with Norrman and Näslund's study (2016) regarding *geopolitical* and *environmental risks*, there seems to be a discrepancy. According to their study, less than 15 percent of respondents reported disruptions from geopolitical issues the last 12 months, and less than 20 percent from extreme weather or natural disasters the last 12 months, making them the least frequently encountered risks. This discrepancy between the rankings of the studies suggests that, while macro risks may occur infrequently, they are perceived as highly severe due to their potential for widespread impact. This likely reflects the increased frequency of large scale disruptions of the sort the last couple of years, including the COVID-19 pandemic, the Ukraine conflict, escalating trade tensions, and climate-related disasters, which have likely heightened awareness of systemic vulnerabilities in global SCs and made these SCR types "top-of-mind".

Furthermore, the results showing generally high perception of seriousness of SCRs seem to correlate with the perception of the importance of SCRM, which were seen in Figure 5.4. There is a high level of consensus on the strategic value of both proactive and reactive SCRM. However, the somewhat larger group rating reactive to be of low and moderate importance, indicates a slight trend toward viewing proactive approaches as more valuable than reactive measures. These results indicate a potential shift in industry mindset (Norrman & Wieland 2020), where prevention is increasingly emphasized, perhaps influenced by the global disruptions that highlighted the limitations of reactive strategies.

5.2 SCRM practices

Section 5.2 presents the empirical findings for RQ1. Sections 5.2.1.1–5.2.1.5 cover the proactive SCRM process, followed by analysis in 5.2.1.6. Section 5.2.2 presents reactive SCRM, 5.2.3 covers methods and tools, 5.2.4 addresses organizational aspects, and 5.2.5 outlines findings on perceived resilience.

5.2.1 The Proactive SCRM process

5.2.1.1 Identification Practices

According to Figure 5.5, at least 75 percent of respondents perceive their organizations as applying risk identification practices to a moderate or high degree, except the practice of *identifying risks related to third-tier suppliers*, where approximately 75 percent rate it as a 4 or below. The practices with the highest mean scores are the *selection of relevant areas for risk identification* (mean of 5.97) and *understanding SC complexity* (mean of 5.84). Boxplot profiles further indicate that nearly all respondents view these two practices as at least moderately implemented, where only a few exceptions report lower levels. A clear decline in risk identification is observed across supply chain tiers, with mean scores dropping from 4.92 for first-tier suppliers to 4.14 for second-tier and 3.07 for third-tier suppliers. The second and third-tier practices have the lowest averages among all identification items, indicating a significantly reduced focus on upstream risks.

Furthermore, when investigating the underlying data, it is found that 28 percent of respondents rated all identification items, excluding items related to the scope of identification, at the same level, with all ratings indicating a high degree of application. The remaining 72 percent of the respondents are not consistent in their ratings for all items included.

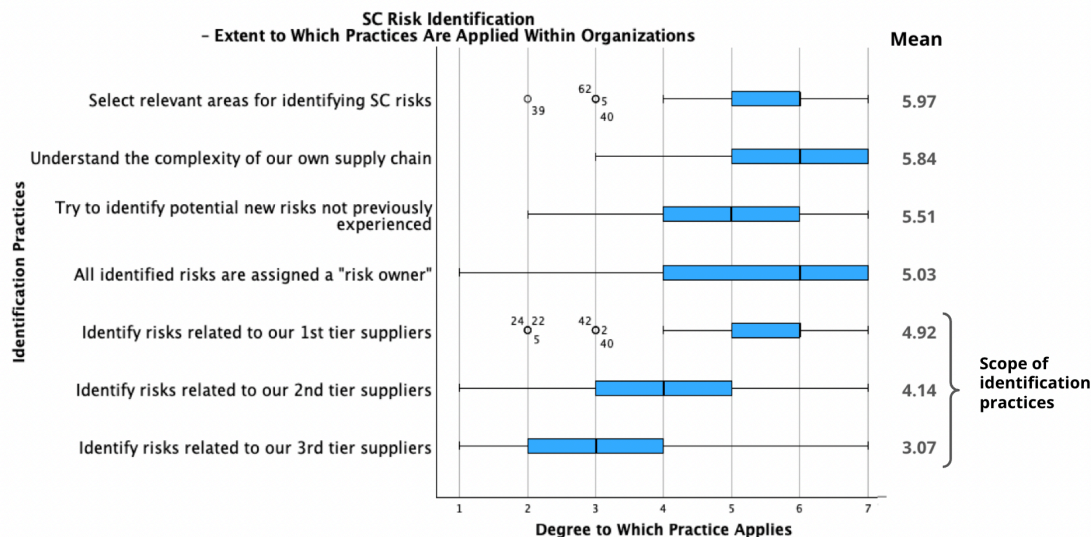


Figure 5.5: The extent to which respondents perceive their involvement in risk identification.

5.2.1.2 Assessment Practices

The step of assessment aims to equip decision-makers with the necessary information, based on key factors, to prioritize risks from most to least critical (Polyviou, Ramos & Schneller 2022). The overall

results of Figure 5.6, indicate that at least 75 percent of the respondents have applied each assessment item on a moderate to high level. The practice that received the highest mean score is the *prioritization of the most critical risks* (mean of 6.05). Except for four outliers, all respondents rated their application level between 5 and 7, making it one of the most implemented practices across the entire proactive SCRM process.

After that, the results show that the most commonly considered factors in risk assessments are the *potential impact of a risk* (mean of 5.75), *the opportunity to mitigate the risk* (mean of 5.65), and the *probability of occurrence* (mean of 5.54). The spread in responses is notably more narrow for evaluating the opportunity to mitigate risks, as nearly all respondents (except a few outliers) report applying this practice to at least a moderate degree. In contrast, the remaining two factors, *investigating root causes* (mean of 4.97) and *evaluating how fast a disruption may unfold* (mean of 4.59), are applied to a lesser extent with a larger respondent group reporting that the practices are applied to only a low degree.

Furthermore, 23 percent of respondents rated all assessment-related items at the same level, with 20 percent applying them consistently at a high level and around 3 percent at a low level. The remaining 77 percent of the respondents are not consistent in their ratings for all items included.

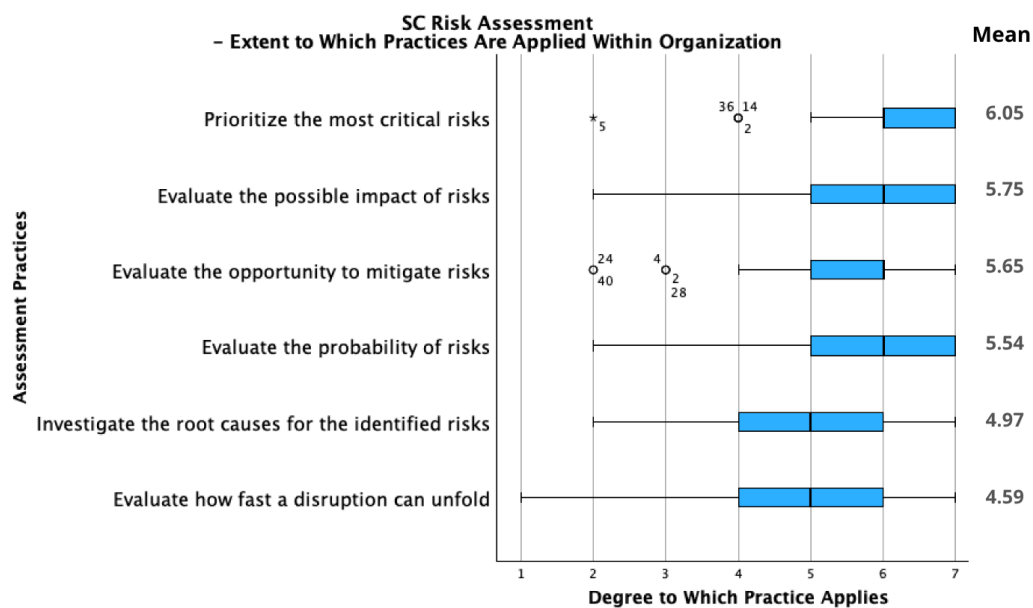


Figure 5.6: The extent to which respondents perceive their involvement in risk assessment.

5.2.1.3 Mitigation Practices

The step of mitigation involves selecting and implementing suitable mitigation strategies based on important factors (Tummala & Schoenherr 2011; Fan & Stevenson 2018; Manuj & Mentzer 2008). Aligned with the results in Figure 5.6, Figure 5.7 presents that the most widely considered factors in the decision to mitigate risks are also related to the *potential impact of risks* (mean of 5.60) and *probability of risk occurrence* (mean of 5.38). Responses related to *probability* show a narrower spread in the boxplot, indicating more consistent application across organizations, with fewer companies using this factor at a low level. Basing mitigation efforts on a *predetermined risk tolerance* is the least applied practice, with a mean score of 3.83 and a wide variation in responses, highlighting a lack of consistency amongst organizations. Overall, the results show that approximately 75 percent

of respondents apply all decision-making factors, except basing the decision on a *predetermined risk tolerance*, at a moderate or high level.

Furthermore, when investigating consistency of answers, 16 percent of respondents rated all mitigation related items at the same level (low, moderate, or high). Approximately 9 percent consistently apply all mitigation practices to a high degree, approximately 2 percent as moderate and approximately 5 percent at a low degree. The remaining 84 percent of the respondents are not consistent in their ratings for all items included.

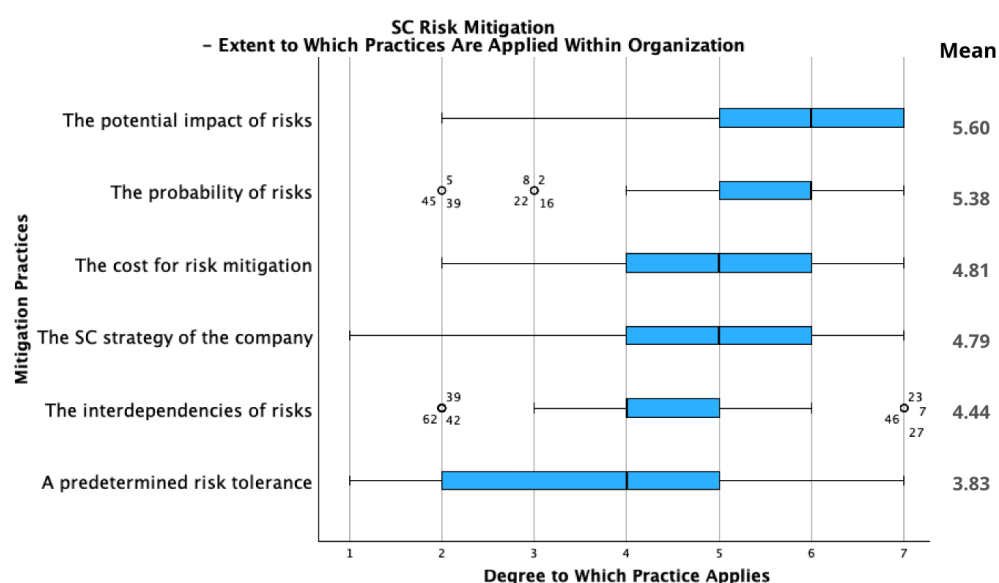


Figure 5.7: The extent to which respondents perceive their involvement in risk mitigation.

In addition to the mitigation practices, respondents were asked to rate the degree to which specific mitigation strategies are applied on a 1–7 scale. The results, presented in Figure 5.8 and Figure 5.9, show that implementation levels vary to a large degree, as the boxplot profiles for 18 of the 24 strategies cover the complete range on the 1-7 range scale. However, all but three strategies have mean values above four, indicating that most companies apply several strategies to at least a moderate extent. This is supported by underlying data, showing that 83 percent of companies rated at least 12 out of 24 strategies as moderately or highly applied, with about 14 percent rating 12 strategies as highly applied.

The strategies with the highest mean scores are *sourcing from creditworthy suppliers* (mean of 5.72), *using multiple sourcing* (mean of 5.28), *improving forecasting techniques* (mean of 5.24), and *improving data security* (mean of 5.18). The strategies related to *transferring- or sharing risk via contracts* (mean of 4.07–4.15), *developing joint SC strategies* (mean of 4.14), *postponement* (mean of 3.60), *outsourcing non-critical activities* (mean of 3.64) and *insourcing* (mean of 3.84) show the lowest usage.

Furthermore, the most and least applied strategies were compared with regard to the representation of the five main categories of mitigation strategies, *accept*, *avoid*, *transfer*, *share* or *reduce* the probability and/or the impact of the risk. All except one of the top eight strategies are risk reducing strategies, meanwhile four out of five of the least applied strategies are risk transfer or risk sharing strategies.

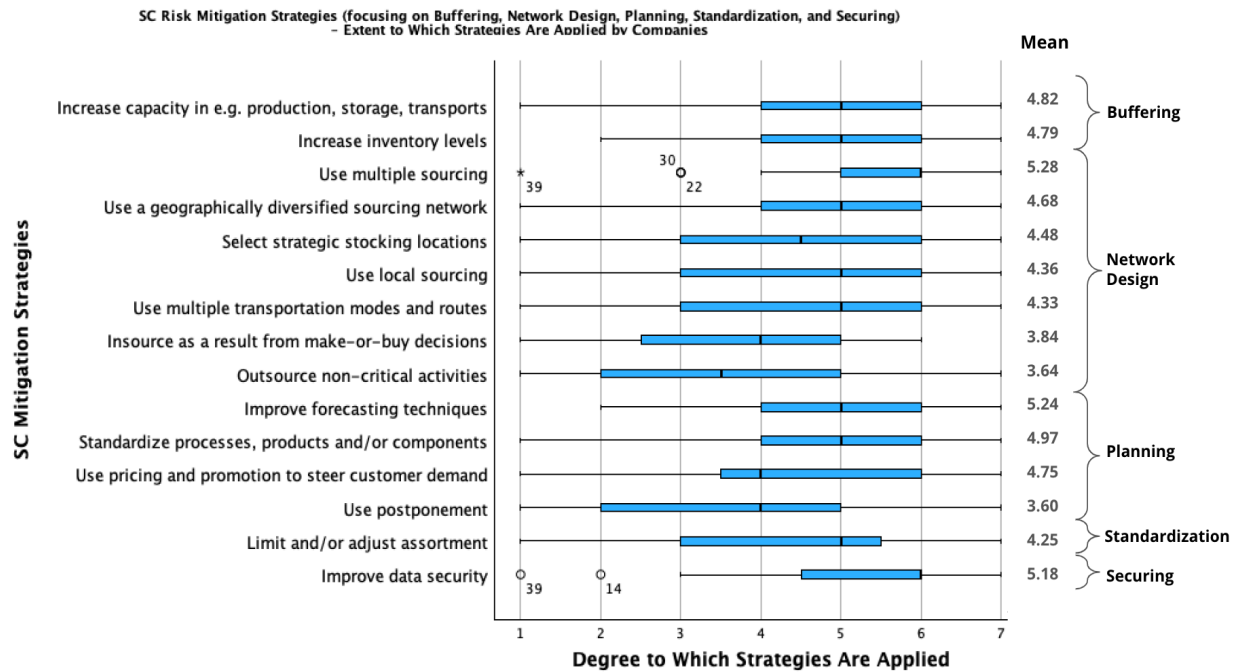


Figure 5.8: The extent to which respondents utilize risk mitigation strategies related to buffering, network design, planning, standardization, and securing.

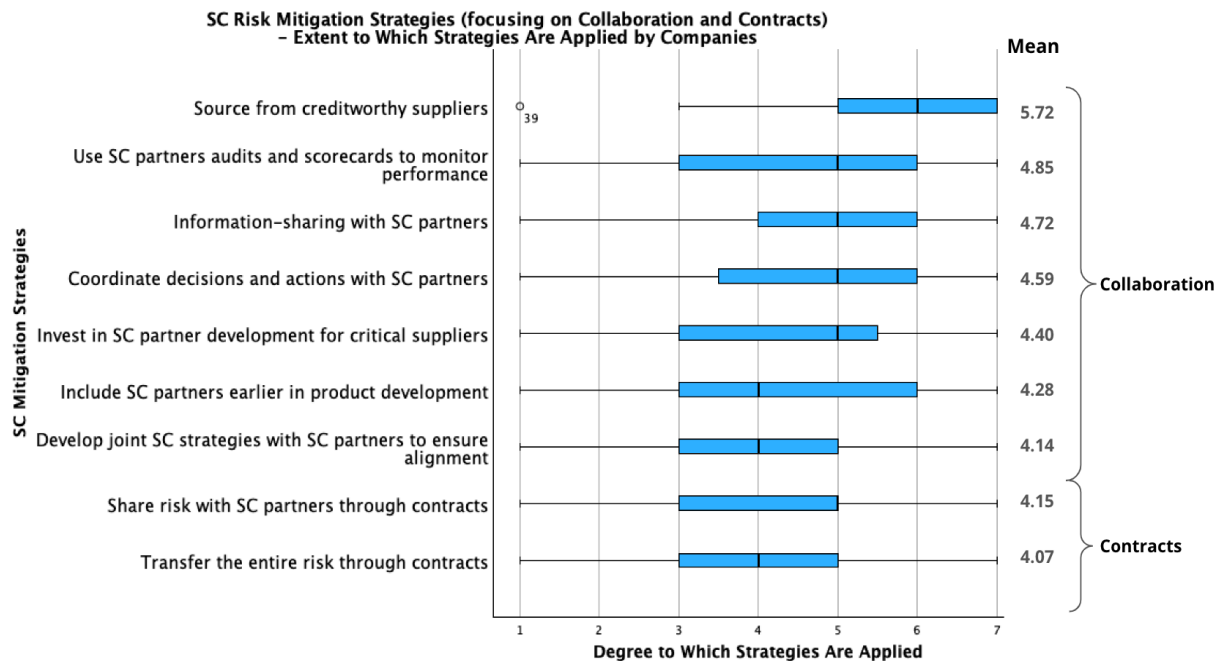


Figure 5.9: The extent to which respondents utilize risk mitigation strategies, related to collaboration and contracts.

5.2.1.4 Monitoring Practices

The step of monitoring aims to track changes in the risk landscape and assess the ongoing performance of SC partners (Polyviou, Ramos & Schneller 2022; Norrman & Jansson 2004). Overall, the results in Figure 5.10, suggest that approximately 75 percent of respondents apply all monitoring practices at a moderate or high level. The mean values of the measured items indicate that the most

applied practice is *monitoring of mitigated risks* (mean of 5.41), followed by *monitoring of unmitigated risks* (mean of 4.97) and lastly *monitoring of SC partners* (4.92). The differences in mean values are small however the two latter practices show a broader spread in responses, with scores spanning the full range of the scale meanwhile the lowest perceived application level of *monitoring mitigated risks* is three (except one single outlier).

Furthermore, 37 percent of respondents rated all monitoring-related items at the same level, with 17 percent applying them consistently at a high level, 14 percent at moderate levels, and around 6 percent at a low level. The remaining 63 percent of the respondents are not consistent in their ratings for all items included.

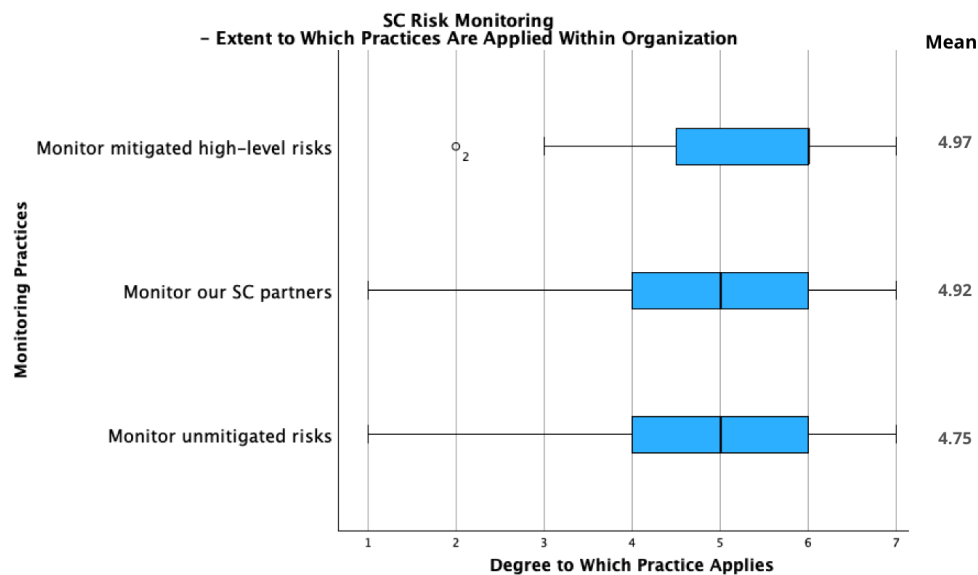


Figure 5.10: The extent to which respondents perceive their involvement in risk monitoring.

5.2.1.5 Frequency of Conducting Procedures

In addition to the implementation level of proactive SCRM process practices, the respondents were asked if they performed activities related to each process step on a planned basis, at least annually. The respondents rated to what degree the statement applied to their company on a scale 1-7.

The results, presented in Figure 5.11, suggest that most companies conduct SCRM activities on a fairly regular and structured basis, at least once per year, indicating a balanced and integrated approach to SCRM. Although differences in mean values are small and not statistically significant, *risk identification* appears to be the most regularly performed activity (mean of 5.29), followed closely by *risk assessment* (mean of 5.25), *risk mitigation* (mean of 5.10), and slightly less frequently, *evaluation of mitigation effectiveness* (mean of 4.75).

The boxplot profiles for all items range from 1 to 7, indicating considerable variation between companies. However, within each company's response, the frequency of identification, assessment, and mitigation is relatively consistent, most vary by no more than ± 1 point on the scale of 1-7. However, *evaluation of mitigation effectiveness* stands out as an exception as it is performed less frequently in roughly one out of four cases, falling behind by more than two points compared to the other activities.

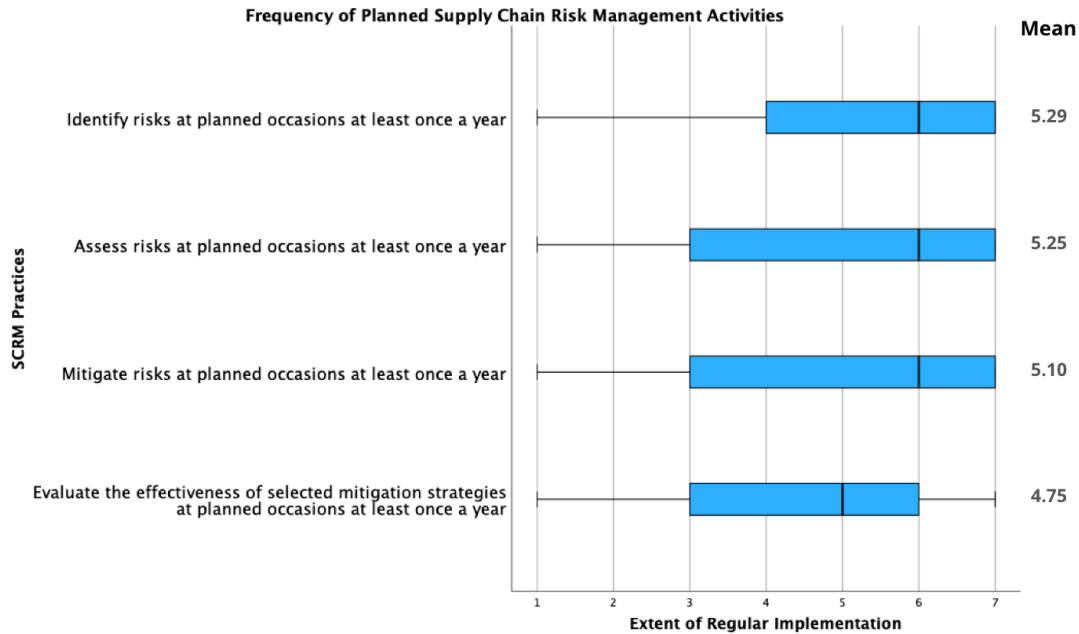


Figure 5.11: The extent to which respondents report conducting various supply chain risk management practices at least once per year.

5.2.1.6 Analysis of Results Related to Proactive SCRM Process Practices

The results related to all four process steps show that, with a few exceptions of individual items, approximately 75 percent of the respondent group seem to apply all practices to a moderate or high degree. This implies that the majority of companies seem to have established some type of proactive SCRM process, including practices related to all suggested process steps. This is further confirmed by the consistency analysis that shows that only 0 to 6 percent of respondents consistently apply all items within each process step at a low level, suggesting that almost all organizations engage with SCRM practices to some extent, even if not always at a high level. On the contrary, approximately 14-28 percent of respondents report consistently applying all relevant practices to a high degree for the steps of identification, assessment and monitoring, indicating that there are groups of companies with consistently high proactive SCRM maturity at the different steps, implementing many of the practices recommended in the literature. Mitigation stands out as the process step with the smallest proportion of respondents applying all practices at a consistently high level. This may be due to the relatively low implementation of using *predetermined risk tolerance* as a basis for mitigation decisions.

Lastly, the high consistency of how frequently companies perform each process step further indicates that the practices related to each step are not only performed at similar level but also with similar time intervals. Noteworthy is however that the activity of *evaluating the effectiveness of mitigation efforts* stands out with lower and more variable application. This monitoring step, which involves assessing how risks evolve post-mitigation, appears to be implemented to a lower degree, suggesting a potential gap in follow up and monitoring. It may also indicate that the “feedback loop” in the proactive SCRM process is not effectively implemented, limiting organizations’ ability to learn from past actions and improve future SCRM.

When instead analysing the results related to each proactive process step, it can be seen that the **identification** practices with the highest mean scores are the *selection of relevant areas for identifying SCRs* and *understanding the complexity of the organization’s specific SC*. These practices are closely

interrelated in the literature, as understanding SC complexity and vulnerabilities facilitates the detection of key exposure areas and helps narrow the scope of risk identification (Kern et al. 2012). The high application level of these items consequently indicates that most organizations adopt a structured and focused identification approach, which, as noted by Fan and Stevenson (2018), enhances both the thoroughness and resource efficiency of the process.

Furthermore, when examining risk areas included within companies' identification scope, the results surprisingly indicate that most organizations include *identification of previously unexperienced risks* to a moderate or high degree. This is notable given the literature's emphasis on the challenges of "forward-looking" risk detection, such as limited SC visibility (Harland, Brenchley & Walker 2003) and a bias toward previously experienced risks (Jüttner, Peck & Christopher 2003). One possible explanation for the relatively high scores of this item is the heightened risk awareness following major global disruptions, which have exposed the consequences of inadequate preparedness.

However, the limitations of the risk identification become apparent when analyzing how far upstream companies extend their risk measures. A clear decline is observed for identifying risks related to first-, second- and third-tier suppliers, highlighting a significant gap in upstream visibility. As Tang (2006) noted 20 years ago, risk identification and assessment becomes increasingly impractical and costly as the organizational distance between the risk and the exposure surface increases. Consequently, risk identification efforts tend to focus on internal operations and immediate partners (Tang 2006), evident also in this study. However, another interesting finding is the greater variation in responses regarding risk identification further upstreams, which shows that there are companies which actually have put efforts into implementation of such practices. This might reflect the significant progress made in the areas of information sharing and assistive technologies, since Tang's article 20 years ago, which have allowed companies to increase visibility in the SC. However, the greater variations upstreams may also reflect variation in SC complexity, as the practices are evidently easier in the case of less complex network structure.

The findings related to the **assessment** indicate that *risk prioritization* is the most widely applied practice, based on the item having both the highest mean score and the narrowest response distribution. This suggests that prioritization is relatively well established across the respondent group. This result is not unexpected, as prioritization similar to narrowing the scope during risk identification, is often a natural and pragmatic step in structuring the SCRM process and managing workload. By adopting such practices, organizations also improve their ability to allocate limited resources effectively and concentrate efforts on the most significant threats (Norrman & Jansson 2004; Kern et al. 2012).

However, as emphasized in the literature, effective prioritization should be grounded in a comprehensive assessment that incorporates multiple dimensions of risk. The results indicate that prioritization is primarily based on rough evaluations of *impact* and *probability*, which are widely recognized as fundamental criteria in risk assessment (Fan & Stevenson 2018). In practice, however, the *opportunity of mitigation* also appears to influence prioritization to a large degree. This likely reflects real-world resource constraints, where decision-makers focus on risks perceived as more actionable, commonly referred to as "low-hanging fruit". While this approach may be practical, it introduces the risk that less severe but more easily mitigated risks are prioritized over more critical threats that are more difficult to address.

Additionally, practices such as *investigating root causes* and *evaluating the speed at which disruptions may unfold* appear to be applied less frequently. Furthermore, assessing speed of disruption can be more difficult to quantify in the absence of prior comparable events. Concludingly, the companies seem to do a “high-level” risk assessment that to a lesser extent is based on a more thorough and underlying analysis, taking more complex and intricate parameters into account.

The literature emphasizes that proactive **mitigation** measures have historically been underutilized due to concerns about their associated costs, especially when the disruptions being targeted in proactive SCRM may never materialize (Tang 2006). While this questionnaire does not measure the financial investment level in mitigation efforts directly, the results indicate that many organizations have implemented foundational practices within proactive SCRM processes. This suggests a shift since Tang’s observation in 2006, reflecting a growing recognition of the proactive measures being justifiable.

Despite this progress, the survey also reveals that decisions on mitigation strategies are still largely driven by quantitative and operational considerations, particularly the factors of *probability of occurrence* and *potential impact*. These are core elements of traditional risk assessment frameworks and provide a solid starting point for mitigation (Fan & Stevenson 2018). However, the limited emphasis on more intricate and strategic factors, such as *interdependencies between risks*, *alignment with corporate strategy*, and the use of *predefined risk tolerance*, points to areas of improvement in order to increase the maturity in organizations’ mitigation approaches.

Furthermore, survey results indicate a clear preference for risk-reducing **mitigation strategies**, particularly those of a tactical or operational nature that can be implemented internally without relying on external SC partners. For example, common strategies include *improving forecasting accuracy*, *enhancing data security*, and *sourcing from multiple suppliers*. High application rates of *supplier audits*, *creditworthiness assessments*, and *investments in supplier development* further reflect a focus on ensuring reliability and performance within the existing supplier base through control and targeted investment, rather than through collaborative transformation. In contrast, more collaborative strategies, such as *risk-sharing contracts* or *joint SC strategy development*, are among the least applied. This suggests that mitigation approaches requiring long-term commitment, mutual investment, or greater inter-organizational coordination are often deprioritized, likely due to their complexity, resource demands, or limited short-term returns. The cost for mitigation being a relevant factor, may also be reflected by the applied mitigation strategies as organizations seem to favor supplier control measures, such as audits and credit assessments to secure critical components, rather than pursuing costlier alternatives like insourcing production, which may fall outside their core competencies.

Another notable aspect is that many widely adopted mitigation practices also serve dual purposes. For example, *enhanced forecasting* reduces risk by mitigating demand uncertainty while also supporting inventory and production planning. Similarly, *standardization* may contribute to both risk reduction and operational efficiency. This dual benefit of reducing risk while also improving day-to-day operations likely facilitates justification of implementation and increases support from a cost–benefit perspective.

The results related to **monitoring** practices which suggest monitoring to be a natural part of the proactive SCRM process signals a positive shift in practice, as monitoring has received limited attention across academic literature (Fan and Stevenson 2018). The growing recognition of this step

underscores an understanding that SCRs are dynamic in nature and can rapidly evolve, making previous assessments obsolete if not regularly revisited (Fan & Stevenson 2018).

More specifically, *monitoring of mitigated risks* is the most widely applied practice, with a higher mean score and a narrower distribution of responses. This likely reflects a preference to evaluate those risks which the organizations have made resource investments to mitigate. As noted by Norrman and Jansson (2004), monitoring these risks is crucial to verify whether the residual risk has been reduced to an acceptable level. If not, adjustments or entirely new mitigation strategies may be required (Fan & Stevenson 2018). Conversely, the somewhat lower application levels for *monitoring unmitigated risks* and *SC partners* suggest that fewer companies have established systematic processes for tracking emerging or evolving risks, which they have previously identified but not taken actions on. However, these are still important in order to keep the risk register and assessments up to date (Fan & Stevenson 2018) in order to determine whether mitigation measures need to be implemented (Norrman & Jansson 2004).

Noteworthy is that even if the companies show strengths related to monitoring mitigated risks, the results related to frequency of conducting the procedures showed that this kind of evaluation is conducted with more widespread intervals than other process steps, indicating that companies might have an over confidence in their mitigation efforts and a false sense of security. A concluding summary of the analysis of proactive SCRM practices can be seen in Figure 5.12.

Key findings related to proactive SCRM practices	
	- Companies implementation levels vary but companies have a lot of proactive SCRM practices in place, despite being deprioritized historically. - All measured proactive SCRM practices, with only a few exceptions, are applied to a moderate or high degree by at least 75% of the respondents. - Close to zero respondents claimed to consistently have a low implementation level for the different process steps. - For each process step, there seems to be a group of (14-28%) companies with consistently high proactive SCRM maturity. - Companies conduct the process steps of identification, assessment and mitigation at similar intervals. The lower frequency of conducting monitoring efforts point out that companies may be overconfident in their mitigation efforts, have a false sense of security and lack structures for continuous improvement.
Identification	Identification practices are in place but a clear decline in risk identification beyond first-tier partners highlights a limited scope and a gap in upstream SC visibility.
Assessment & mitigation	- The prioritization and mitigation decisions are mostly based on “high-level” assessments, including rough estimations of quantitative parameters such as impact and probability, and are to a lesser extent based on thorough analyses of more complex parameters. - For assessment, the high focus on mitigation feasibility introduces a risk that less severe but more easily mitigated SCRs are prioritized over more critical threats that are more difficult to address. - Few companies, base their mitigation decisions on less quantitative and more strategic parameters. For example, the lowest application of predetermined risk tolerances, leaving more room for inconsistent and subjective outcomes.
Mitigation strategies	Companies mostly apply internally focused, risk-reducing mitigation strategies—such as improved forecasting, supplier audits, and standardization—while more collaborative, long-term approaches are less commonly applied, likely due to their high complexity, cost, and limited short-term returns. Many commonly applied strategies also offer dual-purposes of both risk reduction and operational benefits.
Monitoring	- Despite limited attention in literature, monitoring seems to be applied to the same degree as previous proactive SCRM steps. - Monitoring practices mostly focus on mitigated risks. To evolve, companies should focus on strengthening practices related to monitoring of unmitigated risks and SC partners.

Figure 5.12: Summary of key findings on proactive SCRM practices.

5.2.2 The Reactive SCRM Process Practices

5.2.2.1 Results Related to Reactive SCRM Process Practices

Similar to the proactive measures, the respondents were asked the perceived level of implementation of reactive SCRM process practices, rated on a 1–7 scale. As presented in Figure 5.13, each step of the reactive process includes at least one practice with a mean above 5, and all practices score a mean above 4.82, indicating consistent and moderate to high levels of application. Furthermore, the consistent boxplot patterns suggest a relatively uniform approach across the sample. The primary difference between practices lies in the range of responses. While some practices have minimum ratings as low as 1, those with higher mean scores generally have minimum values starting at 3 or 4.

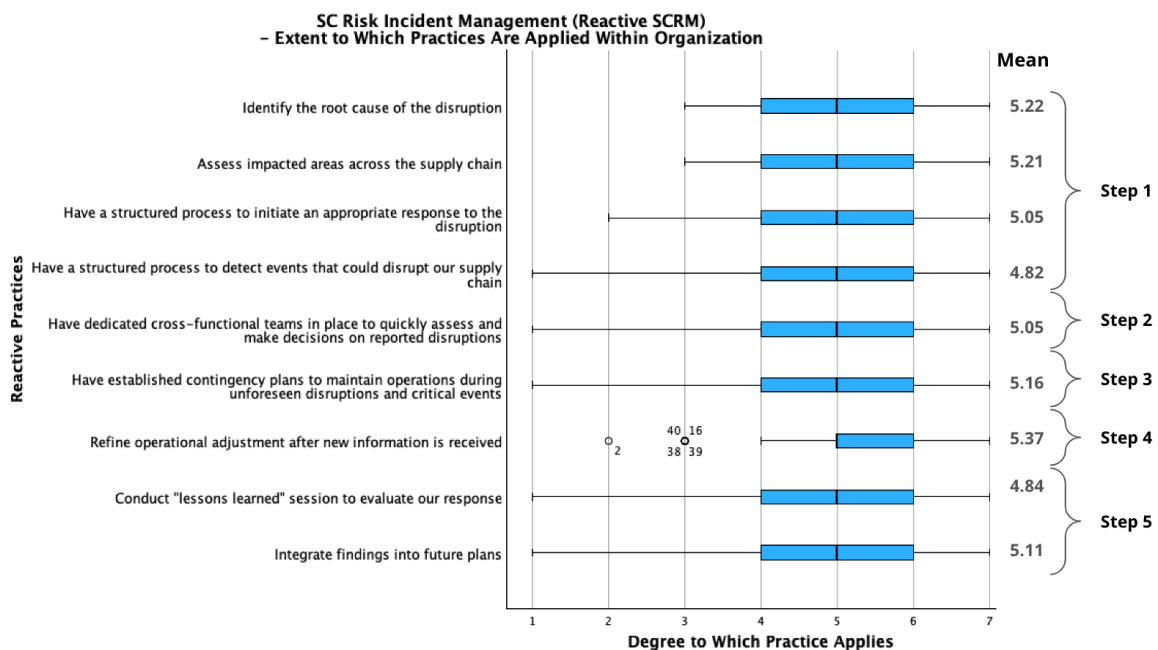


Figure 5.13: The extent to which respondents perceive their involvement in the reactive SCRM process.

Looking into individual practices, the practices with the highest mean values are *refining operational adjustments after new information* (Step 4, mean of 5.37) and *identifying the root cause of the disruption* (Step 1, mean of 5.22). The least frequently applied practices include *structured detection of disruptions* (Step 1, mean of 4.82), and having *post-incident learning sessions* (Step 5, mean of 4.84), though all are still used to a moderate degree.

The only practice with outliers is refining operational adjustments, which also has the highest mean and most distinct boxplot profile. This suggests both a high overall level of application and strong consensus among most companies. The few deviating outliers appear to be outliers across multiple practices, indicating that they may represent a group with limited overall engagement in SCRM.

The analysis of the underlying data presented in Figure 5.13 reveals that only 8 percent of the respondents consistently rated their application level for all reactive SCRM process practices at the same level, all 8 percent having applied all practices at a high level. For Step 1 and Step 5, the internal consistency shows that 20 and 35 percent respectively rated all included items at a high level, 14 and

23 percent respectively at a moderate and 2 and 14 respectively at a low level. As Step 2, Step 3 and Step 4 only are measured by one item each, a more detailed consistency analysis is not possible for these.

5.2.2.2 Analysis Related to Reactive SCRM Process Practices

The similar results across all reactive SCRM process practices, combined with the finding that each process step includes at least one practice with a mean rating above 5, suggest that many organizations adhere to a moderate to high extent to the reactive SCRM process proposed by Hopp, Iravani, and Liu (2012). This is further supported by the fact that no respondents have consistently claimed their implementation to be low. Instead, the majority of respondents report applying the recommended practices at a moderate to high level indicates that most companies are at least somewhat equipped to manage risks that are either unpredictable or not prioritized for mitigation through proactive SCRM efforts (Norrman & Wieland 2020). However, as only 8 percent of respondents consistently report applying all reactive SCRM practices at a high level, the majority of organizations still have potential for further improvement.

When comparing the results for reactive and proactive SCRM practices, respondents appear to rate reactive practices at a higher level throughout the results. This aligns with the historically greater emphasis on reactive approaches, as noted by Norrman and Wieland (2020). However, it is important to consider that the proactive process includes a larger number and broader range of measured items, which may influence the overall results.

The lowest-rated practices, namely, having a *structured procedure for detecting disruptions* and *conducting post-incident lessons-learned sessions*, highlight specific areas where enhancement is most needed. Regarding the latter, organizations benefit from structured analyses of disruption events to refine their response capabilities and integrate the insights gained into future SCRM strategies (Norrman & Wieland 2020). A concluding summary of the analysis of reactive SCRM practices can be seen in Figure 5.14.

Key findings related to reactive SCRM practices	
- Companies implementation levels vary but companies have a lot of reactive SCRM practices in place. - All measured reactive SCRM practices are applied to a moderate or high degree by the majority of the respondents. - No respondents claimed to consistently have a low implementation level for the different process steps. 8% of the respondents claim a consistently high implementation level of all reactive SCRM practices, indicating there is a small group with consistent high maturity. - Companies implement reactive practices more thoroughly than proactive ones, reflecting the historically stronger emphasis on reactive approaches. - The practices lowest rated relate to having a structured procedure for detecting disruptions and conducting post-incident evaluation of response, pointing at areas of improvement.	

Figure 5.14: Summary of key findings on reactive SCRM practices.

5.2.3 Methods and Tools

5.2.3.1 Results Related to Overall Methods and Tools

The next area of research, regard what methods and tools that organizations use in their SCRM practices. The data is based on multiple-choice questions, where respondents could select an unlimited number of options.

As shown in Figure 5.15, only five respondents were unsure of which methods and tools their organization uses, suggesting most have some awareness of current practices. Among the remaining responses, eight organizations reported using no tools, while the most extensive reported use was 13 different methods. On average, organizations apply 5.5 methods, with 30 percent using three or fewer.

The most widely applied tool in SCRM is *KPIs*, reported by 46 respondents (71 percent), clearly standing out as the top choice among all methods. This is followed by tools focused on internal and historical insights, such as *internally produced risk lists* (34 cases), *use of internal historical data to estimate probability and impact* (34 cases), and *SC mapping* (32 cases).

Thereafter the results show a wide spread in the types of tools applied. However, external methods are not very common, such as *externally produced risk lists* (14 cases) and *interviews and surveys with external experts* (13 cases). The least used methods and tools are *manufacturing process specific tools* (8 cases), *scenario analysis* (5 cases), *other prioritization tools* (3 cases), and *game theory analysis* (0 cases).

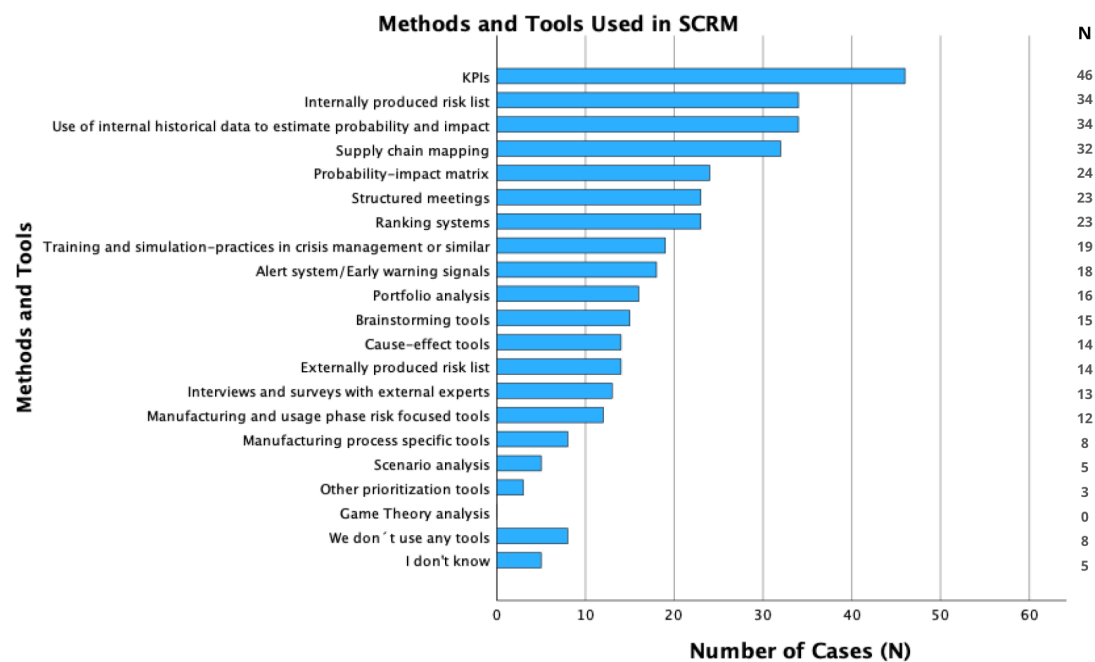


Figure 5.15: Number of respondents indicating the use of each method or tool in their SCRM process.

To cover how companies detect disruptions in reactive SCRM, it was investigated what data sources companies had access to. Overall, all companies except five have at least one detection method in place, according to Figure 5.16. The number of methods used ranges from zero to five, with an average of 2.7 detection methods per company. Two-thirds of the companies use three or more detection methods, while one-third rely on one or two methods. Only one respondent selected 'I don't know', indicating an overall high awareness of currently used data sources.

The most frequently used method is *direct communication from SC partners*, reported by 61 respondents. This is followed by *real-time news and social media monitoring* (49 cases), *tracking regulatory developments* (38 cases), and *monitoring weather and natural disaster warnings* (23

cases,). In contrast, *real-time tracking systems* (7 cases) are less frequently used. Only five respondents (8 percent) answered that they *identify disruptions only after impact*.

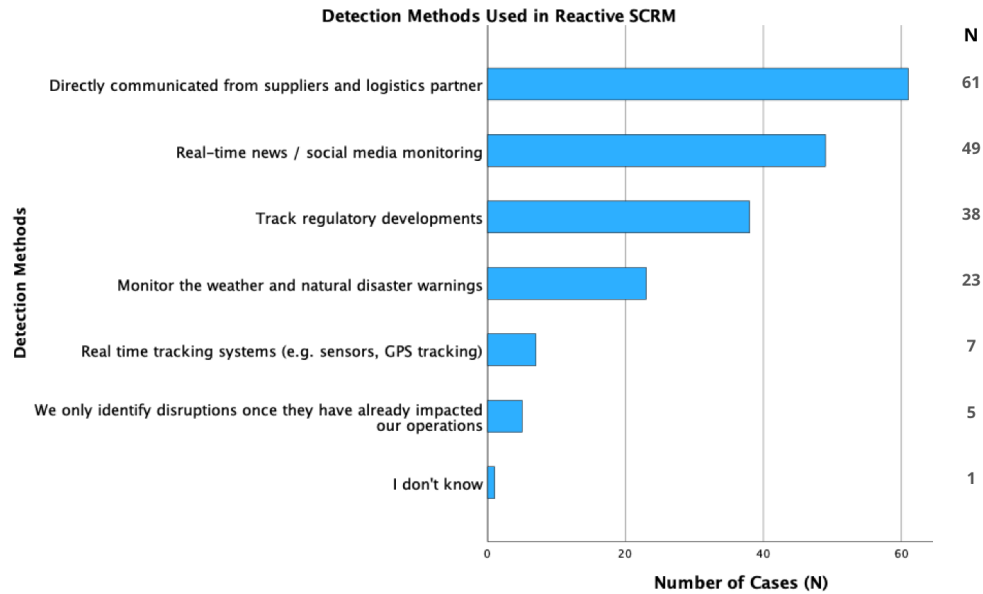


Figure 5.16: Number of respondents indicated the use of each detection method in their reactive SCRM process.

5.2.3.2 Results Related to SCRM IT-Tools

To increase understanding of organizations IT capabilities, the respondents were initially asked what IT softwares they had implemented in their SCRM practices. Generally there is a high level of respondents that do not know what IT softwares they use (12 cases) and 6 cases that say that they don't use any IT software, presented in Figure 5.17. Thereafter, there is a high proportion using *Excel* (42 cases) and thereafter a *Supply planning platform* (21 cases).

More specific SCRM tools, such as *Supplier Risk Management (SRM) / Third-Party Risk platforms* (16 cases), *Risk Management platforms* (11 cases), and *Governance, Risk, and Compliance (GRC) platforms* (10 cases), are used by fewer organizations. Adoption drops further for *Business Continuity Management (BCM) platforms* (7 cases) and is extremely limited for *Resilience platforms* (2 cases).

To examine the distribution of tool combinations, 24 out of 42 respondents use *Excel* without any additional specified SCRM tools. Nine respondents use *Excel* along with one additional SCRM tool, of varying types. Only seven respondents report using *Excel* in combination with two or more SCRM tools. Among those who do not use *Excel*, nine organizations use between one and four specified SCRM tools, most commonly a SRM platform.

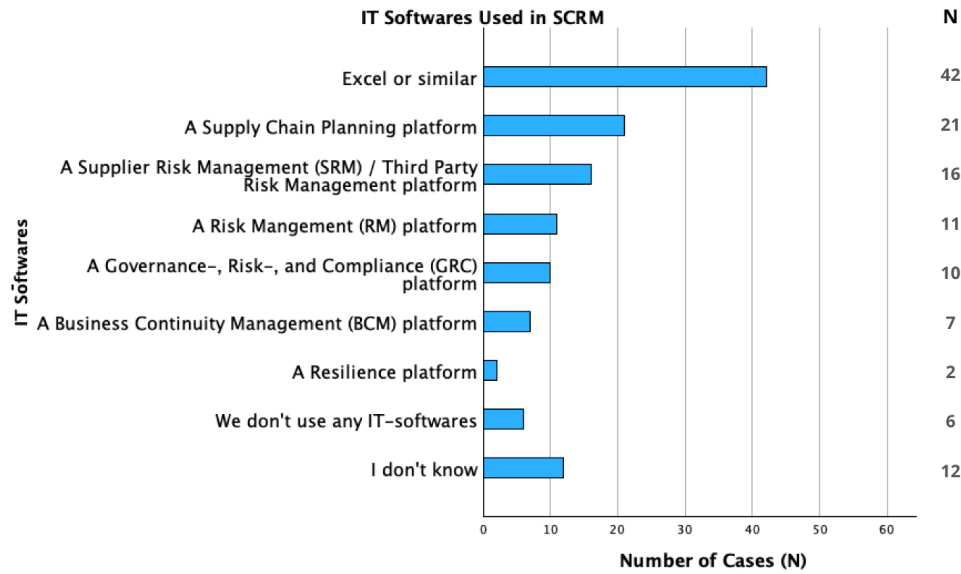


Figure 5.17: Number of respondents indicated the use of each IT softwares in their SCRM process.

The results in Figure 5.17 were further complemented by the respondents perceived level of IT capabilities to support SCRM practices, rated on a 1–7 scale. According to Figure 5.18, most IT capabilities show low levels of application, with mean scores typically ranging between 2 and 3. For several capabilities, the highest reported values only reach 5 or 6, an upper range that is notably lower than what has been observed in other results presented earlier. The least utilized capabilities are *integrated databases shared with SC partners* (mean of 2.19) and *IT systems for monitoring social media to detect risks* (mean of 2.44). The most widely applied capability is having an *integrated IT system that links sales forecasts, product structures (BOM), and supplier data* (mean of 4.48).

When instead asked about the perceived value of the same IT capabilities, rated on a 1-7 scale, the results scores were generally significantly higher compared to the achieved level, shown in Figure 5.19. Overall, respondents rate the value of IT tools moderately high, with most means ranging between 4.2 and 5.6. The highest perceived value is for having an *integrated IT system linking forecasts, product structures, and supplier data* (mean of 5.58). The lowest perceived value is seen for *IT systems monitoring social media* (mean of 3.68) and *integrated databases shared with SC partners* (mean of 4.20), though even these capabilities are still rated moderately high.

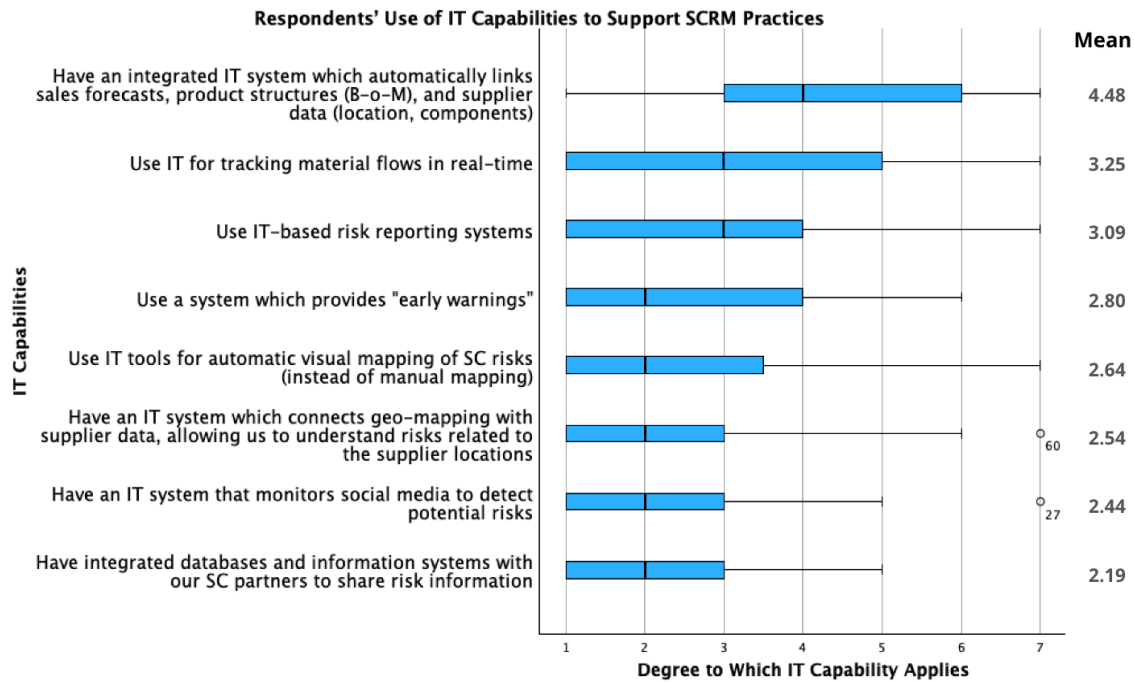


Figure 5.18: The extent to which respondents use IT capabilities to support SCRM practices.

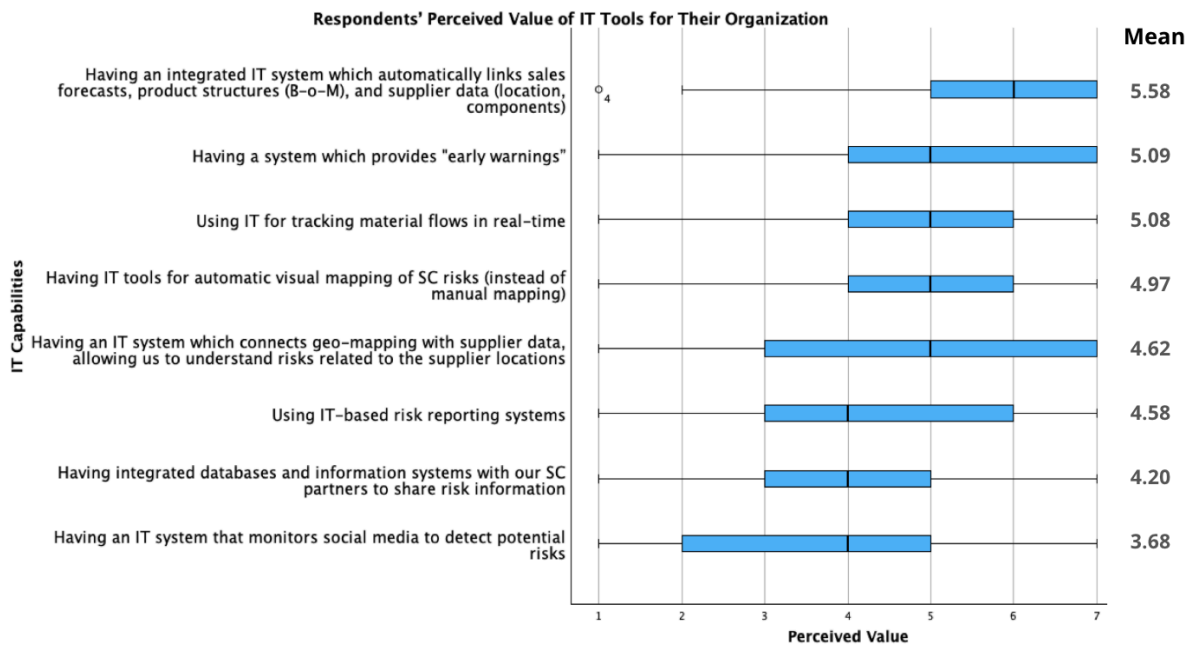


Figure 5.19: The extent to which respondents believe IT capabilities could be valuable for their organization.

5.2.3.3 Analysis Related to Overall Methods and Tools

The results demonstrate a relatively high level of awareness among respondents regarding the methods and tools their organizations employ in SCRM, as only five reported not knowing what is used. Nonetheless, the degree of implementation varies significantly. While eight organizations use no tools at all, others report using as many as 13 different methods. Notably, 30 percent of the

organizations apply three or fewer methods, suggesting that a substantial share operates with limited or underdeveloped toolsets. According to Polyviou, Ramos and Schneller (2022) and Fan and Stevenson (2018), relying solely on subjective judgment in risk response, without the support of structured tools and data can result in less effective and more inconsistent outcomes. Organizations with minimal tool use may therefore benefit from adopting additional methods to enhance decision-making and reduce reliance on individual perceptions of risk.

A further analysis of the results shows that the most widely used method is the use of KPIs, reported by 71 percent of respondents. Likely, the results reflect their versatile usage areas, as they can support several proactive process steps as well as enable early disruption detection in reactive SCRM (Norrman & Jansson 2004; Polyviou, Ramos & Schneller 2022). It is also likely that companies find KPIs easier to implement as they are often used for other operational purposes as well. Lastly, Norrman and Jansson (2004) also presented that some companies might prefer KPIs as they might be easier to interpret and communicate within the organization.

The next most commonly applied tools are internally developed risk lists and the use of internal historical data to estimate probability and impact. This reflects organizations' efforts to avoid repeating past mistakes (by not recognizing risks which have previously caused disruptions) and to quantify key factors during the assessment phase. However, they also reveal a strong reliance on familiar and internally sourced data. While such methods offer a solid foundation, they may limit the ability to detect emerging, project-specific, or externally driven risks (Tang 2006). The literature emphasizes the importance of complementing internal approaches with tools that incorporate external expertise, such as externally developed risk lists or expert interviews (Polyviou, Ramos & Schneller 2022), as well as methods that foster creative thinking, including brainstorming sessions aimed at identifying unconventional or overlooked risks (Mitroff & Alpaslan 2003) or complement the internal knowledge gaps (Polyviou, Ramos & Schneller 2022). Yet, these tools remain sparsely used. This continued inward focus may lead to blind spots in risk identification and assessment, raising concerns about whether organizations are effectively capturing the full range of potential SC risks. The findings suggest a notable gap between recommended best practices and their real-world application, pointing to a key area for improvement in advancing more comprehensive and resilient SCRM capabilities.

Furthermore, similar to the findings of Norrman and Näslund (2016), who reported that 48 percent of organizations did not work with SC mapping at all, the results show that 47 percent still do not apply this practice. Despite this consistency over nearly a decade, it remains surprising given that SC mapping is widely recognized in the literature as a foundational element in risk identification (e.g., Polyviou, Ramos & Schneller 2022). It is also commonly integrated into SCRM IT solutions (Norrman & Jansson 2004; Kodiak Hub n.d.), and has documented benefits in both proactive and reactive SCRM contexts (Polyviou, Ramos & Schneller 2022; Hopp, Iravani & Liu 2012). The continued low adoption suggests that, in practice, many organizations still lack visibility into their SCs, which can hinder both risk identification and rapid response.

Moreover, more advanced tools and industry-specific tools, such as *scenario analysis*, and *game theory*, *HAZOP* and *FMEA*, are rarely implemented. *Scenario analysis*, in particular, has been highlighted in the literature as a valuable method for understanding interdependencies and cascading effects of risks. Its limited use indicates a lack of adoption of more sophisticated analytical approaches, confirming Fan and Stevenson's (2018) claim regarding a gap between advanced academic tools and the simpler, well-established methods commonly used in practice.

Reactive tools like *early warning systems* and *training and simulations*, which proactively can increase reactive SCRM capabilities, are applied by roughly 30 percent of the respondents. This suggests that supporting reactive SCRM through structured methods to build internal capabilities and improve disruption detection is not yet standard practice. According to Norrman and Wieland (2020), regular training and scenario analysis are essential to sustaining a strong risk culture, whether developed in-house or facilitated by external experts. Similarly, Mitroff and Alpaslan (2003) argue that staging hypothetical crises can reveal hidden vulnerabilities and improve future responses. The relatively low adoption of such tools in this study indicates room for improvement in how organizations prepare for and manage unexpected events.

When instead investigating the results related to data sources used for detection of risks in reactive SCRM, the results show that companies primarily rely on *external communication with SC partners* for information. This underscores the importance of strong upstream visibility and collaboration, but also reveals a heavy dependence on human-reported signals. Consequently, firms should prioritize strengthening relationships with high-risk partners and establish clear guidelines and incentives to encourage more proactive incident reporting (Norrman & Jansson 2004). Similarly, the widespread *use of news and social media* monitoring reflects an effort to incorporate broader environmental scanning into detection strategies, though these are also external sources.

In contrast, the adoption of more automated and data-driven methods remains limited. *Real-time tracking systems*, which could provide continuous and immediate visibility, are used by only 11 percent of companies, suggesting underutilization of available technologies such as IoT and sensor-based monitoring (Sheffi 2015).

The lower use of *weather and disaster warnings* and *regulatory monitoring* indicates that many companies may be overlooking the importance of monitoring external systemic risks such as climate change, geopolitical instability, and regulatory shifts. These risks are not easily detected through internal channels alone, making the low adoption of such tools a potential vulnerability. Considering that geopolitical and environmental risks were among the most commonly rated as severe, it is interesting that they are not more actively monitored in practice. However, this may be because not all companies are equally exposed to these risks, depending on the nature of their operations and their geographic location, and therefore do not need to monitor weather warnings or regulatory changes.

The fact that two-thirds of companies use three or more detection methods likely strengthens their disruption detection capabilities through both redundancy and complementarity. Some tools may cover overlapping risk areas, providing backup if one source fails, while others focus on different dimensions, broadening coverage. In contrast, companies using only one or two methods may be more vulnerable, as limited tools reduce the chances of identifying disruptions early—especially if the main detection method fails or misses a critical signal. A concluding summary of the analysis of methods and tools can be seen in Figure 5.20.

Key findings related to SCRM Methods & Tools	
• The implementation of tools vary but 30% apply three or fewer tools, indicating that many companies are reliant on subjective judgement and individual perceptions rather than structured tools and decision frameworks, making the procedures less effective and risk that the outcomes are inconsistent. • KPIs are the most commonly used tool, likely because of versatile usage areas in both proactive and reactive SCRM, their overall commonality, and as they might be easier to communicate across the organization than other tools. • The usage of tools indicate an inward focus which may lead to blind spots in risk identification and assessment, raising concerns about whether organizations are effectively capturing the full range of potential SC risks if not complemented by other tools. • More advanced tools are rarely implemented, indicating a preference for familiar tools and lack of adoption of more sophisticated analytical approaches. • Two-thirds of companies use three or more detection methods which likely strengthens their disruption detection capabilities through both redundancy and complementarity. In contrast, companies using only one or two methods may be more vulnerable, as the coverage of risk detection might be weaker. • Organizations are primarily dependent on external communication from SC partners, underscoring the importance of strong upstream visibility and good collaboration. In contrast, the adoption of more automated and data-driven methods remains limited, suggesting underutilization of available technologies.	

Figure 5.20: Summary of key findings on methods and tools.

5.2.3.4 Analysis Related to SCRM IT-Tools

Regarding IT related SCRM tools, the overwhelming reliance on *Excel* suggests that organizations continue to prioritize familiarity, flexibility, and short term cost-efficiency over adopting specialized SCRM software. Thus, while the market offers an expanding range of advanced platforms (Market Research Focus 2025), the limited adoption of IT tools such as *Supplier Risk Management (SRM)*, *Governance, Risk, and Compliance (GRC)*, and *Business Continuity Management (BCM)* systems, suggests that these tools are not yet widely used. Notably, the results reveal two distinct user groups, one consisting of 24 respondents who rely solely on Excel and no specified SCRM tools, indicating the lowest level of IT maturity in their SCRM practices, and another group of nine respondents who do not use Excel at all but instead utilize one or more dedicated SCRM tools, reflecting a higher degree of IT trust and digital maturity in their risk management work.

The perceived rating of their IT capabilities does reflect the low use of IT tools as most capabilities show low levels of application, with mean scores typically ranging between 2 and 3. The results further suggest that while some IT support for SCRM is in place, it is often focused on internal operations rather than external data sources or collaboration. Capabilities that require more complex integration with external partners or advanced data analytics, such as sharing risk information across SC partners or monitoring external signals like social media, are applied less frequently. This may indicate a focus on strengthening internal visibility and control before expanding to more sophisticated, external-facing SCRM strategies.

However, the respondents seem to recognize the strategic importance of IT capabilities for SCRM, particularly those that enhance internal SC visibility and proactive risk detection. Even the lowest rated capabilities are valued moderately, indicating a general belief in the potential benefits of IT tools in SCRM. Consequently, there is a clear gap between perceived value and real-world implementation. While many IT tools are rated as highly valuable, their adoption in practice remains limited. The largest gap is found in *automatic visual mapping of SCRs*, with a difference of +2.33 between perceived value (mean value of 4.97) and usage (mean value of 2.64). The second largest gap appears for *early warning systems*, which not only show a usage gap of +2.29 but also rank among the top three most valued capabilities, demonstrating a particularly strong case of underutilization despite

strategic importance. These gaps potentially reflect the forecasted market growth for the SCRM Software market in the coming years (Market Research Focus 2025).

Among the top three most valued capabilities, in addition to *early warning systems* (5.09), are *integrated internal IT systems* (5.58) and *real-time material flow tracking* (5.08). The integrated internal system has a comparatively small gap (+1.10), suggesting better alignment between perceived value and actual implementation. In contrast, the other two, early warning systems and real-time tracking, show notable gaps (+2.29 and +1.83 respectively), indicating that even the most valued capabilities are not being fully leveraged in practice. This highlights a critical opportunity for organizations to close the gap between what they consider important and where they choose to invest in IT for SCRM. A concluding summary of the analysis of IT tools and capabilities can be seen in Figure 5.21.

Key findings related to SCRM IT-tools and IT-capabilities
• Despite recognizing the strategic importance of IT in SCRM, most organizations continue to rely heavily on Excel, reflecting low digital maturity and limited adoption of specialized risk management tools. • Organizations have early or selective adoption of advanced IT capabilities in SCRM practices. Meanwhile IT capabilities focused on internal visibility are somewhat more applied, externally oriented functions remain significantly underutilized. • A clear gap exists between the perceived value of IT capabilities and their actual use, particularly for high-potential tools like early warning systems and digitalized SC mapping, suggesting untapped opportunities for improving digitalization of SCRM.

Figure 5.21: Summary of key findings on IT-tools and IT-capabilities.

5.2.4 Organizational Practices

5.2.4.1 Results Related to Organizational Practices

To measure the perceived implementation level of organizational practices, respondents were asked to rate the degree to which different statements applied to their company on a 1–7 scale. These statements were related to the nine organizational capabilities, identified in the literature review. The results are presented in Figure 5.22 and Figure 5.23. Overall, Figure 5.22 shows moderate to high levels of application, with most means ranging between 4 and 5.5. Figure 5.23 shows a noticeable spread across categories, with mean values ranging from just above 3 to slightly above 5, suggesting a moderate overall application with strong variation across capability types.

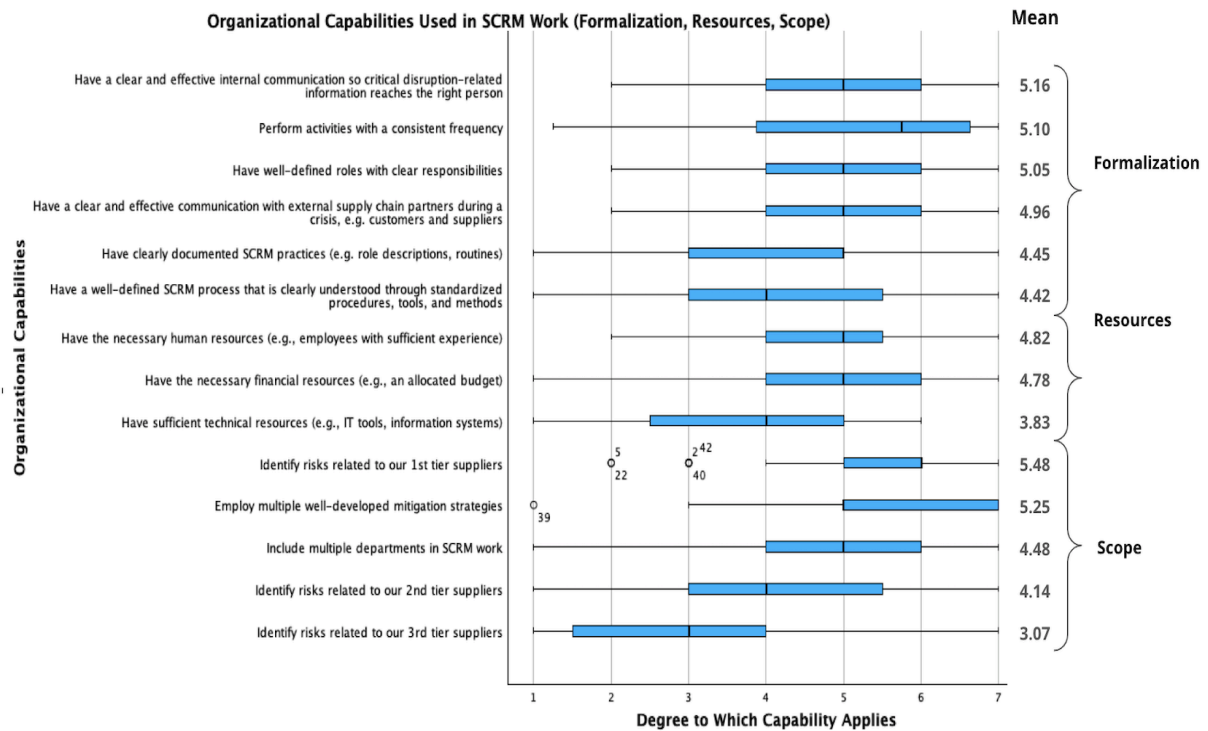


Figure 5.22: The extent to which respondents perceive their involvement in organizational capabilities related to formalization, resources and scope.

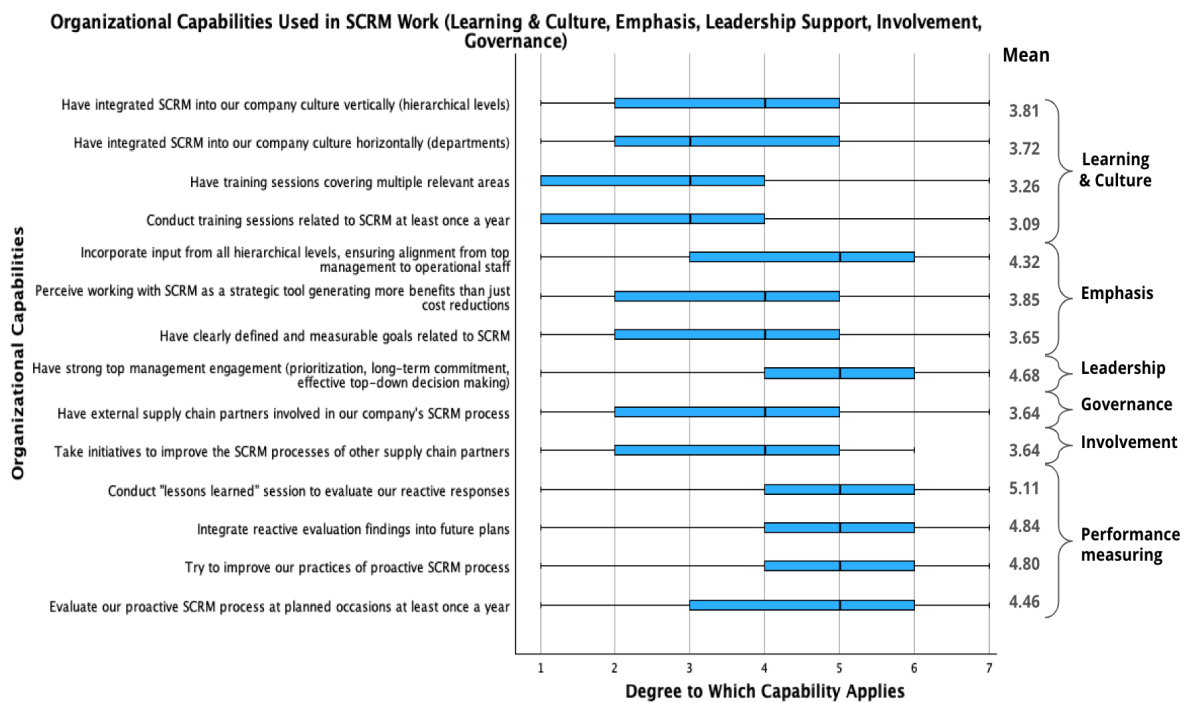


Figure 5.23: The extent to which respondents perceive their involvement in organizational capabilities related to learning and culture, emphasis, leadership, governance, involvement, and performance measuring.

Within the category of formalization, *having clear and effective internal communication during disruptions* emerges as the most widely applied capability, with a mean score of 5.16, followed by

clearly defined roles (mean of 5.05) and *effective external communication* (mean of 4.96). In contrast, *clear documentation of SCRM practices* and the use of *well-defined and standardized processes* show slightly lower mean scores (means of 4.42 and 4.45 respectively). These two practices also exhibit greater variation in responses, as reflected by wider boxplots and the fact that 25 percent of respondents rated them low (scores of 1–3). In comparison, the more frequently applied practices received no lowest scores (1), and fewer than 25 percent of respondents rated them below a 4, indicating a more consistently high level of implementation.

For resources, *having sufficient human resources* (mean of 4.82) and *financial resources* (mean of 4.78) are rated moderate to high, with approximately 75 percent of organizations scoring these at a moderate or high level. In contrast, *technical resources*, such as IT tools and systems, receive a lower mean score of 3.83. The relatively broad boxplot and lower range further indicates more variation and lower application in digital readiness among organizations.

Regarding the scope of the SCRM, the range between capabilities is more notable, both in terms of mean values and boxplot profiles. As previously stated, the ability to *identify risks related to first-tier suppliers* (mean of 5.48) is the strongest applied capability. However, risk identification beyond the first-tier drops sharply as *identifying risks related to second-tier suppliers* has a moderate mean (mean of 4.14), while *identifying risks related to third-tier suppliers* is considerably lower (mean of 3.07), pointing to a limited focus on risks further upstreams. The broader boxplots does however show that there is a variation in how much organizations identify risks for lower tiered suppliers. Thereafter, the *use of multiple well-developed mitigation strategies* (mean of 5.25) is the second most applied capability. *Including multiple departments in SCRM work* also shows a high application (mean of 4.48).

Learning and Culture is the capability associated with lower application level among many of the companies, reflected by the low mean values related to *conducting SCRM training at least once a year* (mean of 3.08), *having training sessions covering multiple relevant areas* (mean of 3.26), and *integration of SCRM into company culture*, both horizontally (mean of 3.72) and vertically (mean of 3.81). These results indicate that companies perceive themselves to be equally underdeveloped when it comes to integrating SCRM horizontally across departments and vertically across hierarchical levels. Furthermore, the boxplots in this category are broad, indicating variation across firms.

The results related to *Emphasis* also show quite low levels of implementation, reflected by the mean values of SCRM being perceived as a *strategic tool beyond cost reduction* (mean of 3.85) and the companies having *clear and measurable SCRM goals* (mean of 3.65). *Incorporating input from all hierarchical levels, ensuring alignment across the organization* (mean of 4.32), making it the most applied practice in this category. The broad boxplots reflect inconsistent application, some organizations are well-aligned and engaged across levels, while others have made little progress in this area.

In contrast many firms perceive that they have strong top management engagement to a moderate to high level (mean of 4.68), resulting in that the capability *Leadership support* is applied to a higher degree. Furthermore, both *Involvement* and *Governance* show moderate means (both have means of 3.64) and broad boxplots, suggesting low and uneven collaboration with external SC partners. Lastly, *Performance Measuring* is the most developed and consistently applied area, including *conducting “lessons learned” sessions* (mean of 5.11), *integrating evaluations into future planning* (mean of 4.84) and *regularly evaluating proactive SCRM processes* (mean of 4.46).

Based on the average scores of the items representing each capability, the responses for each capability were thereafter mapped in a maturity model with four maturity levels. For each respondent, the average score across all items linked to a specific capability was calculated using their responses on the 7-point scale from the questionnaire. These averages were then categorized into one of four maturity levels, which can be seen in Figure 5.24.

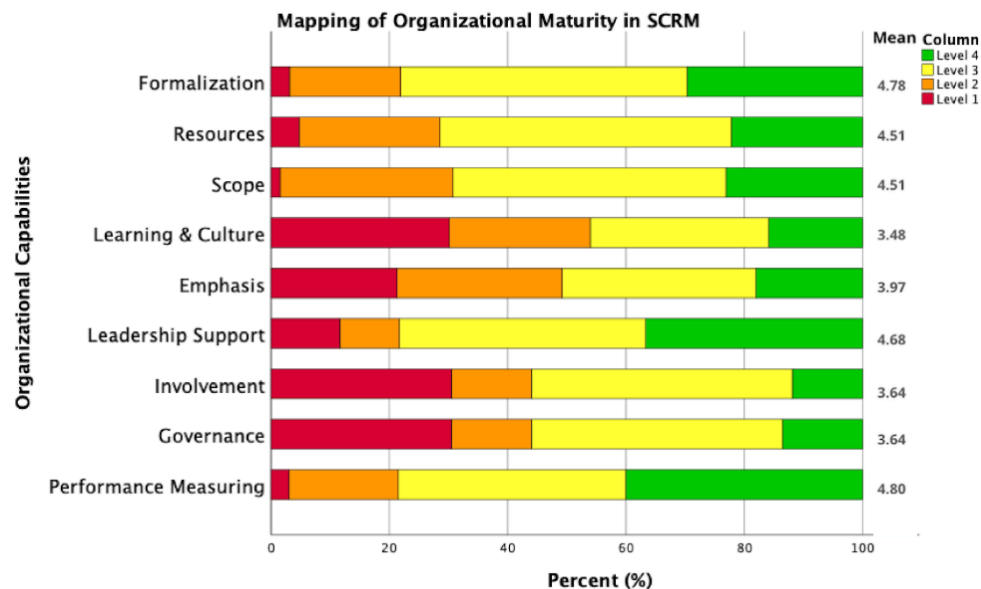


Figure 5.24: Accumulated maturity model for the company's organizational capabilities.

Following the theoretical framework, Level 1 typically represents that no formal actions, resources, or goals are in place. Therefore, average scores below 2.5 were assigned to Level 1. Averages between 2.5 and below 4 were categorized as Level 2, reflecting that some actions are taken but they are not yet broadly applied. Averages between 4 and below 5.5 were assigned to Level 3, indicating that actions are applied quite broadly but not fully across the organization. Finally, averages between 5.5 and below 7 were classified as Level 4, representing a high and comprehensive application of practices.

The results from Figure 5.24 indicate that *performance measuring*, *leadership support* and *formalization* are the most mature capabilities, with 30 to 40 percent of the organizations reaching the highest level of maturity and almost 80 percent of the organizations reaching Level 3 or 4, with the highest means. The capabilities of *resources* and *scope* also display relatively high maturity profiles, with approximately 70 percent of the organizations being concentrated in Levels 3 and 4, and around the highest 25 percent being in level 4.

Learning and culture, *emphasis*, *governance*, and *involvement* stand out as the least mature areas, with only around half of the companies reaching Levels 3 and 4. These capabilities also display lower mean values, along with wider distributions of levels, indicating not only lower overall application but also greater variation in how companies approach them.

5.2.4.2 Analysis Related to Organizational Practices

Based on the results of the questionnaire, several important insights and conclusions can be drawn about the maturity and challenges of organizational SCRM practices. Firstly, when comparing the

means related to organizational aspects of SCRM with proactive and reactive SCRM practices, companies have rated their process practices higher than organizational aspects of SCRM. However, when comparing organizational aspects internally, the results suggest that many organizations have established foundational capabilities related to SCRM, particularly in *formalization*, *resources*, and *performance measurement*. Meanwhile they show significant shortcomings in some areas, particularly areas which require cross-organizational integration, cultural embedding, and external collaboration.

The capability of formalization, the ability to have structured and effectively formalized SCRM processes (Guerra et al. 2024), is among the more developed capabilities. Areas which stand out are effective internal communication and clearly defined roles in SCRM, which aligns with literature stressing the importance of coordinating stakeholders by clear responsibilities and effective communication (Guerra et al. 2024; Polyviou, Ramos & Schneller 2022; Norrman & Wieland 2020). However, the relatively lower scores for standardized processes and documentation imply that companies lack a highly developed structure in the SCRM processes, and point to inconsistencies in process maturity and areas of improvement.

Regarding the resources available, human and financial resources are generally perceived as moderately sufficient. However, resources are seldom unlimited, which still make efficient processes and a good understanding of what mitigation strategies that should be applied highly relevant (Fan & Stevenson 2018). The noticeably lower rating for technical resources further confirms a digital gap, which was suggested in Section 5.2.3.3 Analysis Related to Overall Methods and Tools, indicating that many organizations may lack the tools and IT systems necessary to support data-driven or automated SCRM. This might have further implications on the result regarding the organizational aspect of having a broad scope of the SCRM efforts as challenges in digitalization and underinvestment in IT infrastructure limits visibility and transparency in the SC.

The results for scope reflect a pronounced focus on first-tier suppliers, consistent with the literature's, meanwhile the results show a sharp decline in capabilities for second- and third-tier supplier risk. The results align with Guerra et al. (2024) who highlighted that many firms struggle to expand their visibility beyond direct partners. However, the focus on first-tier suppliers reveals a critical blind spot upstream in the SC, resulting in organizations experiencing greater and uncontrolled risk exposure in these parts. Concludingly, while companies seem to have relatively mature processes for internal and closest scope, they may lack the depth required for proactive, end-to-end SCRM.

The tendency to limit the scope of the efforts also seem to be reflected by the capabilities of Involvement and Governance, which both relate to collaboration with external SC partners. Both capabilities show moderate average scores but with high variation, suggesting inconsistency in how companies engage their SC networks in SCRM. This finding supports the view that many firms have yet to fully embrace a SC-wide approach to SCRM and that inter-organizational joint efforts, coordination, and supplier development remain underdeveloped and challenging, as noted by Guerra et al. (2024).

The results related to the capability of Learning and Culture, present that the aspects of embedding SCRM into the culture by continuous competency development and taking initiatives to increase the internal engagement (Guerra et al. 2024), are among the least developed capability among the respondents. Norrman and Wieland (2020) emphasized that learning and a strong risk culture often fade during periods of stability, however the large-scale disruptions which have been seen affecting many companies the last couple of years may therefore imply that companies have not succeeded to

achieve a SCRM culture in the first place. Therefore, it is necessary for companies to take active measures to continuously work with embedding SCRM into corporate culture, ensuring continuous learning, training both during active disruptions and in more stable periods (Norrman & Wieland 2020).

The difficulties of incorporating SCRM as a fundamental part of the operations are further confirmed by the weak development of capabilities related to Emphasis. Organizations struggle to frame SCRM as a value-generating activity beyond cost avoidance, and many lack clear strategic goals, which might make it difficult to spread the message of the importance of SCRM and create engagement in the organization, despite the literature advocating for strategic integration at all organizational levels (Guerra et al. 2024).

Nevertheless, the relatively strong development of leadership support capabilities suggests that, despite a generally low emphasis on SCRM across organizations, it remains a strategic priority for higher hierarchical levels in many cases (Guerra et al. 2024). As highlighted by Norrman and Wieland (2020), leadership support is a critical enabler of SCRM success, and the observed maturity indicates that top management engagement is present in several organizations. If effectively leveraged, this might potentially create favorable conditions for further advancement in organizational maturity related to other capabilities as top management support is critical for getting SCRM effort proposals approved (Norrman & Wieland 2020). This might be particularly relevant for mitigation efforts related to greater investments such as implementation of SCRM softwares, SC restructuring or cross-functional risk strategies which cannot be implemented at an individual or unit level.

Similarly, performance measuring being the most established and consistently applied aspect of SCRM among respondents, might serve as a good foundation for future improvement as it indicates that companies understand the importance of feedback loops in the processes, as emphasized by Manuj & Mentzer (2008) and demonstrated in Ericsson's structured post-disruption reviews (Norrman & Wieland 2020). However, even if the results relative to other organizational aspects suggest that companies are somewhat aware of the need to learn from past disruptions and are leveraging these insights to enhance future preparedness it should not be forgotten that evaluation practices have been amongst the least applied in the results related to proactive- and reactive practices.

In conclusion, the results indicate that organizations generally show higher maturity in internally focused and operational capabilities, such as performance measurement, leadership support, formalization, and resource allocation, which are all likely to enhance business value. These areas show both higher mean values and stronger consensus. The lower maturity related to scope and identification of risks not associated with the focal company or their closest partners further confirms a tendency to be internally oriented. The capabilities does however indicate a potential of improvement as performance measuring and leadership support reflect that it is seen as a long-term, strategic commitment and willingness to improve.

In contrast, capabilities related to organizational culture, strategic framing, and external collaboration, such as learning and culture, governance, involvement, and emphasis, remain less mature. These areas have lower average scores, more varied distributions in maturity levels, and a larger share of organizations still in lower maturity levels. This variation suggests that these capabilities are more difficult to institutionalize, maybe due to requiring behavioral change, cross-functional coordination, and trust-based relationships with external partners. Their uneven development implies that SCRM is still not fully embedded in company culture, nor consistently treated as a strategic, organization-wide responsibility. These gaps highlight key areas for improvement which, if addressed, could

significantly enhance the impact of risk management on overall business value. While many companies have established solid foundations for managing risks within their operations, the next step lies in advancing cultural adoption, external collaboration, and long-term strategic alignment, key elements for building truly resilient SC. A concluding summary of the analysis of organizational practices can be seen in Figure 5.25.

Key findings related to organizational practices	
- Organizational aspects are generally lower rated than proactive and reactive process practices, however the results indicate that organizations generally demonstrate higher maturity in internally focused and operational capabilities, including performance measuring, leadership support, formalization, resources and scope. These areas show higher mean values and higher consensus to the higher levels in maturity. - In contrast, capabilities related to organizational culture, strategic framing, and external collaboration, such as learning and culture, governance, involvement, and emphasis, remain less mature. These areas have lower average scores, more varied distributions in maturity levels, and a larger share of organizations still in lower maturity levels. This variation suggests that these capabilities are more difficult to institutionalize, maybe due to requiring behavioral change, cross-functional coordination, and trust-based relationships with external partners. Their uneven development implies that SCRM is still not fully embedded in company culture, nor consistently treated as a strategic, organization-wide responsibility.	

Figure 5.25: Summary of key findings on organizational practices.

5.2.5 Resilience

5.2.5.1 Results Related to Resilience

In addition to implemented practices, the respondents were asked regarding their perceived level of resilience on a 1–7 scale. These results are presented in Figure 5.26. Overall, these aspects are rated relatively high, with mean scores above 4.40 across the board and response ranges that do not drop below 2, and, for some items, not even below 4, indicating consistently strong resilience rating among respondents. Notably, none of the aspects were rated at the lowest level (1), and the relatively narrow boxplots across all items indicate a high level of consensus among respondents in how resilient their organizations are perceived to be.

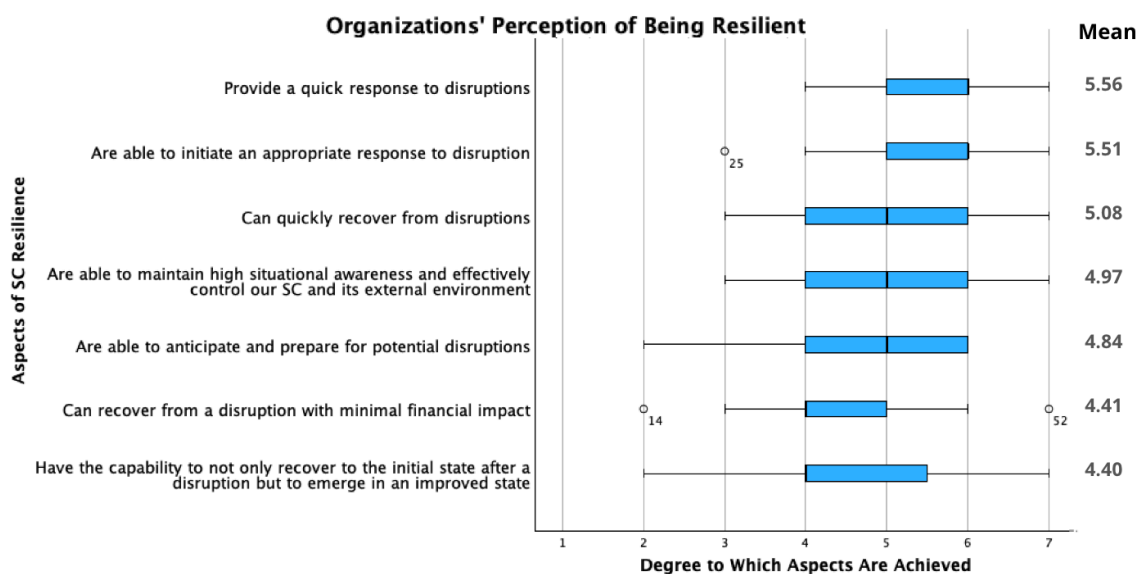


Figure 5.26: The extent to which respondents perceive themselves as resilient.

The most highly rated items relate to reactive SCRM, including the abilities of *providing a quick response to disruptions* (mean of 5.56), *initiating an appropriate response* (mean of 5.51), and *quickly recovering from disruptions* (mean of 5.08), with a strong majority of respondents, between 75 percent and 100 percent, rating these aspects 4 or higher. Items associated with preparedness and proactive SCRM, such as *maintaining high situational awareness* (mean of 4.97) and *anticipating disruptions* (mean of 4.84), received slightly lower mean scores. The boxplots for these two aspects also had wider variation, indicating less consensus among organizations. The lowest-scoring aspects are *recovering with minimal financial impact* (mean of 4.41) and *recovering to an improved state after a disruption* (mean of 4.40).

5.2.5.2 Analysis Related to Resilience

The results reveal 75 percent of the respondents have scored at least a four on all items, indicating that the respondents generally perceive themselves as moderately to highly resilient. This is aligned with the generally high results for implementation of both proactive and reactive SCRM practices. The item with the lowest results further indicates that resilience is somewhat more about bouncing back than bouncing forward for most firms. This implies that many organizations still focus primarily on short-term continuity rather than long-term improvement through disruption. Thus, many companies have yet to achieve a level of resilience that enables them to adapt swiftly to disruptions and leverage recovery efforts for long-term improvement.

Regarding the resilience items related to reactive SCRM, the results show that organizations are confident regarding their reactive ability to *quickly initiate appropriate responses* in case of a disruption and quickly recover thereafter. The items related to reactive capabilities scoring high reflect the high application level of reactive practices seen in Section 5.2.2. The somewhat lower ratings for *managing disruptions with minimal financial impact* suggest that disruptions either have a significant effect on business operations or that financial resources allocated during disruptions are not as constrained as those for proactive measures.

In contrast, while proactive resilience—such as *anticipating disruptions* and *maintaining situational awareness*—is generally high, it is somewhat less developed and shows greater variability across organizations. These results are in line with the slightly lower application of proactive SCRM practices (compared to reactive). Furthermore, it reflects the challenge of building forward-looking capabilities by implementing practices such as advanced sensing, monitoring, and analytical resources. The wider spread in responses also suggests that while some organizations have made progress in this area, others still lag behind. A concluding summary of the analysis of perceived resilience can be seen in Figure 5.27.

Key findings related to perceived resilience	
• Most companies perceive themselves as moderately to highly resilient, consistent with the overall high implementation of SCRM practices. • The lowest-scoring item suggests that, for many firms, resilience is still primarily seen as bouncing back rather than adapting and bouncing forward. • The results also show a slightly higher confidence in reactive resilience related capabilities, reinforcing the earlier findings on practice implementation.	

Figure 5.27: Summary of key findings on perceived resilience.

6. Empirical findings related to challenges in SCRM

Chapter 6 presents the empirical findings related to RQ2. Sections 6.1 outline the perceived challenges associated with proactive SCRM process, 6.2 to reactive SCRM process, and 6.3 to organizational capabilities considered important for SCRM.

6.1 Proactive SCRM Process Challenges

6.1.1 Results of Proactive SCRM Process Challenges

When investigating how difficult the respondents find proactive SCRM process related practices on a 1-7 scale, where 1 stands for not challenging, and 7 for highly challenging. The overall results suggest that most companies perceive most proactive SCRM activities as moderately to highly challenging, with no practice standing out as particularly easy or overwhelmingly difficult. According to Figure 6.1, all means are between 4.41 and 5.10, and 75 percent rank higher than a 4 in all cases but two. Furthermore, the boxplots are relatively consistent when comparing the items. However, for about half of the items, ratings range from 1 to 7, while for the others, the lowest rating given was 2.

Based on the mean values, the practices perceived most challenging are *monitoring and maintaining control over SCRs* (mean of 5.10) and *grasping SC complexity* (mean of 5.02), followed by *identifying previously unknown risks* (mean of 4.94) and *ensuring visibility to identify relevant risk areas* (mean of 4.90). Most other practices fall within a similar range (means around 4.61–4.84). Lastly, *understanding interdependencies between risks* (mean of 4.41) and *prioritizing risks* (mean of 4.48) are scored as the least challenging practices.

Furthermore, the underlying data has been analyzed to assess the consistency of responses regarding perceived challenges across all process steps. When consistency is analyzed across the entire SCRM process, only 9 percent of respondents rated all practices at the same challenge level. Also noteworthy is that no respondents consistently rated all practices as low in difficulty, indicating that all organizations perceive at least some aspects of the SCRM process as moderate or highly challenging.

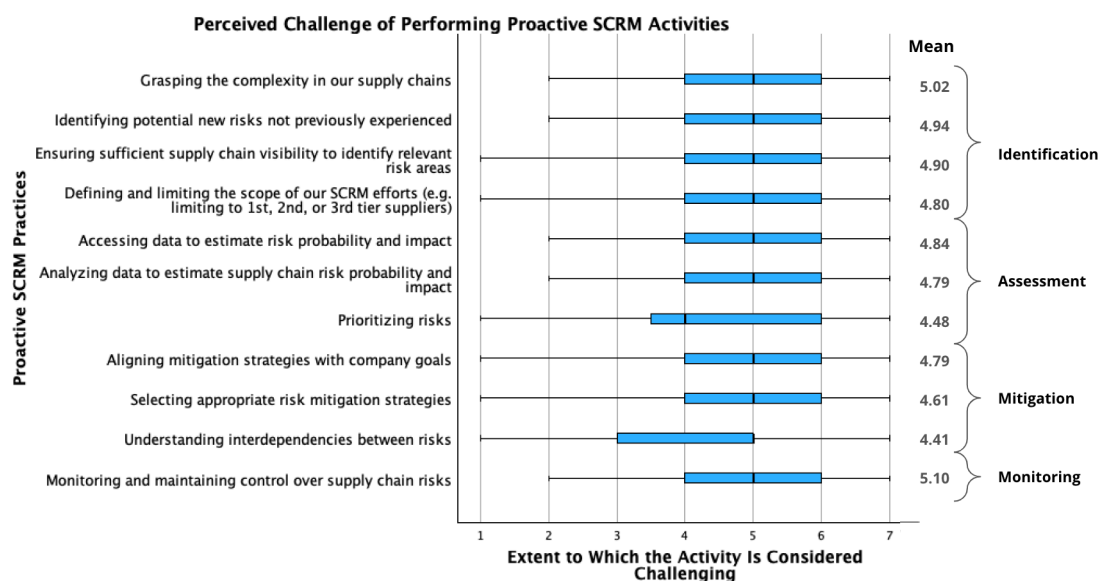


Figure 6.1: The extent to which respondents perceive difficulty in proactive SCRM practices.

Thereafter, a gap analysis has been performed in order to compare the results of perceived level of challenge and the application of the comparable proactive SCRM practice. This gap analysis is plotted in eight plots, presented in Appendix B. In these plots, three of the challenges related to identification, all three assessment challenges, one mitigation related challenge as well as the monitoring related challenge are compared with practices.

The results from the gap analysis indicate that for most challenges, respondents generally rate the level of application of corresponding practices at a similar level as the perceived degree of challenge. This means that organizations with low implementation level, generally also have addressed the practice as low level of challenging while organizations with high implementation levels tend to find the practices highly challenging. However, the results also show, particularly for identification and assessment-related practices, that respondents in many cases seem to find their level of application higher than their perceived level of challenge. In Figure B1 to Figure B6, in Appendix B, notable groups of respondents rate the application level more than two points higher than the challenge level, suggesting a real, and in some instances substantial, difference. Conversely, exceptions are observed for the challenges related to *identifying potential new and unexperienced risks*, and *aligning mitigation strategies with company goals* and *monitoring and maintaining control of SCRs*, where a few outliers report low application levels while simultaneously perceiving the practices as highly challenging.

6.1.2 Analysis of Proactive SCRM Process Challenges

When looking at the results regarding challenges related to proactive SCRM process practices, three out of the four most challenging practices are related to the step of identification. This indicates that Identification might be seen as more challenging than the subsequent steps. However, the challenge related to monitoring also implies that this step might be more challenging. The least challenging practices are related to assessment and mitigation, supporting that identification and monitoring might be perceived as more challenging, compared to the other steps. The differences of the results are small however, indicating that there is no particular risk management practice which significantly stands out for the respondents. Furthermore, the overall results from the consistency analysis show that all respondents found at least one proactive practice as moderately or highly challenging as no one consistently rated all practices to be easy.

Moreover, the gap analysis does not present a clear inverse relationship between perceived challenge and implementation level, as the results show no evidence of substantial groups of respondents having applied practices at low level, meanwhile finding them highly challenging. Rather, the opposite was seen in some cases, especially for the process steps of identification and assessment. Otherwise, the somewhat linear relationships presented may suggest that there is a positive correlation between how actively you work with practices and how challenging you perceive them to be. This might reflect that a deeper understanding of the complexities of the practices are achieved when implementing them to a greater level. In that case, the relationship might imply that less mature companies do not see the difficulties and challenges of implementing practices, and therefore do not see the point in putting resources into such proactive implementation. However, the results might also suggest that organizations which experience them as difficult see a greater value of the practices and therefore continue to be committed and implement SCRM practices regardless of perceived barriers. Conclusively, the gap analysis shows that while proactive SCRM practices are not without difficulties, perceived challenges do not necessarily hinder implementation. A concluding summary of the proactive challenges can be seen in Figure 6.2.

Key findings related to proactive SCRM process challenges	
• Overall many companies show a moderately to high level of difficulty, as 75% rates all practices except two as moderately or highly challenging. The exceptions are prioritization of risks and interdependencies. • There is no clear inverse relationship between level of difficulty and implementation, meaning a consistent pattern showing that higher perceived difficulty leads to lower implementation of SCRM practices. • In many cases, implementation and perceived difficulty seem to increase linear, suggesting that deeper engagement leads to greater awareness of challenges. Conversely, less mature organizations may underestimate the complexity of SCRM and therefore invest less in proactive efforts. • Proactive SCRM practices are not without difficulties but the gap analysis show that perceived difficulty does not necessary hinder implementation.	

Figure 6.2: Summary of key findings on proactive challenges.

6.2 Reactive SCRM process challenges

6.2.1 Results of Reactive SCRM Process Challenges

For challenges regarding reactive SCRM process related practices, rated on a 1-7 scale, Figure 6.3 suggests that respondents find reactive practices slightly less challenging than proactive practices. This is based on the mean values and the boxplot profile, which illustrate that the 50 percent concentration of companies have rated all challenges except one between three and five (means between 3.26-3.90). Additionally, at least 75 percent of the respondents found all reactive related challenges to be low or moderately challenging.

The exception, *assemble a response team with key stakeholders* (mean of 3.26), was instead rated even lower. Furthermore, *identify the root cause of the disruption* (mean of 3.92) and *assess impacted areas across the SC* (mean of 3.79) are the only items which have received scores as high as 7, also indicating that reactive practices are perceived somewhat less challenging than proactive.

Furthermore, the underlying data has been analyzed to assess the consistency of responses regarding perceived challenges across all reactive process steps. When consistency is analyzed across the entire reactive SCRM process, only 21 percent of respondents rated all practices at the same challenge level. None consistently rated all challenges as highly difficult, while 6 percent and 15 percent consistently rated them as moderate and low, respectively.

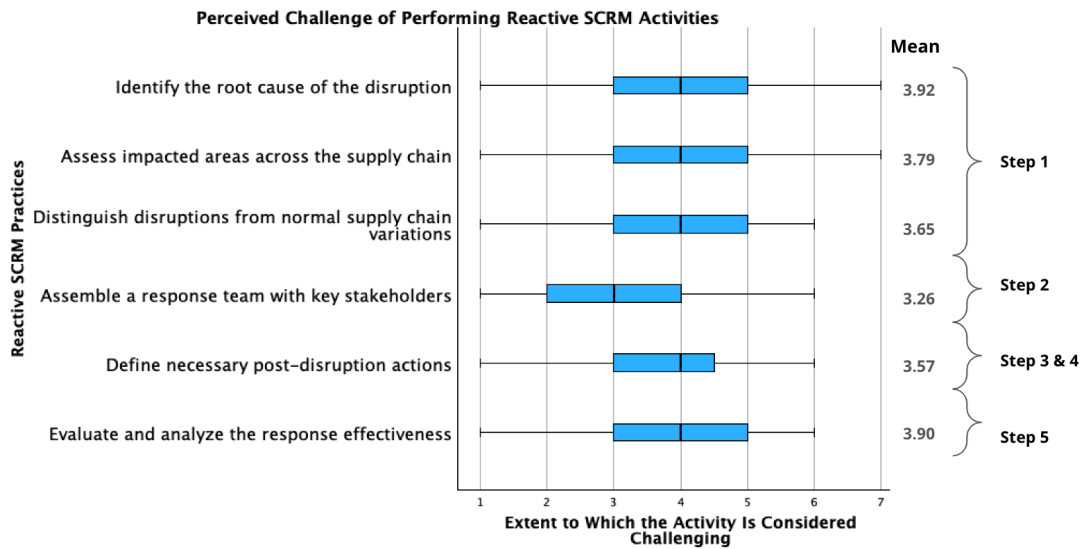


Figure 6.3: The extent to which respondents perceive difficulty in reactive SCRM practices.

To compare the perceived level of challenge with the application of corresponding reactive SCRM practices, six plots covering all challenges have been created, as shown in Appendix C, Figure C1 to Figure C6. The specific items included in the comparison are also detailed in the appendix. The gap analysis results indicate that for all challenges, the majority of respondents rated their level of application of corresponding practices as equal to or higher than the perceived degree of challenge. For the challenge of *evaluating response effectiveness*, a slightly wider dispersion is observed, with some respondents perceiving the practice as more challenging than their current level of application. Nevertheless, for all challenges, substantial groups of respondents report applying these practices at a moderate to high level (scores of 4–7) while perceiving the associated challenges as low (scores of 1–3), indicating an overall trend.

6.2.2 Analysis of Reactive SCRM Process Challenges

A comparison of the perceived challenges associated with reactive and proactive SCRM process practices reveals that reactive activities are generally viewed as less challenging. This is reflected in the lower mean scores and narrower boxplot ranges, with most responses for reactive challenges concentrated between values 3 and 5, compared to 4 to 6 for proactive practices. Additionally, 15 percent of the respondents consistently find all reactive process practices to be only a low level of difficulty. Altogether, these results suggest that companies find reactive steps easier to perform than proactive ones, likely due to their more operational and immediate nature. Unlike proactive practices, which require anticipation, analysis, and planning in the face of uncertainty, reactive steps are typically initiated by the occurrence of a disruption and are often guided by predefined routines or previous experience (Kilubi 2016). Further support for this interpretation is that the most challenging reactive practices are *root cause identification* and *evaluation of responses*, which are less action-oriented and more knowledge-oriented. According to Hopp, Iravani and Liu (2012), identifying root causes can be particularly complex, and companies are advised to use cause-effect tools to facilitate this process. The perceived difficulty of evaluation seems to have an impact on implementation as this was amongst the least applied reactive practices. It may be seen as challenging as it may require establishment of procedures outside the daily operations, involvement of multiple stakeholders and a structure for documentation (Norrman & Wieland 2020).

While this lower challenge perception may reflect a higher level of comfort or familiarity with reactive responses, it could also indicate a limited depth in how some organizations approach post-disruption activities. For instance, for companies which perceive practices such as root cause analysis and evaluations as only moderately challenging, it may suggest that these tasks are not performed systematically or thoroughly, potentially constraining long-term learning and improvement.

When comparing the groups of respondents who find the reactive practices as either low, moderate, or highly challenging with the corresponding groups based on application level, it appears to be larger groups reporting high application levels, compared to the distribution of perceived challenge levels, suggest a tendency among respondents to apply certain practices extensively, and at the same time find them only slightly or moderately challenging. This is further supported by the gap analysis, which reveals substantial groups who apply these practices at a moderate to high level (scores of 4–7) while perceiving the challenges as low (scores of 1–3), suggesting a general pattern.

Although exceptions exist, where some companies report difficulties in implementation due to higher perceived challenges, the majority does not appear to struggle significantly. This may reflect the nature of reactive tasks, which are often procedural, standardized, and not unique to SCRM. For instance, assembling a response team is frequently part of broader crisis management frameworks. Consequently, the lower perceived difficulty and higher implementation may result not from deliberate SCRM capability development, but rather from these practices already being embedded in general organizational routines. A concluding summary of the reactive challenges can be seen in Figure 6.4.

Key findings related to reactive SCRM process challenges
- Reactive practices perceived as less demanding than proactive ones, as at most 50% perceive each practice to be moderately or highly difficult. The relative ease is likely due to their more operational character and suitability for ad hoc implementation, once a crisis hit you know you have to take action. - Root cause analysis and evaluation are most challenging and may benefit from proactive preparation, by using tools or implementing structured procedures. - For all practices, many companies implement reactive practices to a higher degree than perceived challenge, possibly reflecting embedded routines or higher maturity. Additionally, companies may overestimate their implementation implying that their self-perceived maturity may not completely align with literature, which emphasizes proactive preparation to a great degree even for effective reactive response.

Figure 6.4: Summary of key findings on reactive challenges.

6.3 Organizational Challenges

6.3.1 Results of Organizational Challenges

Organizational challenges, have similarly proactive and reactive practices, been measured on a 1-7 scale. Figure 6.5 presents that overall the ranges of the variation of respondents are wide, indicating that companies have different varying perceptions of how challenging the organizational practices are. However, for the majority of the challenges, the concentration of the boxplots ranges between 3 and 5, indicating the challenges are perceived low to moderate by most respondents. The mean values range between 3.95 and 4.75, and no single area stands out as significantly more challenging than the others.

However, when comparing the individual items, the practices perceived most challenging by a larger group of respondents are *integrating SCRM into the company culture* (mean of 4.75), *having sufficient*

and technical resources (mean of 4.53) and having sufficient experience amongst employees regarding SCRM (mean of 4.52). The least challenging areas include *have a clear and effective internal communication* (mean of 3.95), *have a clear and effective external communication* (mean of 4.02), and *obtain support from top management* (mean of 4.06). But as has been declared above, these differences are relatively small. A few outliers appear in the capability area of *having sufficient experience amongst employees regarding SCRM*, suggesting that while almost every respondent assigned this challenge scores between 3 and 6, there are respondents which have assigned the practice with scores in both ends.

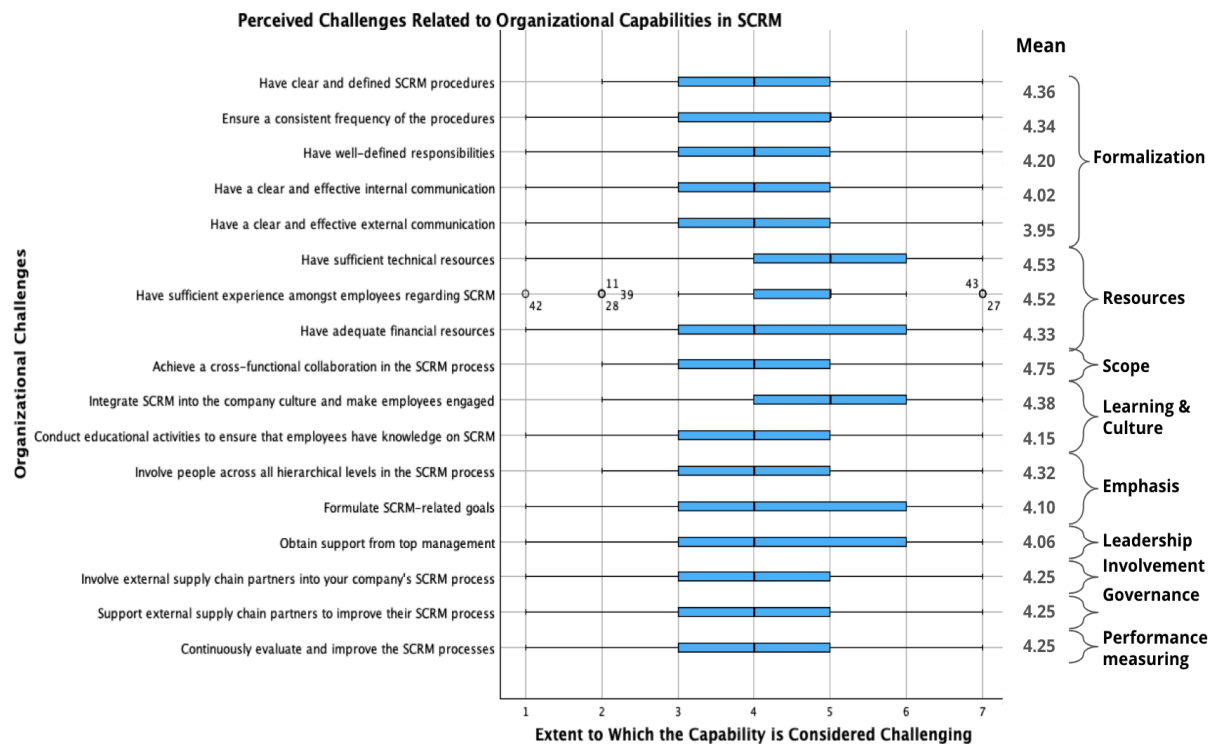


Figure 6.5: The extent to which respondents perceive difficulty in organizational capabilities.

To compare the perceived level of challenge with the application of corresponding organizational aspects, 17 plots covering all challenges have been created, as shown in Appendix D, in Figure D1 to Figure D17. The specific items included in the comparison are also detailed in the appendix.

First, regarding the capability of formalization, there are no substantial groups of respondents who report a low level of implementation while simultaneously perceiving the organizational aspects as highly challenging. Among those who indicate a high degree of success in formalization, the perceived level of challenge varies from fairly challenging (scores of 1-3) to highly challenging (scores of 6-7). However, for aspects such as having well-defined responsibilities, having a consistent frequency of conducting the procedures and having effective internal- and external communication, there appears to be a tendency for organizations to report a higher level of implementation than the perceived degree of challenge.

Regarding the resource capabilities, the gap-analysis related to human- and financial resources show highly dispersed results with varying perception of the risk and implementation. In contrast, the gap analysis regarding technical resources show a higher concentration of companies rating a lower level of practice implementation than their perceived level of challenge. There is a substantial group of

respondents which have stated that their technical resources are sufficient at a low level meanwhile finding it moderately to highly challenging.

Regarding the capability related to covering an appropriate scope of SCRM, the gap analysis reveals a dispersed relationship between perceived implementation and challenge. Nevertheless, more respondents report a higher level of implementation than perceived challenge. At the same time, respondents who report similar levels of application express varying perceptions of difficulty, suggesting that opinions on this issue remain diverse.

A high degree of dispersion is also observed in the two gap analyses related to Learning and Culture. However, in contrast to the results for scope limitation, the variation here primarily reflects varied views on the perceived level of challenge, while most organizations report a low to moderate degree of implementation of training activities. For both training and the integration of SCRM into organizational culture, there are respondents who report low levels of implementation while simultaneously perceiving the capability as highly challenging.

For the capability of Leadership support, the results show a high variation in the perceived level of challenge, yet most respondents report an equal or higher level of implementation relative to the perceived difficulty. A similar trend is observed in the analysis of Performance measurement. Although the perceived level of challenge varies across respondents, the distribution between those who find the practice more challenging than their level of application and those who report the opposite is relatively balanced. Lastly, the gap analyses related to the capabilities of Emphasis, Involvement, and Governance do not reveal any clear patterns.

6.3.2 Analysis of Organizational Challenges

The relatively similar mean scores, ranging from 3.95 for *having an effective external communication* to 4.75 for *integrating SCRM into the company culture*, suggest that most respondents perceive the organizational practices as moderately challenging. However, diverse views of difficulty levels reflected by the wide boxplot profiles indicates that while many companies demonstrate moderate to high levels of organizational maturity on average, a considerable number of companies still appear to struggle with overcoming key challenges. However, to establish the relationships between perceived difficulty and implementation levels, the gap analyses were made.

The results related to formalization show that although respondents differ in how challenging they find the capability, perceived difficulty does not seem to negatively affect implementation. This is based on the fact that there are no substantial groups reporting high difficulty alongside low application. On the contrary, many respondents report higher levels of implementation than difficulty, particularly in sub-capabilities such as *having well-defined responsibilities*, *conducting procedures consistently*, and *maintaining effective internal- and external communication*. A similar trend is seen in the capability *accurately limiting the scope of SCRM*, where more respondents report higher implementation than perceived challenge than the opposite relationship. This indicates a general confidence in these capabilities and might suggest that organizations have overcome obstacles, even if some level of challenges persist.

Regarding resource capabilities, the gap analysis of *having sufficient technical resources* shows that several respondents report low levels of implementation paired with high perceived difficulty. This suggests that challenges in this area may be directly limiting progress and should be prioritized. In

contrast, the responses for *human* and *financial resources* are more dispersed, with no strong patterns emerging. Interestingly, some respondents report success in securing financial resources despite perceiving them as very challenging, implying that the challenge might not always be a limiting factor of success.

For the capability of learning and culture, particularly the practice of *conducting regular SCRM training*, most respondents report low to moderate implementation, while perceived difficulty spans the entire scale. This indicates that low implementation is not universally tied to high perceived difficulty. Instead, it may reflect other factors such as deprioritization or limited resources. In contrast, for *integrating SCRM into organizational culture*, there appears to be larger groups which report low implementation meanwhile high perceived challenge, suggesting that cultural integration is a particularly difficult area for many organizations.

For capabilities such as emphasis, involvement, governance, and leadership support, the gap analysis did not reveal any clear tendencies. For the capability of performance measuring however, the perceived difficulty and application levels seem to align for the concentration of the respondent group although the scores vary. This might suggest that the perceived level of difficulty could be limiting further capability development, thereby hindering companies from overcoming challenges and progressing toward higher levels of maturity. It may also indicate that as companies mature, they develop a deeper understanding of the challenges involved. A concluding summary of the organizational challenges can be seen in Figure 6.6.

Key findings related to organizational SCRM challenges
• Most organizational challenges are seen as moderate, but variation across responses shows that some companies still struggle significantly with key aspects of SCRM. • Many companies report higher implementation than perceived difficulty in formalization- and scope related practices (e.g., defined responsibilities, consistent procedures), indicating these challenges are often overcome. • Technical resources remain a major constraint, with many companies reporting both low implementation and high difficulty in this area. Mixed outcomes for human and financial resources, as some firms succeed despite perceiving these as challenging, suggesting difficulty doesn't always limit progress. • Low implementation of regular training seems to not always linked to high difficulty, pointing instead to potential deprioritization or resource constraints. • Cultural integration is a key challenge, with low implementation and high perceived difficulty showing that aligning SCRM with organizational culture is still a major barrier. • Capabilities like governance, leadership support, and involvement lack consistent patterns, indicating varying levels of maturity and inconsistent approaches across firms. • Performance measurement may be constrained by difficulty as implementation and difficulty scores often align here, suggesting difficulty may limit progress in developing performance-focused capabilities.

Figure 6.6: Summary of key findings on organizational challenges.

7. Empirical findings related to comparison of industry and company size

Chapter 7 presents the findings for RQ3, comparing responses across industries (section 7.1) and company sizes (section 7.2). It highlights overall trends, statistically significant differences, and notable patterns based on group averages.

For each comparison between industries or company sizes, the p-values obtained from the Kruskal-Wallis test serve as the primary basis for comparison between groups, alongside the mean of each item. Items identified as dependent will be presented with their corresponding p-values in parentheses and are reported if they fall below the 0.05 or 0.10 thresholds, the latter included to highlight results that are marginally significant and may still indicate meaningful trends worth further consideration. This test only indicates that a difference exists between at least one of the groups, but it does not specify which one. Therefore, mean comparisons will be conducted to determine which specific group differs.

7.1 Industry Comparison

7.1.1 Background

Significant differences between industries were observed in the perceived importance of SCRM. Both *proactive SCRM* ($p = 0.064$) and *reactive SCRM* ($p = 0.009$) showed variation. Retail scored the lowest in both areas, while manufacturing rated proactive SCRM as more important than reactive. In contrast, food rated reactive SCRM as more important than proactive, as shown in Figure 7.1.

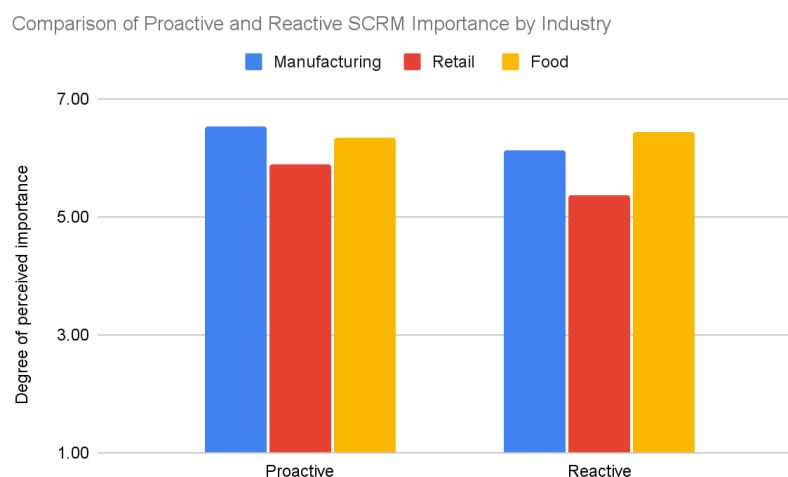


Figure 7.1: Average ratings of proactive and reactive SCRM importance across industries.

For risk areas, five significant differences were identified: *economic risks* ($p = 0.052$), *operational risks* ($p = 0.047$), *quality risks* ($p = 0.005$), *sustainability-related risks* ($p = 0.023$), and *technology risks* ($p = 0.075$). Economic risks were rated highest by retail, technology risks highest by food, while for the remaining three risk types, retail consistently received the lowest ratings, with manufacturing and food showing similarly high levels. These patterns are illustrated in Figure 7.2.

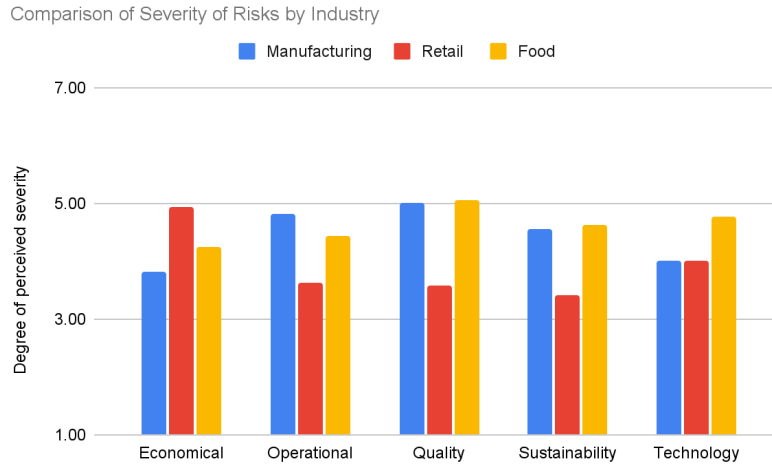


Figure 7.2: Average severity ratings of risks with significant differences across industries.

In terms of department involvement in SCRM, four significant differences were found: *local sites* ($p = 0.017$), *supply chain* ($p = 0.072$), *operations* ($p = 0.028$), and *engineering* ($p = 0.008$). Local sites, supply chain, and operations were most involved in manufacturing and food and then retail notably behind. Engineering involvement was high in manufacturing but very low in food and retail, which can be seen in Figure 7.3.

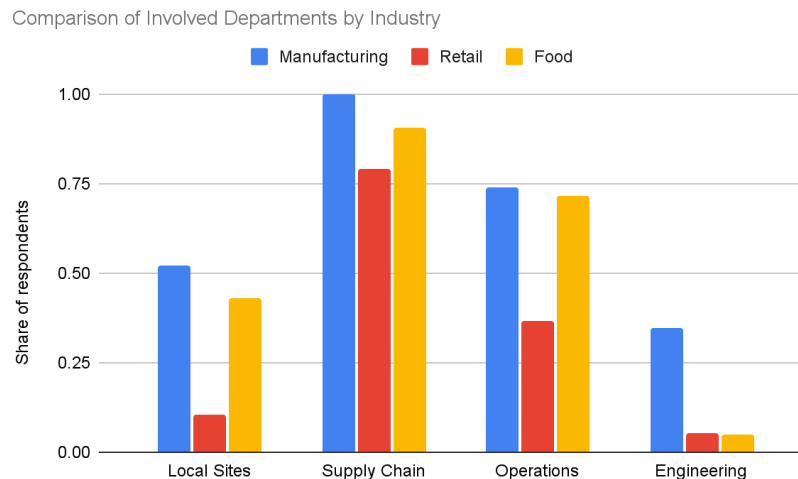


Figure 7.3: Share of respondents involving each department in SCRM, showing significant differences across industries.

The lower importance ratings of SCRM in retail compared to manufacturing and food likely reflect retail's overall lower focus on structured SCRM, as will be evident throughout this chapter. This may stem from many reasons, such as retail's downstream position in the supply chain, where they typically lack production control and instead rely on upstream suppliers and distributors for risk mitigation (Ge, Pan & Shen 2019). Consequently, they are less exposed to production-related disruptions, often purchasing finished goods rather than assembling complex components. Additionally, retail customers can also often be less specific in their purchasing needs, for example, if one t-shirt is out of stock, alternatives are usually available that satisfy their need. These factors can reduce the perceived need for SCRM among retail companies. Both manufacturing and food companies place greater emphasis on SCRM compared to retail, with manufacturing particularly

focused on proactive measures and food companies prioritizing reactive efforts, patterns that are consistently reflected throughout this chapter.

In contrast to retail, manufacturing and food companies operate as producers and thus face higher exposure to supply-side risks, increasing the need to work with SCRM. Manufacturing firms require a broad range of raw materials, often sourced globally, and frequently deliver critical components to downstream customers, meaning a single disruption can halt production across multiple supply chains (Harris 2024). Food producers also depend on raw materials (Lindow 2012) but face additional complexity due to strict food safety and quality requirements, as well as the logistical challenges of perishability and sensitive transport and storage conditions (Oliveira et al. 2023). Additionally, both manufacturing and food industries are subject to stricter regulatory requirements, including safety, environmental standards, and traceability (Oliveira et al. 2023), which further increase the need for formalized SCRM practices. Together, these factors explain why manufacturing and food companies tend to perceive SCRM as more important and apply it more extensively than retail.

Retail's high ranking on economic risks reflects a sensitivity to inflation, tariffs, and exchange rate changes, probably due to the industry's strong dependence on importers and logistics providers and consumers spending a large share of their household budgets on retail (European Commission, n.d.), which can quickly affect spending. Meanwhile, food's high technological risk ratings may stem from its reliance on inter-organizational and international supply chains with limited transparency (Norrman & Eriksson Ahre 2024), making system integration and coordination more difficult and increasing the risk of disruptions.

In contrast, operational, sustainability, and quality risks are rated equally high by manufacturing and food companies. Higher operational risk exposure, such as equipment failures or skill-related issues, is expected, as both industries involve production activities. Their elevated concern for quality risks likely comes from the critical importance of food safety in the food industry and product safety in manufacturing, both of which can impact brand reputation and customer health (Oliveira et al. 2023). Lastly, sustainability risks are probably perceived as more severe due to their producer roles and growing external pressure to reduce environmental footprints (World Economic Footprint 2022).

Finally, the greater involvement of local sites, SC, and operations departments in manufacturing and food indicates a stronger integration of departments SCRM, reflecting the complexity and criticality of their production processes. The strong involvement of engineering in manufacturing highlights that they have a stronger emphasis on areas like product development.

7.1.2 Proactive SCRM

There were a few significant differences in proactive SCRM, which can be seen in Figure 7.4. For identification activities, there was one significant difference; *understanding supply chain complexity and its implications* ($p=0.080$). Food companies rated this highest, followed closely by manufacturing.

Comparison of Proactive Activities by Industry

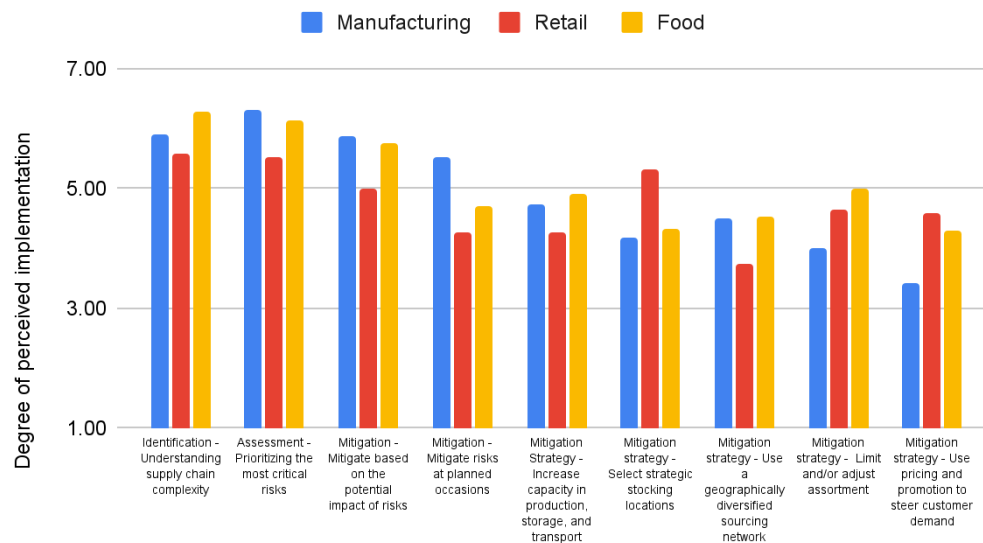


Figure 7.4: Average application levels of proactive SCRM activities, with significant differences across industries.

Although not statistically significant, it's noteworthy that manufacturing reported the most active evaluation of first-, second-, and third-tier suppliers, suggesting a structured approach to upstream risk visibility. For assessment, one aspect showed one significant difference, *prioritizing the most critical risks* ($p=0.066$), and for mitigation activities there were two significant differences: *evaluate the potential impact of risks* ($p=0.088$) and *mitigate risks as planned when they occur* ($p=0.098$). For all three activities, retail consistently lagged behind. Manufacturing and food showed similarly higher levels for the first two, while for the third, mitigating at a planned frequency, manufacturing ranked the highest. For monitoring there were no significant differences.

Five significant differences were identified in mitigation strategies. Retail reported considerably lower application levels than the other industries for both *increase capacity in production, storage, and transport* ($p=0.041$) and *use a geographically diversified sourcing network* ($p=0.085$). In contrast, food showed the highest application for *limit and/or adjust assortment* ($p=0.042$). Meanwhile, retail ranked highest in *select strategic stocking locations* ($p=0.077$) and *use pricing and promotion to steer customer demand* ($p=0.025$). Especially, manufacturing rated pricing and promotion to steer customer demand much lower than the other industries.

Across all stages, significant differences in identification, assessment, mitigation and mitigation strategies, manufacturing and food show higher levels of engagement than retail, with the exception of two mitigation strategies. As discussed in Section 7.1.1, this aligns with their higher perceived importance of SCRM and greater risk exposure, which explain retail's consistently lower application levels.

When examining mitigation strategies, the differences become more pronounced, and notably, despite overall lower engagement, retail reported the highest application in two specific areas. Firstly, retail's high use of strategic stocking locations may stem from the wide range of delivery options, frequent demand for fast-moving consumer goods (European Commission, n.d.), and the growing pressure from omni-channel retail to adapt quickly to changing customer needs, placing greater

emphasis on responsive network design (Myerson 2021). Furthermore, as the final link to customers (Ge, Pan & Shen 2019), retail companies can leverage pricing and promotional tactics more readily than manufacturers or food producers.

7.1.3 Reactive SCRM

Although no significant differences were found between industries in reactive activities, mean values show that retail ranked lower than manufacturing and food, that scored similarly high, as illustrated in Figure 7.5. More specifically, manufacturing scored highest in steps 1 and 3, while food scored higher in steps 2, 4, and 5. Additionally, for detecting disruptions, there were no significant differences between industries. However, it can be seen in Figure 7.6 that for most of the alternatives, manufacturing or food is using the detecting methods the most and comparably retail has the highest application is for *detect through news or social media*, and also that they *only detect once already occurred*.

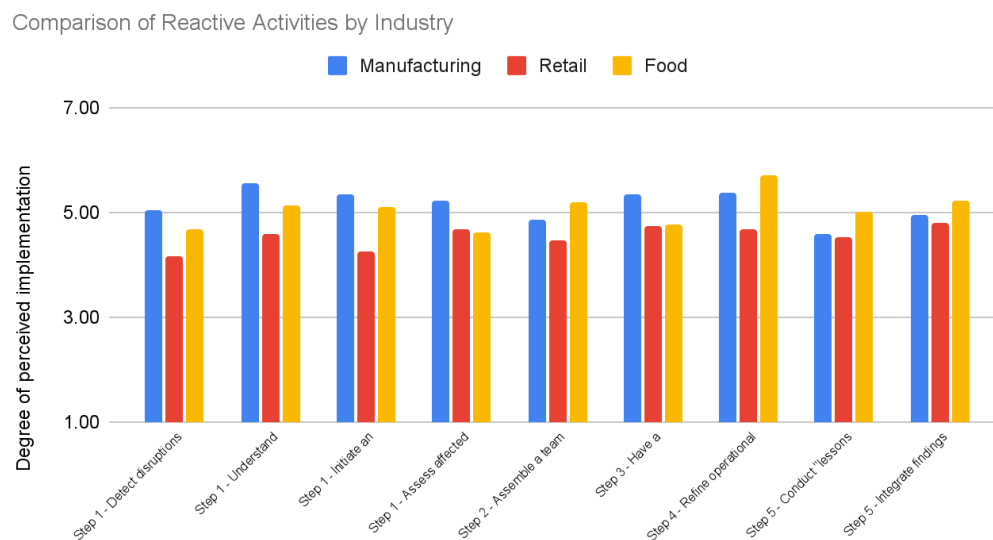


Figure 7.5: Average application levels of reactive SCRM activities across industries.

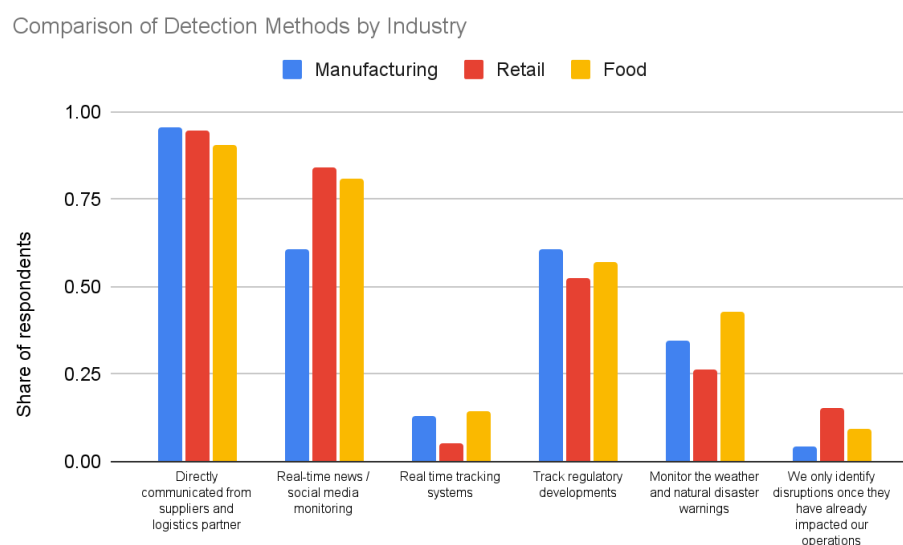


Figure 7.6: Share of respondents using detection methods across industries.

As stated in the results, no significant differences were found in reactive SCRM between industries; however, retail consistently showed lower mean values than manufacturing and food, except in two more ad hoc detection methods. This further indicates that retail relies on a less structured approach with fewer formal SCRM activities, aligning with their overall low application of proactive measures.

Manufacturing's higher scores in steps 1 and 3 likely reflect stronger capabilities in the early stages of reactive SCRM, particularly in areas of recognizing and initiating a response (step 1) and the use of established contingency plans (step 3). As previously noted, manufacturing companies typically operate with structured processes and rated highest in importance of proactive SCRM, enabling quick identification of disruptions and rapid response through prepared protocols.

In contrast, food's higher scores in steps 4 and 5 may be linked to the industry's focus on recovery and post-incident evaluation, which was seen in their ranking of importance in reactive SCRM which was the highest. Given the critical importance of food safety, any contamination or disruption forces food producers to be agile and to act with thoroughness to prevent recurrence.

7.1.4 Organizational Capabilities

For organizational capabilities, four significant differences were found on a 5 and 10 percent level: *incorporating input across all hierarchical levels* ($p=0.074$), *having clear and effective internal communication* ($p=0.019$), *clear and effective external communication* ($p=0.099$), and *including multiple departments in the SCRM scope* ($p=0.050$). Food companies scored highest in both internal and external communication, while manufacturing led in the other two areas and retail lagged behind. The significant differences can be seen in Figure 7.7.

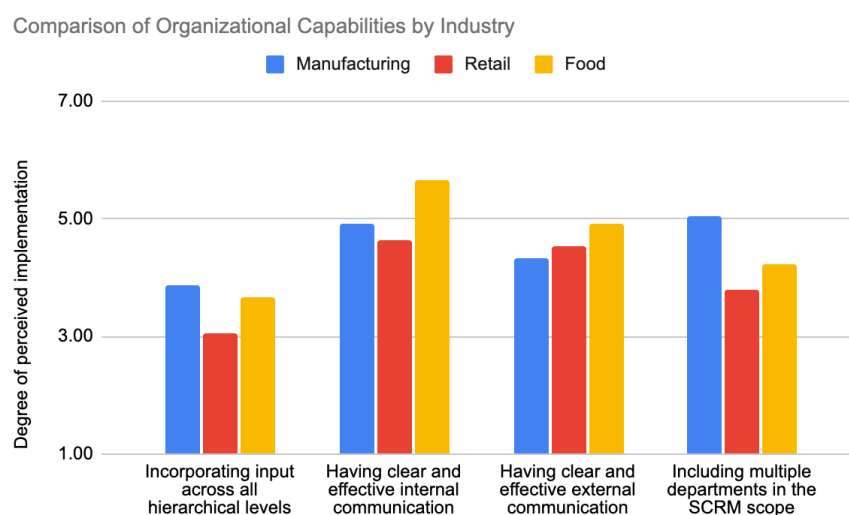


Figure 7.7: Average application levels of organization capabilities, with significant differences across industries.

The differences observed in organizational capabilities between industries provide valuable insights into how SCRM is embedded within organizational structures. Food companies scoring highest on both internal and external communication suggests a strong focus on coordination and timely information sharing with both internal teams and external stakeholders, likely driven by the critical need for swift action in food safety and quality-related disruptions. In contrast, manufacturing companies reported the highest levels of incorporating input across hierarchical levels and involving

multiple departments. This indicates a more structured approach to SCRM integration, reflecting the complexity of manufacturing SCs and the need for broad organizational alignment to manage operational risks effectively. The results imply that while food prioritizes communication to manage urgent, customer-facing risks, manufacturing relies on cross-functional involvement and internal structure to mitigate and prevent disruptions. Retail, on the other hand, ranks lowest in three out of four organizational capabilities, reinforcing the overall pattern of limited SCRM engagement observed in other areas. This suggests that not only is SCRM seen as less critical in retail, but it also lacks the structural and cross-functional support needed to embed risk management practices effectively within the organization.

7.1.5 Methods, Tools and IT

For methods and tools, six significant differences were found across industries. *manufacturing-specific tools* ($p = 0.081$) were used most by food companies, followed by manufacturing. Risk tools focused on the *manufacturing and usage phase* ($p = 0.006$) were almost exclusively used by manufacturing. The *probability-impact matrix* ($p = 0.032$) was used most by manufacturing, then retail, and least by food. *Portfolio analysis* ($p = 0.019$) was mainly applied by manufacturing, followed by food. *Internal historical data to estimate risk probability and impact* ($p = 0.094$) was used most by food, then retail, and least by manufacturing. Lastly, *alert systems and early warning signals* ($p = 0.025$) were most used by manufacturing, with significantly lower usage in food and retail. Overall, the utilization of different methods shows greater variation compared to previous results, where retail has almost consistently lagged behind. In this case, also manufacturing reported the lowest usage in some areas, while food scored lowest in others.

For IT software tools, two significant differences were found; the use of *Excel or similar familiar software* ($p = 0.033$) and the use of *Business Continuity Management (BCM) systems* ($p = 0.015$). Manufacturing was the most active user across nearly all IT tools, especially specialized SCRM IT-systems like BCM. Food companies reported the highest use of Excel, followed by retail. All significant differences can be seen in Figure 7.8.

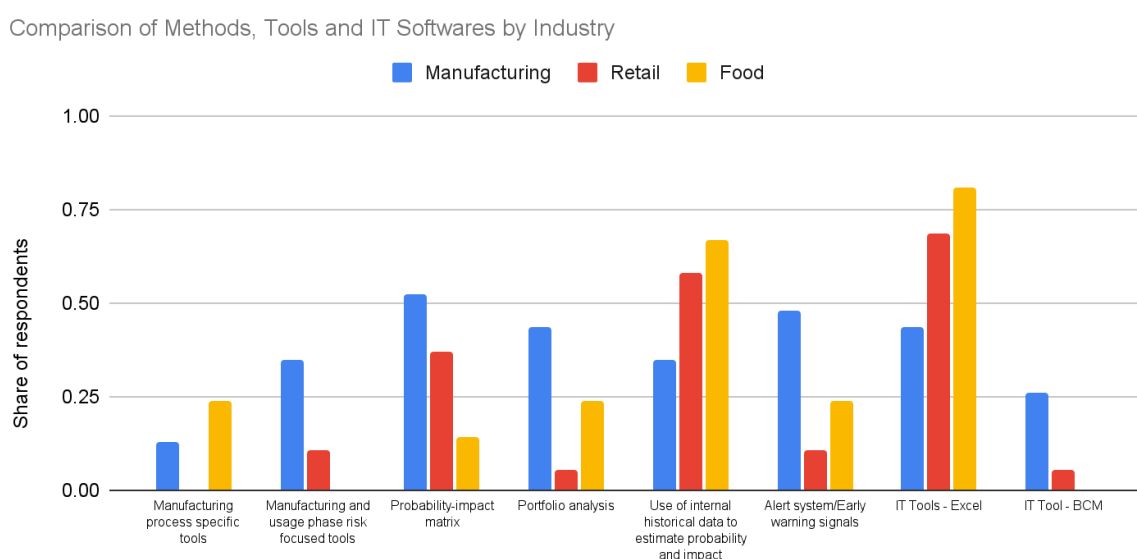


Figure 7.8: Share of respondents using methods, tools and IT softwares, with significant differences across industries.

For IT capabilities, there were two significant differences: *having a system that provides a geo map of supply chain dependencies* ($p=0.013$) and *using a system that provides early warnings* ($p=0.107$). For all but one item, both significant and non-significant, manufacturing recorded the highest scores in IT capabilities. This can be seen in Figure 7.9. For perceived IT value, one capability stood out as significant: *integration of IT into SCRM processes* ($p=0.060$), which was the highest for food. For all IT Capabilities, but one, food was the industry rating it as the most valuable, which can be seen in Figure 7.10.

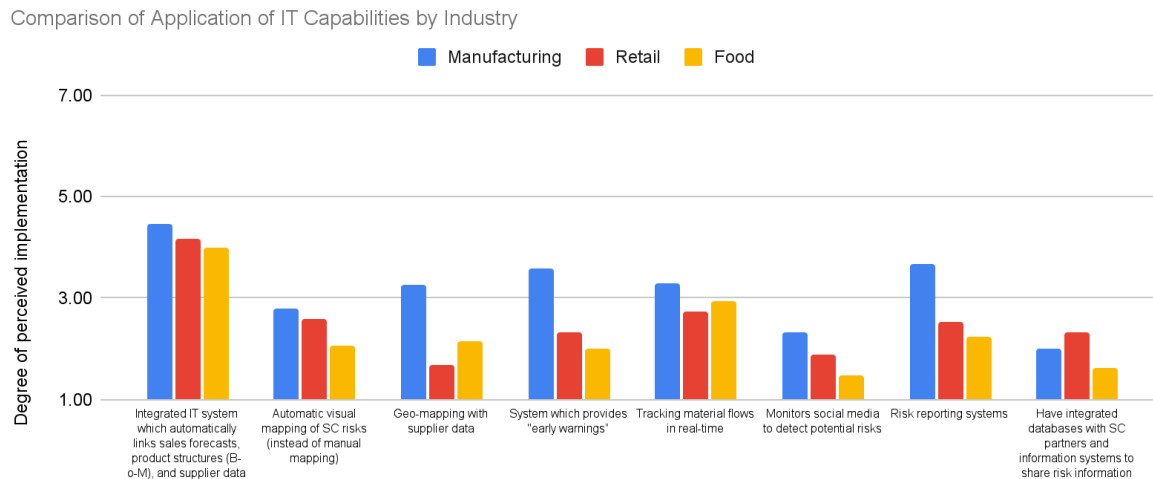


Figure 7.9: Average ratings of IT capabilities across industries, with significant differences found only in 'Geo mapping with supplier data' and 'Risk reporting systems'.

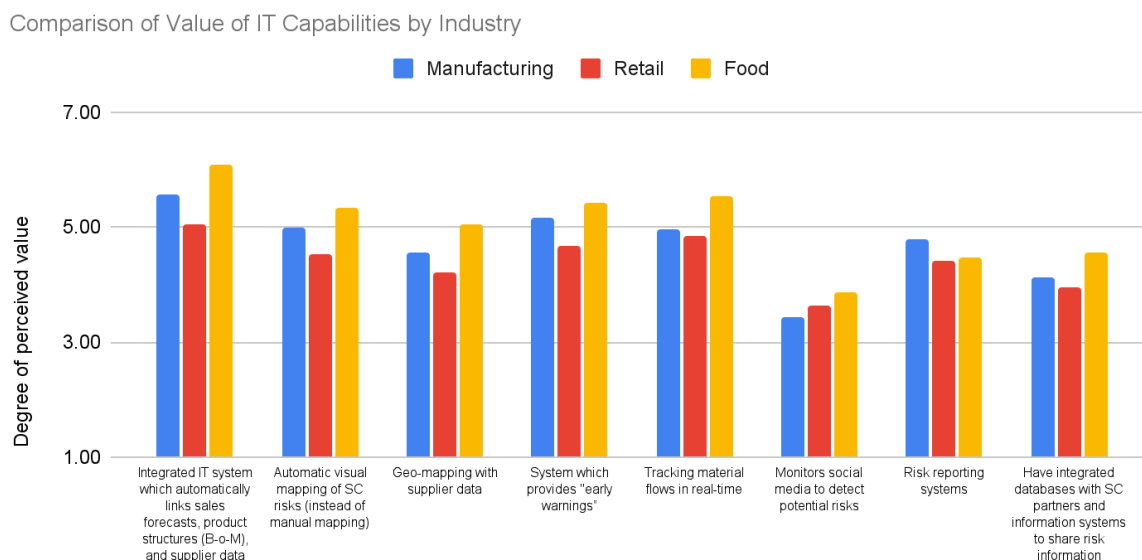


Figure 7.10: Average perceived value of IT capabilities across industries, with significant differences found only in 'Integration of IT into SCRM processes'.

The results on methods and tools revealed greater variation in which industry reported the highest usage. Manufacturing had the highest use in four out of six significantly different tools but showed the lowest use of internal historical data to estimate probability and impact. Food companies reported the

highest use in two tools, internal historical data and manufacturing process-specific tools. Unlike earlier findings, retail did not consistently rank lowest and showed second highest usage in three of the six tools. This indicates that different tools serve different industry needs, rather than one industry uniformly applying the most tools.

Looking more closely, the use of manufacturing process-specific tools, such as those analyzing flow or temperature to identify risks, is as expected absent in retail, but relevant for both manufacturing and food, which require close production control for reasons like food safety and quality assurance. Manufacturing's higher use of tools focused on risks during the manufacturing and usage phases likely reflects that their products often have long lifespans, in contrast to food products, which are more perishable. Additionally, manufacturing's more frequent use of probability-impact matrices and portfolio analysis highlights their structured risk assessment practices and aligns with their previously noted emphasis on proactive SCRM. Manufacturing further shows high use of early warning systems in both tools and IT capabilities, reflecting a strong need for timely risk detection. Lastly, food and retail rely more on internal historical data, likely due to its accessibility with fewer dedicated SCRM systems and the absence of more advanced analytical tools.

The findings on IT software and capabilities reflect a clear divide in digital maturity across industries. Manufacturing companies show the highest level of implementation, using advanced, dedicated systems such as Business Continuity Management (BCM) and widely adopting all IT capabilities to the highest level of the three industries, except for one. This demonstrates a strong integration of IT in their SCRM efforts. In contrast, food and retail companies rely more on familiar, accessible tools like Excel, likely due to lower operational complexity or resource constraints. Interestingly, although food companies have lower implementation levels, they rate IT capabilities as highly valuable. This suggests that they recognize the potential of advanced IT for SCRM but have yet to fully adopt such solutions.

7.1.6 Challenges

No significant differences between industries were found regarding challenges in proactive, reactive, or organizational aspects. Nor did any consistent trends emerge when comparing mean values across industries. This is particularly notable given the previously observed variations in application and utilization levels.

7.1.7 Resilience

For resilience, there were two marginally significant differences: *ability to quickly recover from disruptions* ($p = 0.104$) and *recover with minimal financial impact* ($p = 0.108$). Note that the differences look small in Figure 7.11 as it does only take mean values into account and not the data related to each respondent, as taken into account in the statistical test. Both capabilities were rated highest by manufacturing companies. Overall, manufacturing and food show similarly high levels of perceived resilience, whereas retail lags noticeably behind. An exception was found in the capabilities *can recover from a disruption with minimal financial impact* and *capability to not only recover to the initial state after a disruption but to emerge in an improved state*, where food was rated at the same lower level as retail, while manufacturing rated considerably higher. These differences can be seen in Figure 7.11.

Comparison of Resilience by Industry

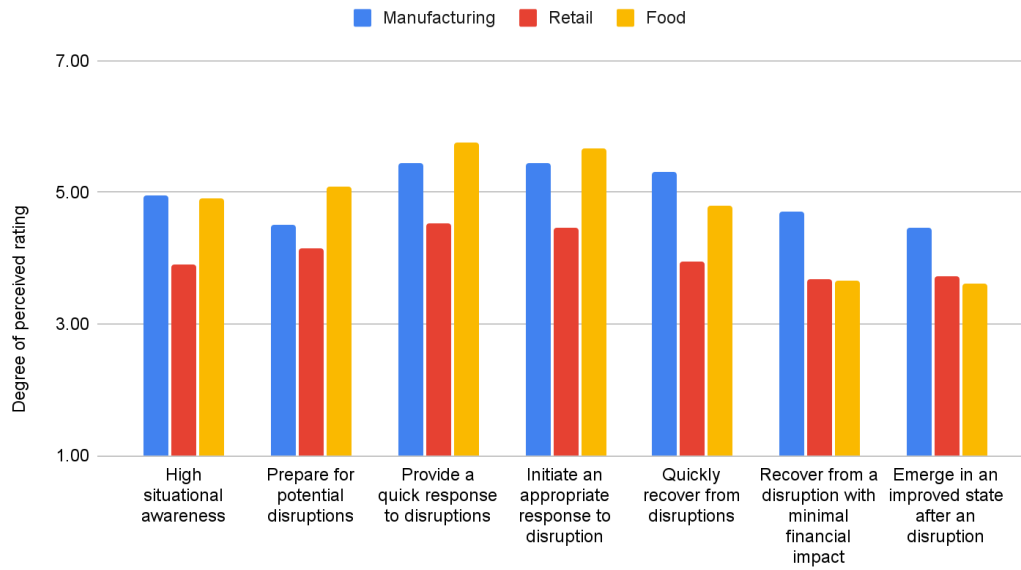


Figure 7.11: Average perceived ratings of resilience across industries, with significant differences found only in 'Quickly recover from disruptions' and 'Recover with minimal financial impact'.

The overall perceived resilience ratings reveal a clear pattern: manufacturing and food companies rate themselves as more resilient, while retail lags significantly behind. This aligns with the broader findings in all comparisons, where manufacturing and food consistently show higher ratings of SCRM importance, higher levels of SCRM engagement, the same ratings on challenges, and broader application of methods, tools, and IT compared to retail. The main distinction between manufacturing and food lies in the final two resilience aspects, recovering with minimal financial impact and emerging stronger after a disruption, where food scores similarly to retail. This suggests that manufacturing's more structured and proactive SCRM efforts may enable a more cost-efficient recovery and even post-disruption improvement, compared to food companies.

7.1.8 Concluding Points on Industry Comparison

A concluding summary of industry comparison can be seen in Figure 7.12.

Overall findings		
- Manufacturing followed by Food show the highest overall maturity, assign greater importance and perceive higher risk severity in SCRM, while Retail constantly lags behind. - No major differences were found between industries in reactive SCRM or perceived challenges - Resilience ratings were higher for Manufacturing and Food, especially in financial recovery and emerging to a better state after the disruption for Manufacturing.		
Manufacturing	Food	Retail
SCRM focus: strongest emphasis on proactive practices with highest implementation Risks perceived most severe: Operational, Quality, Sustainability Departments involved: local sites, supply-chain, operations, engineering Reactive strengths: detection & initial response and contingency plan (steps 1 & 3) Org. capabilities: focus on incorporating departmental and hierarchical levels in SCRM IT/Methods/tools usage: highest adoption of methods and tools, SCRM softwares and IT capabilities	SCRM focus: places most emphasis on reactive practices, similar implementation as Manufacturing in proactive Risks perceived most severe: same as Manufacturing, plus Technology Departments involved: same as Manufacturing but without engineering Reactive strengths: operational adjustment & evaluation (steps 4 & 5) Org. capabilities: leads in internal and external communication IT/Methods/tools usage: relies on simpler tools (e.g., Excel) yet rates IT value highest	SCRM focus: views SCRM as least important and applies the fewest practices Risk perceived most severe: Economic Ranks lowest involvement in departments, organization capabilities, IT/methods usage Reactive approach: ad-hoc detection via social media or after disruption have occurred Mitigation strategies: strongest in strategic stocking and pricing/promotions to steer demand

Figure 7.12: Summary of key findings on industry comparison.

7.2 Size comparison

Section 7.2, presents the empirical findings related to the size comparison, included in RQ3. Company size is measured by revenue, as it reflects the scope, complexity, and financial exposure of the SC better than number of employees.

7.2.1 Background

Overall, many areas in the background are considered as non significant dependent on the size and are relatively same for all sizes. Examples of this are the importance of proactive and reactive SCRM, most departments involved in the SCRM work and most risks.

A notable observation was that most companies in size group 3 had a higher national presence within Sweden, with only a few operating internationally, while the majority of size group 4 companies had a broader international presence, with only a small number limited to Sweden or the Nordic region. This distinction may have influenced the differences observed between size groups 3 and 4, as both represent large companies but with different operational scopes. Additionally, the majority of size 1 companies consisted of manufacturing and food companies, and only one retail company, which can also have an effect on the results.

Departments involved in SCRM that showed significant differences by company size were *risk* ($p = 0.009$) and *top management* ($p = 0.075$). Almost no small companies (size 1–2) included a separate risk department, while nearly 50 percent of the largest companies did. Conversely, top management involvement was highest among smaller companies, especially in size 2, and decreased as company size increased, which can be seen in Figure 7.13.

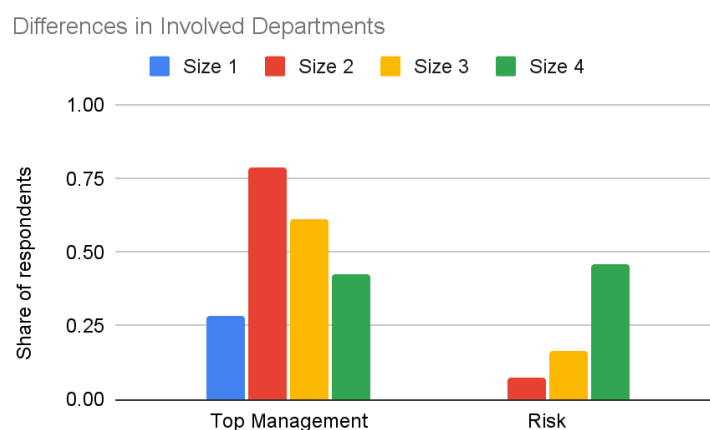


Figure 7.13: Share of respondents involving each department in SCRM, with significant differences across company sizes.

Significant size-dependent differences were also found in the severity of certain risk areas, *legal* ($p = 0.033$), *demand* ($p = 0.081$), and *social* ($p = 0.096$). Legal and social risks were rated more severe by larger companies (size 3–4), while demand risk was rated highest by smaller companies (size 1). On the contrary, the risk areas *geopolitical*, *environmental*, *logistical*, and *financial* showed almost no difference between company sizes. This can be seen in Figure 7.14. Overall, risk severity tended to increase with company size, although certain risks such as demand and logistical risks were perceived as more severe by smaller companies. These patterns were observed in the group means but were not statistically significant for all categories.

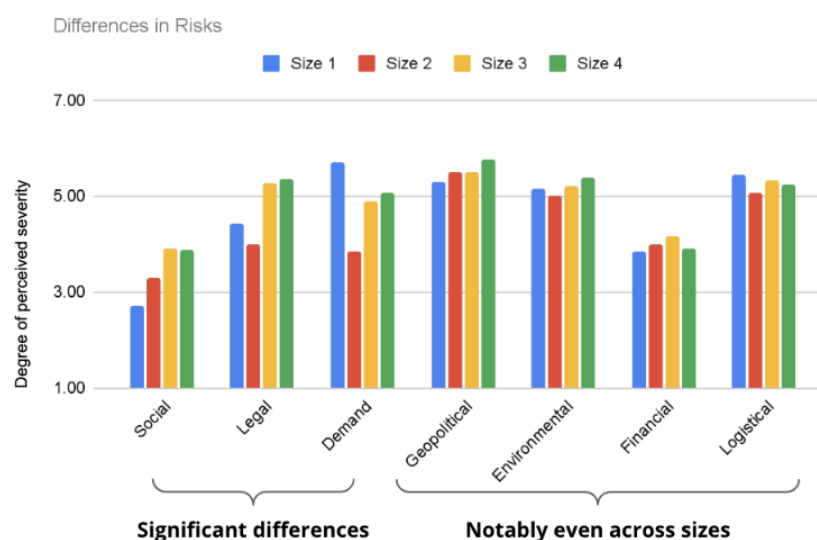


Figure 7.14: Average severity ratings of risks across company sizes, with significant differences observed in the three categories on the left, while the four categories on the right show minimal variation and no significant differences.

The significant differences regarding the included departments in SCRM can likely be explained by smaller firms that might lack dedicated SCRM departments and instead integrate SCRM responsibilities into existing functions. In contrast, larger organizations with greater resources are more likely to have established specialized risk departments. Additionally, top management tends to be more directly involved in SCRM within smaller companies, likely due to flatter organizational structures and shorter distances between daily operations and executive leadership.

The variation in how companies perceive the seriousness of various risk types may instead reflect the specific types of risks to which they are more exposed. Large companies rated legal risks significantly higher, which may be explained by their greater exposure to public and regulatory scrutiny. They often face stricter reporting obligations, more demanding compliance requirements, and are more affected by tariff changes due to their extensive involvement in international trade (Schwarz 2024). It is also likely that social risks become more relevant for bigger companies as high revenue often correlates with larger workforce, higher public visibility, and broader stakeholder exposure, making them more susceptible to labor actions and reputational backlash. In contrast, smaller companies might be more affected by demand risks, such as variations in demand or competition, as smaller variations in sales might have a greater impact on the business due to limited capacity and less financial stability.

On the other hand, the flattest risk areas were geopolitical, environmental, logistical, and financial. The three first are the highest ranked risks, reflecting that risks such as war and terrorism (geopolitical), natural disasters and pandemics (environmental), and delivery disruptions (logistical), tend to impact all companies regardless of size. These are systemic risks that no organization seems to be able to fully avoid or insulate itself from. Overall, risks appear to increase with company size, likely due to the larger, more complex, and geographically dispersed SCs of bigger firms, which involve a greater number of components, suppliers, and regulatory environments, as described above (Schwarz 2024).

7.2.2 Proactive SCRM

When it comes to proactive activities, companies generally apply them at similar levels, with a slight upward trend indicating that larger companies engage more in SCRM activities than smaller ones. However, some practices show the opposite pattern, which will be discussed later. No significant differences were found for assessment or monitoring activities.

All the significant differences for proactive activities can be seen in Figure 7.15. Among the identification practices, one significant difference was found between company sizes. Larger companies reported *assigning risks to a “risk owner”* significantly more often than smaller companies ($p = 0.049$). For mitigation practices, two items were found to be marginally significant at the 10 percent level, *deciding on mitigation strategies based on the probability of risks* ($p = 0.102$) and *deciding on mitigation strategies based on the supply chain strategy of the company* ($p = 0.106$). There was a decrease in the use of probability-based strategies with increasing company size, whereas the use of SC strategy increased with size. For mitigation strategies, three showed significant differences based on company size, *multiple sourcing* ($p = 0.018$), *insource as a result of make-or-buy decisions* ($p = 0.103$), and *improve data security* ($p = 0.076$). All three were applied more frequently in larger companies (Size 3 and 4) than in smaller ones (Size 1 and 2).

Differences in Proactive Activities

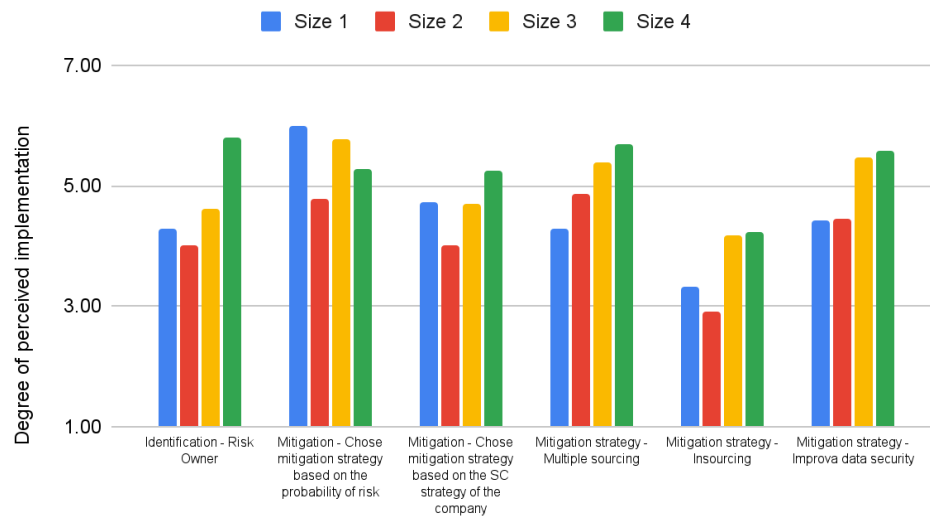


Figure 7.15: Average application levels of proactive activities, with significant differences across company sizes.

For all significant differences, larger companies generally demonstrated a higher level of application than smaller companies, except in *deciding on mitigation strategies based on the probability of risks*. These differences may arise for several reasons. For example, assigning a risk owner is likely more common in larger companies, as they are exposed to more risks and have more employees involved, making clear accountability essential to prevent risks from being overlooked or lost between departments. On the other hand, smaller companies tend to base mitigation more on probability, likely because they focus on the most probable events due to limited resources, while larger companies have the capacity to prepare for a wider range of risks, including low-probability but high-impact events. Larger companies also appear more likely to base mitigation strategies on their overall SC strategy, as they need to emphasize alignment across the organization to avoid departmental silos, a challenge smaller companies face less frequently due to their simpler structures.

Finally, all three mitigation strategies showed significant differences by size. *Multiple sourcing* showed a clear upward trend among larger companies, probably because they have greater purchasing volumes, more complex and larger SCs, and the resources to manage multiple supplier relationships, reducing dependency and increasing resilience. *Insourcing as a result of make-or-buy decisions* and *improving data security* were also more common in larger companies, likely because these organizations have more complex operations requiring strategic sourcing and sees making data protection a higher priority.

7.2.3 Reactive SCRM

Reactive SCRM activities appear to be relatively evenly distributed across company sizes, which can be seen in Figure 7.16. However, *Step 3 - establishing contingency plans*, is the only one significantly dependent on company size ($p = 0.073$). This difference may stem from the fact that larger companies are often more mature and possess greater organizational capabilities, such as more resources and formalized documentation (as discussed in the next chapter), which enable them to develop more structured contingency plans. Additionally, the complexity and scale of larger organizations create a greater need for clearly defined response plans in the event of disruptions. But overall, there appear to

be no major differences between company sizes, with all implementing reactive responses to disruptions equally much. This contrasts with proactive measures, where greater variation was observed between company sizes. Additionally, there were no significant differences in ways companies detect disruptions either.

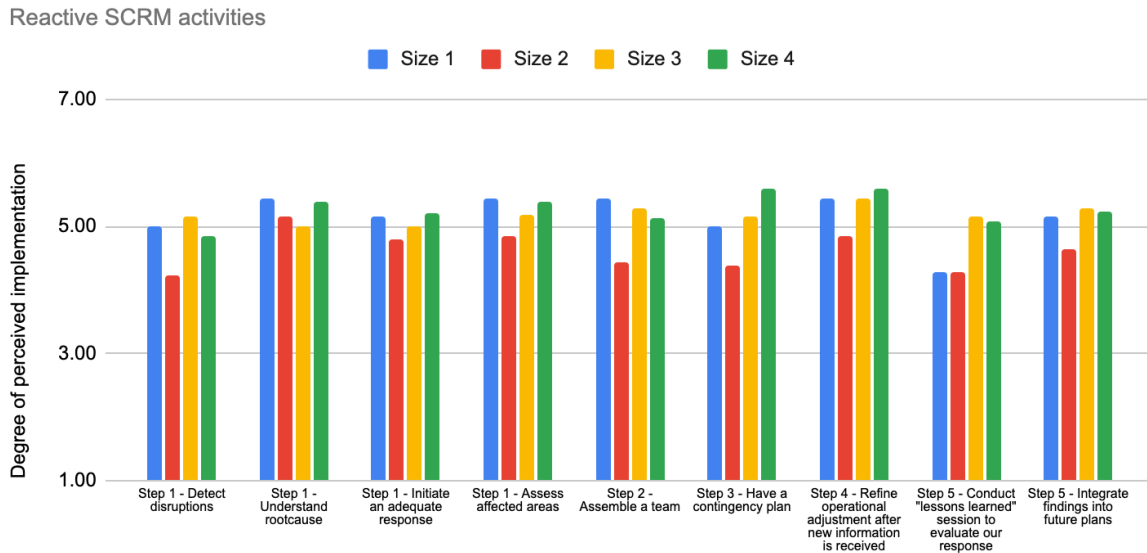


Figure 7.16: Average application levels of reactive activities across company sizes, where only “Step 3 - Have a contingency plan” is significant.

7.2.4 Organizational Capabilities

For organizational capabilities, eight significant differences were identified, which can be seen in Figure 7.17. In general, six out of eight capabilities follow a similar pattern: ratings increase with company size, with Size 2 consistently scoring the lowest and Size 4 the highest, but Size 1 typically ranks either highest or second highest. The only exceptions are *external communication*, where Size 3 companies report the highest capability, followed by Sizes 1 and 2 at slightly lower levels, and Size 4 the lowest, and for *taking initiatives to improve the SCRM processes of supply chain partners* ($p = 0.083$) having a more downward trend for increased company size.

The significant differences with the same pattern are firstly *clearly documented SCRM practices* ($p = 0.077$), where clearly documented SCRM practices showed the same pattern as described above. Significant differences were also found for resources: *financial resources* ($p = 0.036$) and *technical resources* ($p = 0.009$), both showing higher ratings in larger companies. In the learning and culture category, three out of four capabilities differed significantly by company size: *integrating SCRM into company culture across hierarchical levels* ($p = 0.045$), *conducting SCRM training sessions at least once a year* ($p = 0.011$), and *offering training that covers multiple relevant areas* ($p = 0.011$).

Differences in Organizational Capabilities

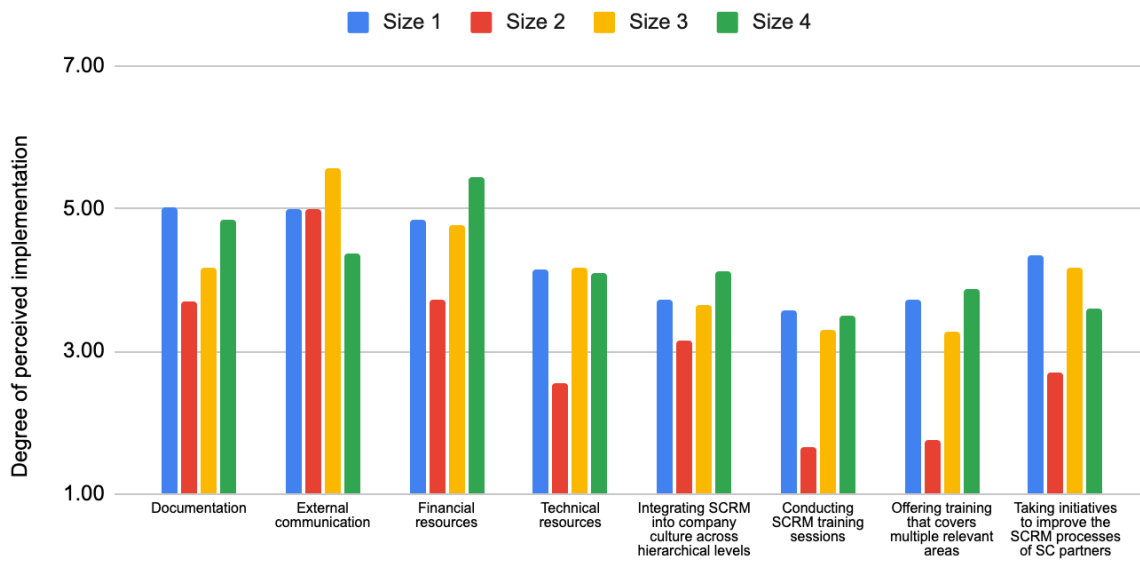


Figure 7.17: Average application levels of organizational capabilities, with significant differences across company sizes.

The overall pattern suggests that larger companies (combining Size 3 and 4) generally demonstrate higher levels of organizational capability in SCRM compared to combining Size 1 and 2, especially compared to Size 2. This is quite expected, as larger organizations have more complex SCs, perceive SC risks as more severe, and appear to implement more SCRM practices. As shown in Figure 7.17, they also have greater financial resources, which allows them to invest in better technical systems and offer more extensive and well-developed training. This combination of greater resources and focus likely explains why larger companies also have a more integrated SCRM culture across all hierarchical levels. However, the initiative to support supply chain partners in improving their SCRM processes shows a downward trend with increasing company size, which suggests that despite having greater financial resources and influence, larger companies may not engage as actively in supporting external partners, possibly due to the complexity and scale of managing numerous partners.

However, it is important to note that Size 1 companies rank higher overall than Size 2 companies and in some cases perform on par with larger firms. This is particularly evident in areas such as documentation, where Size 1 companies report the highest scores. This can likely be attributed to leaner organizational structures and fewer employees, making internal documentation and record-keeping more straightforward. Similarly, external communication ranks high for both Size 1 and Size 2 companies, even surpassing Size 4. Smaller firms may find it easier to maintain close communication with external partners due to having fewer SC relationships. Beyond these areas, the strong performance of Size 1 companies may also reflect the presence of highly engaged small manufacturing firms in the sample, as highlighted in section 5.4.

In contrast, Size 2 companies consistently report the lowest scores across almost all categories. A likely explanation is that these mid-sized firms experience growing operational complexity but lack the fully developed systems, processes, and resources of larger organizations. They might also occupy a transitional phase, where informal approaches are no longer sufficient, yet formalized structures have not been fully implemented. Additionally, Size 2 includes a larger proportion of retail companies compared to Size 1, which may also contribute to their lower overall performance.

7.2.5 Methods, Tools and IT

Significant differences for methods, tools, and IT softwares can be seen in Figure 7.18. For methods, only two showed significant differences between company sizes, *SC Mapping* ($p = 0.064$) and the *probability-impact matrix* ($p = 0.103$). *SC Mapping* was used more frequently by smaller companies, while the use of a probability-impact matrix increased with company size. For IT softwares, the only significant difference was for the use of *Supplier Risk Management platforms* ($p = 0.039$), which were most common among the largest companies. Although not significant, smaller companies showed higher usage of *Excel* and *SC Planning platforms*, with p -values between 0.116 and 0.176.

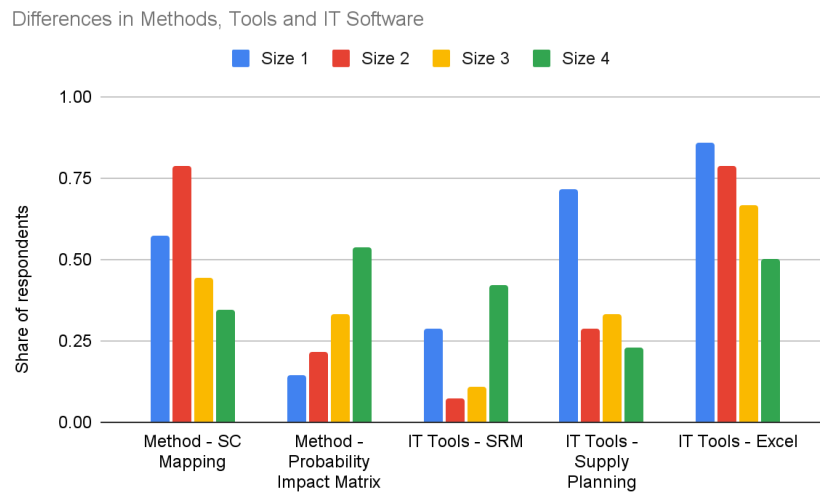


Figure 7.18: Share of respondents using methods, tools and IT softwares, with significant differences across company sizes.

For IT capabilities, larger companies generally showed a higher level of integration, with a significant difference found for the use of *systems providing early warnings* ($p = 0.041$). Interestingly, for three of the eight measured capabilities, smaller companies reported the highest application, including a significant difference for the use of *IT-based risk reporting systems* ($p = 0.028$). The significant differences can be seen in Figure 7.19.

For the perceived value of IT capabilities, no significant differences were found, and the average values were similar across all company sizes.

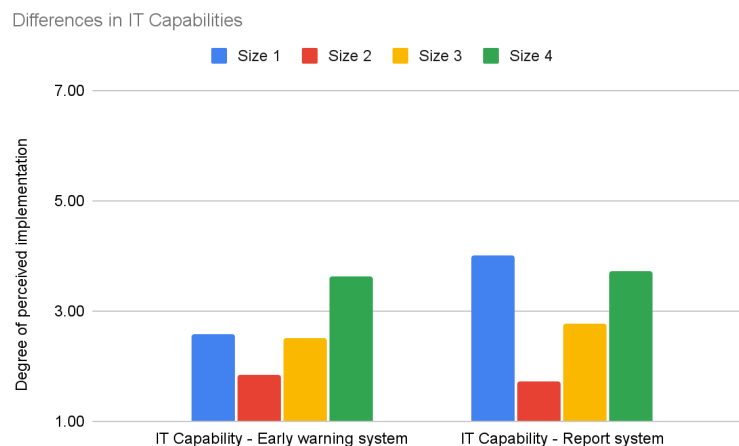


Figure 7.19: Average ratings of IT capabilities, with significant differences across company sizes.

The higher use of *SC mapping* by smaller companies likely reflects their simpler and less complex SCs, which makes full mapping more feasible. In contrast, larger companies may find it impractical due to the scale and complexity of their supply networks.

The upward trend in the use of the *probability-impact matrix* among larger companies can be explained by their broader risk landscapes, where structured tools are valuable for effectively visualizing and prioritizing risks.

The findings on IT tools indicate that smaller companies tend to rely on familiar, flexible, and cost-effective solutions such as *Excel* and *SC planning* platforms, while larger firms have both the capacity and the need for more advanced, specialized systems like *Supplier Risk Management platforms*. Similarly, for IT capabilities, an upward trend is evident among larger companies across most categories, consistent with previous findings in organizational capabilities that link increased company size to higher digital maturity. However, Size 1 companies also show higher levels of IT capability than Size 2 companies. This may be explained by the earlier discussion on sample composition, as Size 1 includes a higher proportion of manufacturing firms, which have previously been shown to exhibit greater digital maturity compared to other industries.

The lack of significant differences in the perceived value of IT capabilities suggests that companies of all sizes recognize their importance, even if their levels of implementation differ.

7.2.6 Proactive, Reactive, and Organizational Challenges

Challenges on proactive activities that are significantly dependent on the size of the company are the following: *defining and limiting the scope of our SCRM efforts (e.g. limiting to first-, second, and third-tier suppliers)* ($p=0.025$), *ensuring sufficient supply chain visibility to identify relevant risk areas* ($p=0.011$), *accessing data to estimate risk probability and impact* ($p=0.060$), *analyzing data to estimate supply chain risk probability and impact* ($p=0.032$), and *selecting appropriate risk mitigation strategies* ($p=0.059$). Interestingly, both the smallest (Size 1) and largest (Size 4) companies report higher levels of difficulty for all those significant proactive challenges, with a clearer upward trend from Size 2 to 4, meaning that the largest companies perceived them as more difficult. This can be seen in Figure 7.20.

For challenges on reactive SCRM, the only significant challenge is *assess impacted areas across the supply chain* ($p=0.015$), which has a downward trend for size 1-3 but a high score for size 4, which can be seen in Figure 7.21.

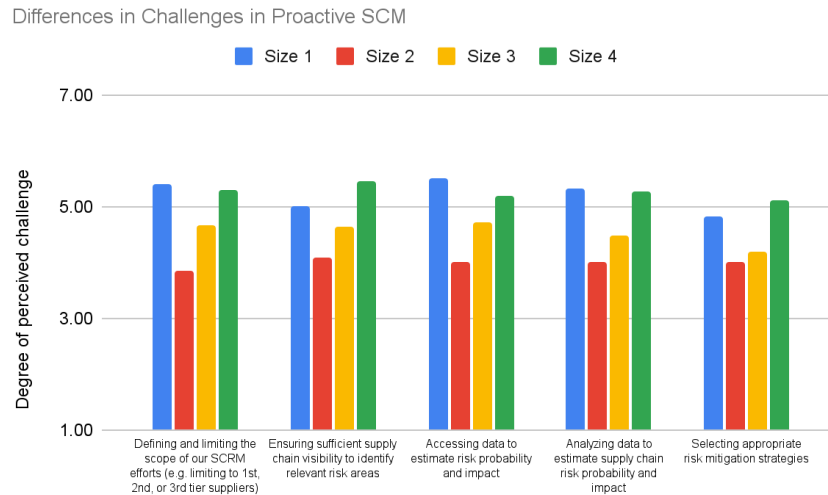


Figure 7.20: Average ratings of difficulty in proactive SCRM, with significant differences across company sizes.



Figure 7.21: Average ratings of difficulty in reactive SCRM, with significant differences across company sizes.

For challenges in organizational capabilities, 8 capabilities are considered significant: *have a clear and effective internal communication* (Formalization, $p = 0.038$), *have a clear and effective external communication* (Formalization, $p = 0.024$), *adequate financial resources* (Resources, $p = 0.017$), *adequate technical Resources* (Resources, $p = 0.058$), *formulate SCRM-related goals* (Emphasis, $p = 0.041$), *involve people across all hierarchical levels in the SCRM process* (Emphasis, $p = 0.033$), *involve external supply chain partners into your company's SCRM process* (Involvement, $p = 0.087$), *support external supply chain partners to improve their SCRM process* (Governance, $p = 0.001$). These can be seen in Figure 7.22.

In all but one of the areas, Size 2 companies reported the lowest levels of perceived challenge. For internal and external communication, perceived difficulty gradually declined from Size 1 to Size 3, with Size 4 reporting the highest levels of challenge. Thereafter, a downward trend appeared in involving and supporting external supply chain partners in SCRM, where larger companies found it

less difficult. Involving people across all hierarchical levels also became more challenging with increasing company size. No clear pattern emerged regarding adequate financial and technical resources or the formulation of SCRM-related goals, though Size 2 consistently reported lower levels of perceived difficulty compared to the other sizes.



Figure 7.22: Average ratings of difficulty in organizational capabilities, with significant differences across company sizes.

Interestingly, both the smallest (Size 1) and largest (Size 4) companies report higher levels of difficulty for all significant proactive challenges, with a clear upward trend from Size 2 to 4. This pattern can be interpreted in two ways. For larger companies (Size 4), these challenges are expected due to the increased complexity and scale of their SCs. Managing visibility across global, multi-tier networks, analyzing large volumes of data, and aligning mitigation strategies across departments and regions becomes more demanding as organizations grow. These findings align with earlier results showing that large companies struggle particularly with deeper-tier risk assessments and maintaining SC transparency through the large and complex multi-tiered network. Additionally, it was discovered that more companies in Size 4 had an international presence than in Size 3, which have been seen to increase SC complexity even further.

In contrast, for smaller companies (Size 1), high challenge ratings may reflect their struggle to implement proactive SCRM effectively due to limited resources, formal structures, or technical support systems. Mid-sized companies (Size 2 and 3), meanwhile, seem to occupy a relative "sweet spot", large enough to have the ability to incorporate some structures and tools, yet not so large that complexity becomes overwhelming.

For reactive SCRM challenges, the only significant difference was found in the challenge of assessing impacted areas across the SC, with difficulty decreasing from Size 1 to Size 3 but rising again for Size 4. This pattern may reflect the general increase in SCRM maturity as company size grows, enabling better assessment capabilities. However, for Size 4 companies, the increased scale and complexity of evaluating widespread supplier networks and operations likely makes thorough assessments more challenging.

Organizational capability challenges appear more pronounced in larger companies, particularly in the areas of internal and external communication as well as involving people across all hierarchical levels. Larger firms naturally involve more departments, employees, and hierarchical layers, which increases the complexity of maintaining clear and efficient internal communication and incorporating all people in the work. Similarly, external communication becomes more difficult as larger organizations work with a greater number of SC partners and must coordinate SCRM across a broader network.

In contrast, larger companies reported fewer challenges in involving and supporting external supply chain partners in SCRM, likely because they can have greater power and financial resources enable them to provide assistance, a capability smaller firms often lack.

For areas without a clear trend across all sizes, such as financial and technical resources and goal-setting, the only notable difference was that Size 2 companies consistently reported lower rankings. A possible explanation is that once companies begin implementing these practices, they become more aware of their complexity and the need for further improvement, as also noted in section 5.3.

7.2.7 Resilience

Lastly, looking at resilience, where for all areas it was generally an upward trend for Size 1-3, with Size 3 having the highest score on all, and for Size 4 going down a little. There were three significant differences, *maintain high situational awareness and effectively control our SC and its external environment* ($p=0.050$), *provide a quick response to disruptions* ($p=0.042$), and *initiate an appropriate response to disruption* ($p=0.021$), where Size 3 standing out particularly. This can be seen in Figure 7.23.

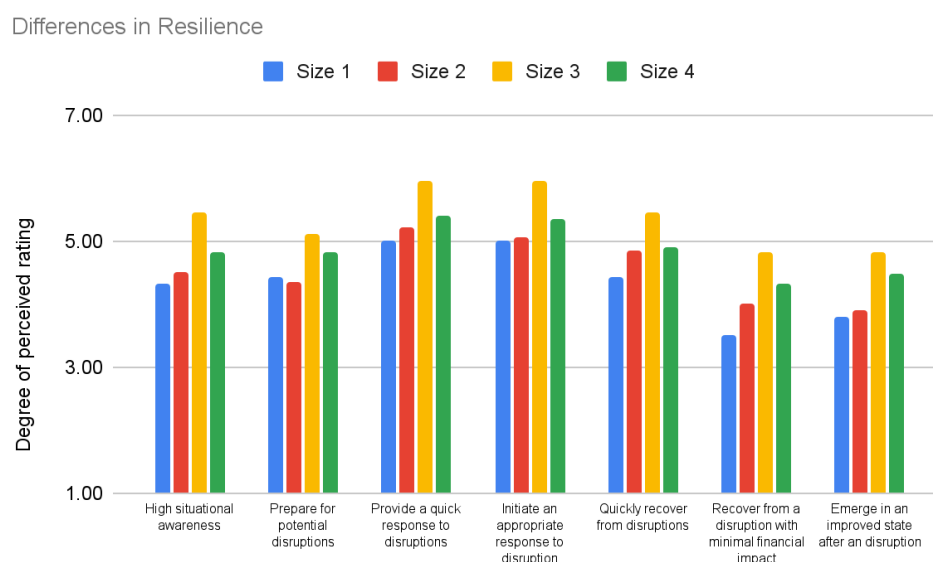


Figure 7.23: Average perceived ratings of resilience across company sizes, with significant differences found in ‘Maintain high situational awareness and effectively control our SC and its external environment’, ‘Provide a quick response to disruptions’, and ‘Initiate an appropriate response to disruption’.

This aligns well with the broader findings above, where Size 3 and 4 companies generally show higher application in proactive activities and in Steps 3–5 of reactive responses, and higher application across most organizational capabilities, except for formalization and human resources. At

the same time, perceived challenges in both proactive and reactive SCRM are notably higher for Size 1 and 4, while Size 2 and especially Size 3 report fewer obstacles. Altogether, this suggests that Size 3 firms are the most actively engaged in SCRM practices while maintaining a relatively lower perceived burden, which can be the reason for the result seen in their perception of different resilience measures being the highest of all company sizes and in all resilience aspects.

7.2.8 Concluding Points on Size Comparison

A concluding summary of industry comparison can be seen in Figure 7.24.

Overall findings	
• Larger companies generally apply more SCRM practices, tools, and IT capabilities, with Size 3 and 4 showing the highest levels of implementation. • Many areas did not differ significantly across company sizes, like many risks severity, SCRM importance, reactive SCRM work and IT capability value • Proactive and reactive challenges are rated highest by Size 1 and 4, while Size 2 and 3 report lower difficulty. • Organizational challenges show no clear pattern, varying across sizes for different challenges. • Size 3 companies demonstrate the highest perceived resilience, likely due to strong application and balanced challenge levels compared to larger firms.	
Small companies	Large companies
Risk perception: rate demand risks as most severe Departments involved: top management Proactive: overall working less Org. capabilities: external communication and governance IT/Methods/tools usage: SC mapping and rely on easier tools - Excel and supply planning platforms, less IT capabilities	Risk perception: rate legal and social risks as most severe due to regulatory pressure and public exposure Departments involved: risk department Proactive: Works more with proactive measures, no differences seen in assessment and monitoring. Reactive: Step 3 has a higher implementation by larger firms Six out of eight organizational capabilities - Documentation, Financial and Technical resources, Integrating SCRM into company culture across hierarchical levels, Conducting SCRM training sessions and with relevant areas IT/Methods/tools usage: Probability-Impact matrix, greater use of advanced SCRM IT systems and advanced IT capabilities

Figure 7.24: Summary of key findings on company size comparison.

8. Conclusion and Discussion

This chapter concludes the study by summarizing the answers to the research questions and discusses the findings generalizability and potential alternative interpretations. Following this, the theoretical and practical contributions are discussed. Lastly, the study's delimitations are outlined with suggestions for future research to guide both practitioners and the academic community in further exploration of the topic.

8.1 Answering the Research Questions

The purpose of our thesis was to explore the current practices of SCRM employed by practitioners and to identify the key challenges companies face in their efforts. Additionally to understand if this differs between companies' size and industry. This focus stems from the growing frequency of disruptions and rising risk exposure, which have elevated interest in SCRM and SC resilience. To capture a broad set of perspectives and gather easily examinable data, the authors conducted a questionnaire, allowing for more responses than interviews. Despite its recognized importance, a clear gap remains between the perceived need and the actual implementation of SCRM practices.

8.1.1 Conclusions for RQ1

The first research question, RQ1, was “*What practices do organizations use to proactively and reactively manage risks in their supply chains?*”. It aimed to explore how organizations manage SCRM, focusing on key elements such as proactive and reactive processes, applied methods and tools, and supporting organizational capabilities.

RQ1

SCRM PRACTICES

Proactive SCRM process

The suggested proactive SCRM process includes the steps of *risk identification*, *risk assessment*, *risk mitigation* and *risk monitoring* (Fan & Stevenson 2018). Overall, around 75 percent of respondents report applying proactive SCRM practices at a moderate to high level, except for basing mitigation decisions on predetermined risk tolerance and identifying risks beyond first-tier partners. Consistent frequencies across activities further suggest that companies generally perform all process steps (identification, assessment, mitigation and monitoring) on a similar, at least annual basis, indicating a structured approach, though evaluation of mitigation effectiveness appears somewhat less established. Additionally, there seem to exist a group of companies of around 20 percent of the respondents with high proactive SCRM maturity, applying all practices related to the process steps to a high degree. On the contrary, close to zero respondents claimed to consistently have low application for the different steps.

The analysis shows that most organizations apply structured approaches to risk identification, particularly by narrowing the scope and understanding SC complexity. Despite the literature highlighting challenges related to identifying previously unexperienced risks (Harland, Brenchley & Walker 2003; Jüttner, Peck & Christopher 2003), many organizations also attempt to identify these, likely driven by increased awareness of the consequences of inadequate preparedness. However, identification efforts sharply decline beyond first-tier suppliers, reflecting limited upstream visibility.

Risk assessment also seems to be a well-established component of the SCRM process, with most organizations systematically prioritizing risks based on quantitative aspects such as impact and probability. Many also factor in the feasibility of mitigation, which is reasonable for ensuring actionable outcomes but may result in an overemphasis on more easily addressed risks at the expense of more critical threats. The less frequent application of practices such as root cause analysis and disruption speed evaluation indicates limited use of structured cause-effect focused tools and reflects challenges related to quantification of certain measures.

Proactive mitigation efforts, which have historically been underutilized due to cost concerns (Tang 2006), are now more commonly implemented, indicating a shift in mindset towards justifying these measures despite potential disruptions not materializing. Most organizations also base their mitigation decisions on traditional factors like risk impact and probability, indicating foundational practices are in place. However, limited attention to strategic elements such as risk interdependencies, alignment with corporate strategy, and use of predefined risk tolerance points in the direction of potential areas of improvement to achieve more well-grounded decisions.

Regarding the applied mitigation strategies, organizations seem to prioritize risk-reducing strategies that are internally manageable, operationally focused, and serve dual purposes by being aligned with broader efficiency objectives. These include improving forecasting accuracy, enhancing data security, and standardization of processes and products, all of which may be more easily justified from a cost-benefit perspective. Additionally, supplier controls, such as audits and credit assessments, are preferred over more costly options like insourcing. More collaborative strategies, which require long-term commitment or external coordination, such as risk-sharing contracts or joint SC strategies, are generally deprioritized.

Despite limited attention in literature, most respondents apply monitoring practices at a moderate to high level, showing broad implementation and recognition that SCRs require ongoing evaluation to avoid outdated assessments. Monitoring mitigated risks is the most common practice, ensuring residual risks remain acceptable. In contrast, less frequent monitoring of unmitigated risks and SC partners highlights areas for improvement.

Reactive SCRM process

The suggested reactive SCRM process consists of five steps, including *recognition and initiation of a response*, *creation of a response management team*, *development of an initial action plan*, *revision of the initial plan given new information* and *evaluation and analysis of the response in a post-incident state* (Hopp, Iravani & Liu 2012). Approximately 75 percent of the organizations apply the reactive SCRM process to a moderate or high degree, suggesting a general alignment with the suggested process and similar with a slightly higher implementation level than proactive practices. This implies that a majority of firms are at least reasonably equipped to manage unpredictable risks that cannot be addressed through proactive mitigation. However, as only a small share of the respondents report consistently applying all reactive practices at a high level, there is still considerable room for improvement. In particular, the practices receiving the lowest ratings, having structured procedures for disruption detection and post-incident evaluation, point to specific areas where development is most needed.

Methods and tools to work with proactive and reactive SCRM

SCRM methods and tools include methods which facilitate both proactive and reactive processes, both analogue and digitalized. The analysis reveals a relatively high awareness of SCRM methods and tools among respondents, yet it also highlights significant variation in the degree of implementation. A substantial share of organizations operate with limited toolsets, often relying on internal and familiar methods such as KPIs, historical data, and internally developed risk lists. While these provide a valuable foundation, may be easier to access and may be easier to communicate across the organizations, they are insufficient for capturing the full range of potential SCRs. In order to also cover emergent, external, or abnormal and avoid blind spots in the steps of identification and assessment, companies are recommended to complement these tools with for example brainstorming methods, external risk lists or external expertise.

Moreover, foundational practices such as SC mapping remain underutilized, despite their widespread recognition in the literature, inclusion in modern SCRM systems and companies evident difficulties with SC visibility. Similarly, more advanced analytical tools like scenario analysis and early warning systems are applied only sporadically, reinforcing the observed gap between academic recommendations and practical implementation.

Regarding reactive detection data sources, two-thirds of the companies adopt multiple sources, which complement each other and enhance the robustness of detection methods. However, the most commonly used approaches still rely heavily on human-reported and external signals, while the use of automated and data-driven tools remains limited. As having a structured approach for detecting disruptions has been stated as an improvement area for many companies, companies can for example improve by establishing clear guidelines and incentives to encourage more proactive incident reporting from SC partners, and overlook the analyses procedures of other types of incoming data.

Regarding IT-methods, the findings reveal that most organizations still rely heavily on Excel, favoring familiarity and short-term efficiency over specialized SCRM software. While advanced IT tools exist, their adoption remains limited, correlating with the relatively early or selective adoption of advanced IT capabilities in SCRM practices. IT capabilities that support internal visibility are somewhat implemented, but more advanced, externally oriented functions remain significantly underutilized. Despite this, respondents recognize a high strategic value of IT in SCRM. The gap between perceived value and actual use, most notably regarding digitized visual mapping and early warning systems, underscores substantial untapped potential to strengthen SCRM by aligning perceived importance with actual investment and use.

Organizational aspects

Organizational aspects cover nine key factors which must be addressed to ensure effective SCRM processes, including *formalization, resources, scope, learning and culture, emphasis, leadership support, involvement, governance* (Guerra et al. 2024) and *performance measuring* (Polyviou, Ramos & Schneller 2022). The results indicate that while multiple organizational aspects received lower ratings compared to proactive and reactive SCRM process practices, many organizations demonstrate a relatively high maturity in internally focused SCRM capabilities, such as performance measurement, leadership support, formalization, resource allocation and scope. These more mature areas suggest that companies are increasingly recognizing the value of SCRM and have made progress in

establishing structured processes and increased focus on SCRM. However, the analysis reveals significant shortcomings in the resource and scope capabilities, including a narrow focus on first-tier suppliers and limited digital and technical resources.

Furthermore, the analysis also presents weaknesses in capabilities that require broader organizational integration and external collaboration, related to learning and culture, governance, involvement, and emphasis. These are less developed and exhibit greater variation, suggesting that SCRM is not yet fully embedded in organizational culture or treated as a shared responsibility across functions and partners.

Together, these findings suggest that while many firms have built the basic structures needed for SCRM, the next phase of development requires a shift toward more holistic and outward-facing approaches. This includes investing in cultural change, building collaborative relationships across the SC, and aligning SCRM more clearly with long-term strategic goals. Strengthening these dimensions is essential for achieving resilient, end-to-end SCRM in an increasingly complex and uncertain environment.

Resilience

Lastly, the perceived resilience was measured in order to evaluate if the implementation of practices seem to reflect the confidence companies have in their ability to manage risks. SC resilience was defined as *a SC's adaptive capability to prepare for and respond to disruptions, recover in a timely and cost-effective manner, and ideally progress to an improved post-disruption state* (Tukamuhabwa et al. 2015).

The results indicate that most companies consider themselves moderately to highly resilient, consistent with their relatively high implementation of SCRM practices. Slightly higher scores for reactive resilience further reflects the slightly stronger focus on reactive measures. This alignment supports the idea that increased engagement in SCRM enhances a company's ability to manage risks as well as disruptions. However, the findings also reveal a tendency to focus on "bouncing back" rather than adapting and "bouncing forward," suggesting a need for further development of a more long-term focus in both proactive planning and reactive response and recovery.

8.1.2 Conclusions for RQ2

The second research question, RQ2, was “*What are the greatest challenges companies face when working with SCRM and how do they seem to impact the implementation of SCRM practices?*”. The purpose of this question was to provide practitioners with valuable insights into where to prioritize their efforts and help explain why certain areas may be less developed.

RQ2

SCRM CHALLENGES

Proactive SCRM process challenges

The proactive SCRM process challenges include challenges regarding the practices related to the proactive SCRM process, covered in RQ1. When examining the challenges companies face within the proactive steps of SCRM, the findings indicate that the Identification phase stands out as the most challenging, followed by Monitoring. However, the differences of the results are small, indicating that there is no particular proactive process step, which is seen as significantly more challenging than the

others. Overall, 75 percent of the respondents find all except two practices as moderately or highly challenging. The exceptions are prioritization of risks and understanding interdependencies between risks which are perceived as easier.

When comparing perceived level of difficulty with corresponding implementation level there was no clear inverse relationship between perceived difficulty and implementation. In fact, very few respondents report applying practices at a low level while simultaneously perceiving them as highly challenging. Rather, multiple comparisons show a linear relationship. This pattern may indicate that organizations become more aware of challenges as they deepen their engagement with SCRM, highlighting a potential positive correlation between experience and perceived complexity. Simultaneously, this might imply that less mature companies lack understanding of the difficulties and challenges of implementing SCRM practices, and as a consequence do not put any considerable resources into such proactive implementation. Furthermore, some comparisons even show that respondents have rated their application level as higher than the perceived level of difficulty. Conclusively, the gap analysis shows that respondents that while proactive SCRM practices are not without difficulties, perceived challenges do not necessarily hinder implementation.

Reactive SCRM process challenges

The reactive SCRM process challenges include challenges regarding the practices related to the reactive SCRM process, covered in RQ1. When examining the challenges companies face within the reactive dimension of SCRM, the results indicate that reactive practices are generally perceived as less demanding than proactive ones. Most respondents rate these activities as only moderately challenging, with narrower response ranges and lower average difficulty scores. This suggests that organizations find reactive tasks more manageable, likely due to their operational nature and their greater possibility for ad hoc implementation, as opposed to the forward-looking analysis and planning required in proactive processes.

The gap analysis further reveals that many organizations implement reactive practices at moderate to high levels despite perceiving them as only mildly challenging. This lower perceived difficulty could indicate greater maturity in handling reactive tasks, either through dedicated SCRM initiatives or because such practices (for example assembling response teams or managing disruptions) are already embedded in broader crisis or incident management frameworks. However, it may also reflect a misalignment between companies' self-perceived maturity and the more structured expectations outlined in the literature, particularly regarding practices which according to the literature require proactive preparation to achieve the best outcomes.

Organizational SCRM challenges

The organizational SCRM challenges include challenges related to the nine key organizational aspects for SCRM, covered in RQ1. When examining the organizational challenges that companies face in implementing SCRM practices, the findings show that no practice stands out as particularly challenging with the concentration of the respondents finding the organizational aspects to be moderate. However, substantial variation in responses reveals that there are still companies that continue to struggle with key organizational aspects.

When comparing perceived level of implementation with perceived level of difficulty, the results show that many organizations appear to maintain higher implementation levels than level of difficulty

in areas such as *formalization* and *scope* of SCRM. For the capability of *performance measuring*, the results showed a somewhat linear relationship between implementation and perceived difficulty. These relationships between the two dimensions may reflect a tendency that companies achieve an increased understanding of the challenges related to the practices, the higher implementation levels they achieve. Additionally, it suggests that despite these practices being perceived as highly difficult in some cases, it does not seem to hinder organizations to overcome the challenges.

When investigating the challenges related to resource aspects, *human-* and *financial resources* showed similar tendencies as the capabilities above. However, the more dispersed results imply more varying opinions of the difficulty of these practices. When instead looking at constraints related to *technical resources*, there are substantial groups of respondents that have low implementation along with high perceived difficulty. This relationship indicates that the perception of difficulty in this case might actually affect the performance negatively. The same applied to the capability of *integration of SCRM into organizational culture* as it emerges as a persistent struggle, with many companies reporting low implementation and high challenge. Concludingly, technical resources and cultural integration of SCRM seem to be critical barriers for organizations SCRM work.

In contrast, low application levels of *regular SCRM training* does not seem to necessary align with high perceived difficulty. Instead, the implementation level is relatively low regardless of perceived difficulty, suggesting that capability development through learning is not yet widely institutionalized but neither necessarily highly affected by challenges. Thus, in the case of *learning* capabilities, low implementation is not always related to high perceived difficulty, implying that implementation levels are not necessarily limited by the perceived level of difficulty but perhaps other factors such as priorities and resources.

Lastly, regarding the capabilities of *governance*, *leadership support*, and *involvement*, no strong trends were observed, pointing to inconsistent approaches, maturity levels, and levels of difficulty across firms.

Altogether, these findings highlight that while some organizations have managed to establish effective internal structures and routines for SCRM, others are still navigating foundational challenges, particularly in terms of technical resources and cultural integration. The varying impacts of perceived difficulty on implementation levels suggest that some challenges seem to act as genuine constraints, while others may not actually impact the organizational maturity of the company.

8.1.3 Conclusion for RQ3

The last research question, RQ3, was “*Do organizations of different industries and sizes demonstrate variations in their SCRM work?*”. The purpose of this question was to explore whether industry or company size influences how organizations approach SCRM, including differences in the extent of applied practices, the severity of perceived risks, and the nature of the challenges they face.

RQ3

VARIATIONS IN SCRM WORK

Comparison of industries

Overall, clear differences were observed in how industries approach SCRM. Manufacturing and food overall rates higher engagement in SCRM, importance of SCRM, risk exposure and perceived difficulty in challenges than retail. As producing companies, they both experience operational, quality and sustainability risks very severe.

To look more specifically at each industry, manufacturing companies demonstrated the highest engagement, applying a wide range of practices and especially involving the most departments and hierarchical levels to support a broad scope of risks they perceive. They also rated proactive SCRM as most important, reflected in applying the most structured SCRM practices, especially proactive ones. Furthermore, manufacturing shows the highest technological maturity, using the most IT tools, softwares and capabilities. These factors contribute to a high level of resilience, particularly in financial recovery and emerging stronger after disruptions. Manufacturing may place such high focus on SCRM due to its role as a producer dependent on a very wide range of globally sourced raw materials, its delivery of critical components that can cause downstream production halts, and its exposure to stricter regulations, factors that increase both risk and the need for SCRM.

Food companies ranked second in SCRM maturity, generally showing levels similar to or slightly below manufacturing. They placed particular emphasis on reactive SCRM and recovery capabilities, which they considered especially important. As producers with strict safety and quality demands and being a social vital function, food companies must understand their entire SCs, since quality failures at any tier can pose severe consumer risks and societal impacts. This drives them to focus on swift recalls and showed the highest level of well-coordinated internal and external communication. However, this responsiveness often seems to come at a higher financial cost compared to manufacturing. Furthermore, food companies also highly value IT capabilities but have not yet reached manufacturing's level of digital maturity, they still rely more on Excel and simpler tools for SCRM tasks. Consequently, food companies demonstrate relatively strong engagement with SCRM, which is reflected in their self-assessed resilience levels, closely aligned with those of manufacturing.

Retail consistently scored the lowest across nearly all SCRM areas, viewing SCRM as less important, perceiving risks as less severe, and applying the fewest practices, indicating that the industry falls significantly behind. This likely stems from a combination of factors, including retail's downstream supply chain position, lower exposure to production-related disruptions, and reliance on upstream partners for risk mitigation. Combined with lower overall risk exposure, less stakeholder pressure, greater product flexibility, and milder consequences of disruptions—since customers can easily substitute out-of-stock items—retailers may perceive less need for structured SCRM. As a result, retailers tend to rely on more ad hoc detection methods, such as identifying disruptions after they occur or through external alerts like social media. Their supply chain position also shapes a different strategic focus, reflected in two of the few areas where they reported the highest application, strategic stocking to support their flexible omnichannel delivery and fast moving products, and pricing and promotions to steer demand, effective for their customer-facing position. Lastly, retail reported the highest exposure to economic risks, due to their dependence on imports, logistics providers, and customer's sensitivity to changes in price which can quickly affect spending. The theory supports this view, noting that companies typically invest in SCRM after experiencing significant disruptions, where it seems that retail is not as affected by disruption which may explain their limited SCRM focus.

Despite these differences, no significant variations were found in perceived challenges across industries or reactive SCRM application. In resilience, manufacturing and food again outperformed retail, with manufacturing excelling in financial recovery and food in quick disruption response.

Comparison of company sizes

The analysis revealed clear patterns related to company size and SCRM practices. Overall, larger companies reported greater risk exposure and showed the highest application of proactive and reactive

SCRM practices, organizational capabilities, methods, tools, and IT solutions. However, challenges were similarly high for both the smallest and largest firms, making mid-sized companies (Size 3) appear the most resilient.

Larger companies reported greater involvement from dedicated risk departments, likely because only they have the resources to establish such functions, while smaller firms showed stronger engagement from top management, facilitated by flatter organizational structures. Perceived risk severity generally increased with company size, especially for legal and social risks, reflecting higher regulatory demands and societal pressure. In contrast, smaller companies rated demand-related risks as more severe. Nonetheless, some risks were rated similarly across all sizes, suggesting certain threats are universally unavoidable.

In proactive SCRM, Size 3 and 4 companies showed greater engagement, likely due to their exposure to a broader range of risks and, as suggested in theory, the tendency for organizations to expand SCRM efforts following disruptions. In reactive practices, there were no clear difference between company sizes except for Step 3 - Have a contingency plan, where larger companies had a higher implementation. Regarding organizational capabilities, Size 3 and 4 companies score highest across most areas, and smaller companies fall behind, especially Size 2. An exception is documentation and human resources, where smaller companies, especially size 1, work more actively with.

Use of methods, tools, and IT also varied. Smaller companies favored SC mapping and flexible and simple tools like Excel and supply planning platforms, suitable for their less complex operations. Larger firms, consistent with their higher digital maturity, used more integrated SCRM IT systems and advanced capabilities.

For perceived challenges in proactive and reactive SCRM, the highest levels were found in Size 1 and Size 4 companies. Small companies struggle with capacity and resources to implement SCRM, while large companies face the complexity of coordinating across multiple departments and global supply networks. Mid-sized companies (Size 2 and 3) report fewer obstacles, suggesting they may be in a “sweet spot” of having enough structure without excessive complexity. For organizational challenges varied across company sizes, with Size 2 companies consistently reporting the lowest perceived difficulty. Larger firms found internal and external communication and involving all hierarchical levels more challenging due to greater structural complexity, while reporting fewer challenges in involving and supporting external partners thanks to greater resources. Some areas, like financial and technical resources, and goal setting, showed no clear trend except that Size 2 again perceived these as least difficult.

Finally, in resilience, Size 3 companies showed the highest scores across most aspects, likely reflecting their higher application of SCRM practices and capabilities, although Size 4 companies also reported strong performance but facing greater challenges in both proactive and reactive SCRM.

8.2 Generalizability

Firstly, in Chapter 5 and Chapter 6, SCRM practices and challenges were analyzed based on responses from 65 participants, a sample size considered sufficient for the study (Denscombe 2017). In Chapter 7, the sample was then further divided by industry and company size to identify significant differences depending on these parameters. Even if the subgroup sizes were assumed to be sufficient to draw significant differences on Kruskal Wallist test (Lomuscio 2021), the robustness of results for RQ3 could be increased by larger, more equally sized subgroups sizes, ideally with at least 30 respondents per industry and size group respectively. However, of the more than 160 measured items and transformed variables, only a small percentage showed significant differences between industries or sizes. This suggests limited variation in SCRM practices or perceptions across these groups, supporting the generalizability of the results of the complete sample.

The results are therefore assumed to be generalizable for retail-, food-, and manufacturing companies with a Swedish presence. Manufacturing, a particularly broad category, includes sub-industries such as food, textiles, furniture, paper, pharmaceuticals, electronics, and automotive (SCB 2025). While further research should examine these individually, the authors believe the results broadly apply across most manufacturing types, with some exceptions due to the variations of SC structures. Thereafter, few industries have SC as complex as those in manufacturing, retail, and food, which involve extensive refining, multiple components, and diverse product ranges. While some of the results may be applicable also to other industries like defense, agriculture, construction, energy, and healthcare due to some shared characteristics, these industries may have unique properties which may cause differences compared to the investigated industries. In contrast, the results are not assumed to be applicable for industries such as education, transport, telecommunications, real estate, and culture, as they have no or fundamentally different SCs, not necessarily covering a physical material flow.

However, it should be noted that the results may reflect a slightly higher overall maturity than what represents the complete industry, due to a potential response bias. As the questionnaire focused on SCRM and how companies work with these issues, it may likely have attracted participants already engaged or interested in the topic, while companies without relevant practices may have opted out. This might have caused an underrepresentation of companies with low SCRM maturity.

Finally, the authors believe that, given Sweden's position as a high-income EU country, the findings are likely to be generalizable to other high-income countries within the EU. This assumption is based on shared regulations, geographical proximity, and common business practices across EU member states.

8.3 Other Possible Interpretations of the Results

Overall, the results and analysis presented in this thesis are largely based on the 65 responses received through the questionnaire. Even if the sample is assumed to be sufficient, it is essential to consider potential sources of errors in the results.

Firstly, questionnaires have inherent limitations, such as respondents avoiding extreme values (e.g., 1 or 7) and declining response quality toward the end of longer surveys. Moreover, individual interpretation of the questions may affect the collected data. This can both be related to the interpretation of the questions, such as when respondents were asked to rate on a scale of 1-7 if they *conducted practices at planned occasions at least once per year*, as well as individuals' perception of

the scale (1-7). Due to the limitations of Google Forms, respondents did not have the opportunity to clarify uncertainties with the researchers. These factors might potentially cause inconsistencies of answers.

Furthermore, industry and size comparisons face some limitations as some companies identified with two industries, and as the size distribution was not perfectly distributed, possibly skewing results. Additionally, the industry representations within the size groups and vice versa might affect the results as no tests comparing the factors effect were conducted. Lastly, despite instructions given in the questionnaire, some respondents may have reported global revenue instead of the revenue related to the geographical subdivision, which might affect the consistency of the size classification.

Moreover, there might be flaws in how the results were interpreted. Firstly, boxplot diagrams can sometimes hide more detailed differences in the data, particularly when it comes to the distribution of responses. While they effectively summarize central tendency and spread, they do not show how many responses fall at specific points within each range. For example, if 50 percent of the responses are concentrated between scores of 4 and 6 for two items, information regarding the number of respondents at the lower or upper extremes is not presented. As a result, important nuances, such as a clustering of answers or skewed distributions, may not be immediately visible.

Secondly, higher scores of implemented practices are consistently assumed to be a result of higher maturity, something that might not fully capture the concept of maturity. While high scores are a good indication of high maturity, some companies may deliberately choose not to engage in certain practices they find unnecessary. These aspects are not captured by the data, especially as it is entirely based on quantitative data and as there were no opportunities for the respondents to elaborate or explain their responses. Moreover, much of our analysis focuses on means and trend identification, without always testing for statistical significance.

8.4 Theoretical Contributions

According to the literature review on SCRM by Fan and Stevenson (2018), several key research gaps have been identified. This thesis contributes to addressing many of these gaps:

First, Fan and Stevenson (2018) point to a clear disconnect between the methods and tools advocated by researchers and those actually used by practitioners, highlighting the need to bridge theory and practice. This thesis addresses that gap by empirically examining the actual methods, tools, and practices applied by companies, thereby identifying the extent to which they align with academic recommendations. Second, previous research has often focused on isolated stages or subsets of the SCRM process, resulting in a lack of holistic, end-to-end understanding. By capturing practices and challenges across all steps identified in both proactive and reactive SCRM processes—as well as overarching methods, tools, and organizational structures—this thesis offers a more comprehensive view of how companies manage supply chain risks in practice.

Third, the risk monitoring stage has received limited attention in the literature, despite being a crucial element of the SCRM process. This thesis includes the monitoring dimension within the broader analysis of proactive SCRM practices, thus contributing to the limited body of knowledge on how companies monitor risks over time. Fourth, there has been a lack of benchmarking data related to SCRM practices and challenges. The broad yet detailed scope of this thesis enables benchmarking of

both proactive and reactive SCRM practices and perceived challenges—across industries, company sizes, and in aggregated form.

Lastly, Fan and Stevenson emphasized the need for more research across different settings, since critical risks and effective practices may differ by industry or country. While each size group and industry is not explored in full depth, this thesis does capture and analyze key differences in how companies of varying sizes and industries operate and perceive SCRM-related aspects, contributing to the contextual understanding of SCRM.

8.5 Practical Contributions

The findings of this thesis offer a practical contribution in several key areas. Firstly, they provide a benchmarking foundation for companies seeking to evaluate their current SCRM practices against industry patterns and identify specific areas for improvement. The thesis also presents a comprehensive overview of the SCRM process—including key steps, methods, and tools—which can serve as a practical framework to help organizations better understand SCRM, appreciate its strategic value, and apply it more effectively in day-to-day operations.

For consultancies such as 4C Strategies, the results offer valuable insights into the varying needs and maturity levels of potential clients. This knowledge can support the development of tailored tools and services that fit different organizational contexts and resource capacities. The thesis highlights several specific areas where support may be particularly beneficial. For example, many companies still focus risk identification efforts solely on first-tier suppliers, suggesting a need to expand visibility further upstream in the supply chain. Risk ownership is often unclear or fragmented, indicating a potential for improvement through clearer role definitions and accountability structures. In terms of mitigation, critical dimensions are often overlooked, pointing to a need for more comprehensive and structured risk response planning.

The study also reveals gaps in reactive SCRM capabilities. Many organizations struggle with detecting disruptions early, evaluating incidents afterward, and implementing structured recovery processes. These reactive components—while essential—are underdeveloped and present clear opportunities for enhanced support and tool development.

When it comes to methods and tools, the findings show a widespread reliance on internal and historical data, with many companies lacking the capability to monitor external signals or detect anomalies. Excel remains the dominant tool, while more advanced IT systems are significantly underutilized. Although the strategic value of digital tools in SCRM is broadly recognized, actual implementation remains limited, and these areas are often viewed as particularly challenging. This suggests a concrete opportunity for increased adoption of fit-for-purpose digital solutions tailored to different levels of technological readiness.

From an organizational standpoint, the thesis identifies low implementation and high difficulty in areas related to learning and culture, and long-term strategic alignment in SCRM. Training is underdeveloped, and efforts to embed SCRM more broadly across the organization are limited. Furthermore, collaboration with supply chain partners—either by involving them in one's own SCRM processes or supporting them in developing theirs—is rare, despite its potential to strengthen overall resilience.

Industry-specific differences further emphasize the need for tailored approaches. For instance, while companies in the food sector highly value IT capabilities, they often fall short in implementing them. The retail sector consistently performs lowest across most SCRM dimensions, with more reactive and informal practices, and a tendency to underestimate risk severity. Size differences are also evident: larger firms report higher perceived risks and challenges, while smaller companies rely more on simple, cost-effective tools like Excel.

Altogether, these findings outline clear, practical areas where consultancies like 4C Strategies—and companies themselves—can focus their efforts to build stronger SCRM capabilities. This includes enhancing digital tool adoption, fostering strategic and cross-organizational alignment, improving upstream and downstream collaboration, and embedding a proactive risk culture throughout the organization.

8.6 Delimitations and Future Research

As stated in Section 1.4, certain limitations were defined for this study. Firstly, the thesis only includes companies with a presence in the Swedish market. Secondly, it is limited to companies operating in at least one of the following industries: retail, food, or manufacturing.

In total, the study received responses from 65 companies, providing a basis for general insights. However, when dividing the data by industry and company size, the distribution was uneven, and some categories had relatively small sample sizes. These were able to show significant differences in some cases, but future research could aim for a larger and more balanced sample, with equal representation across industries and company sizes, to enable more robust comparisons and more statistically significant conclusions.

Moreover, many of the findings could not be fully explained by existing literature. It would therefore be valuable to conduct further qualitative research, such as interviews with representatives from different industries and company sizes, to explore the underlying reasons for the observed patterns.

Expanding the scope to include more industries and countries would also be of interest. This would help assess whether the results from Swedish companies can be generalized internationally and reveal additional differences or similarities across new industries.

Finally, the dataset itself offers further unexplored opportunities. Future research could, for example, investigate correlations between experienced risks and applied practices or analyze whether the use of specific methods or tools reduces perceived challenges within SCRM activities.

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Appendix A

The measurement theory of the questionnaire, including information of constructs, items, questions and potential sources as well as question number in the questionnaire.

Second order construct: Control questions		
Potential first order construct	Question & Potential Source	No
	<i>What is your job title?</i> <i>Single choice</i> CEO / CFO; Vice President (Supply Chain Management, Operations, Purchasing, Risk); Supply Chain Management Director / Head of Supply Chain / Logistics; Operations Director / Head of Operations; Purchasing Director / Head of Purchasing; Risk Director / Head of Risk; Supply Chain / Logistics Manager; Operations Manager; Purchasing Manager; Risk Manager; Supply Chain / Logistics Team member; Purchasing Team Member	1
	<i>Which company do you work for?</i> Open answer	2
	<i>What is the size of your company?</i> <i>If your company is a subdivision of a larger global organization, please include your subdivision's specific size when responding. For example "Company X Nordics".</i> <i>Single choice</i> Less than 100 employees; Between 100 and 499 employees; Between 500 and 999 employees; Between 1000 and 4999 employees; Between 5000 and 9999 employees; More than 10000 employees; I don't know	3
	<i>What is the annual revenue of your company?</i> <i>If your company is a subdivision of a larger global organization, please include your subdivision's specific size when responding. For example "Company X Nordics"</i> <i>Single choice.</i> Less than 100 million SEK; Between 100 and 499 million SEK;	4

	Between 500 and 999 million SEK; Between 1 and 2.49 billion SEK; Between 2.5 and 4.99 billion SEK; Between 5 and 9.99 billion SEK; Between 10 and 99 billion SEK; Greater than 100 billion SEK; I don't know	
	<i>Which industry/industries is your company operating in?</i> <i>If your company fits within more than one of the suggested industries, you can choose several alternatives.</i> Retail; Food; Manufacturing; Other	5

Second order construct: Background			
Potential First Order Construct	Item	Question & Potential Source	No
	<i>Who is responsible for the work related to proactive Supply Chain Risk Management (SCRM) in the company?</i> <i>Single choice</i> No one; One individual; A team of employees from the same department; A team of employees from different departments; Top management; Other; I don't know		7
	<i>Which departments or parts of the organization are involved in Supply Chain Risk Management (SCRM)?</i> <i>Multiple choice</i> No one; Top management (CEO etc); Local sites; Risk; Logistics / Supply chain; Purchasing / Procurement; Operations / Production; Quality; Financial; Legal; Engineering / Product development; Marketing; Other		8
	<u>Adapted from Um & Han 2021; Norrman & Näslund 2016</u> <i>SC risks can cause disruptions in your SC. How serious do you consider the following risk types to be for your company and its SC?</i> <i>[7-point scale: 1) Not serious at all – 4) Moderately serious – 7) Highly serious]</i>		9

	RiskEconomical; RiskGeopolitical; RiskEnviron; RiskInfra; RiskSocial;RiskLegal; RiskSupply; RiskCorporate; RiskFinancial; RiskNetwork; RiskLogistical; RiskOperation; RiskQuality; RiskSecurity; RiskSustain; RiskTech; RiskDemand	Macro economical risks (e.g. exchange and interest rate changes); Geopolitical risks (e.g. wars, terrorism, trade wars); Environmental risks (e.g. natural disasters, pandemics); Infrastructural risks (e.g. poor infrastructure); Macro social risks (e.g. labor strikes, activism); Macro legal risks (e.g. change in laws, import and export regulations); Supply market risks (e.g. limited available suppliers and capacity); Corporate risks (e.g. cultural differences, poor communication); Financial risks (e.g. supplier credit risk); Network related legal risks (e.g. contractual and legal disputes); Logistical risks (e.g. delivery reliability); Operational risks (e.g. equipment breakdowns, poor work skills); Quality risks (e.g. poor product quality, lack of quality control); Security risks (e.g. cybersecurity); Sustainability risks (e.g. contamination, unsafe work environment); Technology risks (e.g. incompatible or unreliable IT systems); Demand risks (e.g. demand variation, forecasting errors, competition changes)	
	<u>Adapted from Norrman 2025; Norrman & Näslund 2016</u> <i>To what degree do you consider that proactive and reactive Supply Chain Risk Management (SCRM) is important for your company's success?</i> [7-point scale: 1) Not important at all – 4) Moderately important – 7) Highly important]		6
	SCDOImPro SCDOImRea	Proactive SCRM Reactive SCRM	

Second order construct: Proactive Process Practices			
Potential First Order Construct	Item	Question & Potential Source	No
Identification	<u>Adapted from El Baz & Ruel 2021; Norrman 2025</u> <i>SC risk identification is the proactive step of recognizing and understanding risks within your supply chain. To what degree do the following statements apply to your company?</i> [7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully		10

	<i>applicable]</i> IdAreas We select relevant areas for identifying supply chain risks IdNew We try to identify potential new risks not previously experienced IdComplex We understand the complexity of our own supply chain IdOwner All identified risks are documented and assigned a "risk owner".	
Assessment	<u>Adapted from Norrman 2025; El Baz & Ruel 2021</u> <i>SC risk assessment is the proactive step of evaluating and comparing identified risks to prioritize the most critical risks. To what degree do the following statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i> AsProb We evaluate the probability of risks. AsImpact We evaluate the possible impact of risks AsCause We evaluate the possible sources for risks AsOpMit We evaluate the opportunity to mitigate risks AsFastUnfold We evaluate how fast a disruption can unfold AsPriority We compare risks and prioritize the most critical ones	11
Mitigation	<u>Adapted from Norrman 2025</u> <i>SC risk mitigation/treatment is the proactive step of choosing and implementing strategies to handle SC risks, e.g. reduce the likelihood and/or impact of SC risks. To what degree do the following statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i> MitCost We choose strategy based on the cost for risk mitigation MitImpact We choose strategy based on the potential impact of risks MitProb We choose strategy based on the probability of risks MitStrategy We choose strategy based on the SC and company strategy	12

	MitDepend MitTolerance	We choose strategy based on how mitigating one risk can affect other risks We choose strategy based on a predetermined risk tolerance	
Mitigation Strategies	<u>Adopted from Norrman 2025; Eryarsoy et al. 2021</u> <i>Companies adopt various risk mitigation approaches to different extents. To what extent does your company apply the following strategies focusing on buffering, network design, planning, standardization, and securing?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i>		13
	MitStrat1-15	Increase inventory levels; Increase capacity in e.g. production, storage, transports; Use multiple sourcing; Use a geographically diversified sourcing network; Use local sourcing; Outsource non-critical activities; Insource as a result from make-or-buy decisions; Select strategic stocking locations, e.g. to reduce costs, increase service levels; Use multiple transportation modes and routes; Use postponement in e.g. production and payments; Improve forecasting techniques; Use pricing and promotion to steer customer demand; Standardize processes, products and/or components; Limit and/or adjust assortment; Improve data security	
	<u>Adopted from Norrman 2025; Eryarsoy et al. 2021</u> <i>Companies adopt various risk mitigation approaches to different extents. To what extent does your company apply the following strategies focusing on collaboration and contracting?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i>		14
	MitStrat16-24	Information-sharing with SC partners; Invest in SC partner development for critical suppliers; Include SC partners earlier in product development; Use SC partners audits and scorecards to monitor performance; Coordinate decisions and actions with SC partners;	

	Develop joint SC strategies with SC partners to ensure alignment; Source from creditworthy suppliers; Transfer the entire risk through contracts, e.g. by insurances and agreements; Share risk with SC partners through contracts	
Monitoring	<u>Adapted from Norrman 2025</u> <i>Risk monitoring is the proactive step of following up SC risks. To what degree do the following statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i> MoMit We regularly monitor mitigated high-level risks MoUnmit We regularly monitor unmitigated risks MoPartners We regularly monitor our SC partners	15
Frequency	<u>Adapted from Norrman 2025</u> <i>SC risk identification is the proactive step of recognizing and understanding risks within your supply chain. To what degree do the following statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully Applicable]</i> IdFreq We identify risks at planned occasions at least once a year	10
	<u>Adapted from Norrman 2025</u> <i>SC risk assessment is the proactive step of evaluating and comparing identified risks to prioritize the most critical risks. To what degree do the following statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i> AsFreq We assess risks at planned occasions at least once a year	11
	<u>Adapted from Norrman 2025</u> <i>SC risk mitigation/treatment is the proactive step of choosing and implementing strategies to handle SC risks, e.g. reduce the likelihood and/or impact of SC risks. To what degree do the following statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i> MitFreq We mitigate risks at planned occasions at least once a year	12
	<u>Adapted from Norrman 2025; El Baz & Ruel 2021</u>	16

	<i>Evaluation of the efforts made and the proactive SCRM process can help companies identify improvement potential. To what degree do the following statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i> MoEffective We evaluate the effectiveness of selected mitigation strategies at planned occasions at least once a year	
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Second order construct: Reactive Process Practices

Potential First Order Construct	Item	Question & Potential Source	No
	<u>Adapted from Norrman 2025; Eryarsoy et al. 2021</u> <i>Reactive SCRM focuses on responding to and recovering from the impact of disruptions after they have occurred. To what degree do the statements apply to your company?</i> <i>[7-point scale:</i> <i>1) Not applicable at all – 4) Moderately applicable – 7) Highly applicable]</i>		18
Step 1	ReaStep1Detect	We have a structured process to detect events that could disrupt our supply chain	
	ReaStep1Cause	We identify the root cause of the disruption	
	ReaStep1Initiate	We have a structured process to initiate an appropriate response	
	ReaStep1AssessArea	We assess impacted areas across the supply chain	
Step 2	ReaStep2Team	We have dedicated cross-functional teams in place to quickly assess and make decisions on reported disruptions	
Step 3	ReaStep3Plan	We have established contingency plans to maintain operations during unforeseen disruptions and critical events	
Step 4	ReaStep4Revise	We refine operational adjustment after new information is received	
Step 5	ReaStep5Eva	We conduct "lessons learned" session to evaluate the response	

Second order construct: Methods & Tools

Potential First Order Construct	Item	Question & Potential Source	No
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SCRM Methods & Tools	<i>What methods and tools does your company use in the proactive and/or reactive SCRM processes?</i> <i>If your company uses an IT software, please specify which features it includes.</i> <i>Multiple choice</i>	21
	Supply chain mapping - mapping of the network to identify critical components, processes and supply chain partners; Internally produced risk list - a continuously developed list of risks that have caused disruptions for your company in the past; Externally produced risk list - externally produced list of categories of risks which can be used to identify relevant risks for your company; Brainstorming tools - tools which facilitate brainstorming of risks, e.g. Wheel of crisis; Structured meetings - meetings using for example the Delphi method to agree on relevant risks, probability/impact-estimation etc.; Interviews and surveys with external experts - use external experts to for example identify relevant risks, make probability/assessment estimates etc.; Cause-effect tools - e.g. Fault Tree Analysis, Event Tree Analysis, Bowtie-analysis, Ishikawa diagram (fishbone diagram) which can visualize cause-and-effect relationships of risks; Manufacturing process specific tools - e.g. Hazard and operability study (HAZOP) which combine P&ID diagrams with analysis of process parameters such as flow and temperature to identify risks in the process; Manufacturing and usage phase risk focused tools - e.g. Failure mode and effect analysis (FMEA) used to identify risks in manufacturing and customer usage-phase as the product is still in the design stage; Probability-impact matrix - a matrix which can be used to map out risks according to their probability and impact and prioritize them accordingly; Portfolio analysis - e.g. Kraljic matrix which categorizes and prioritizes components/products based on the factors "profit impact" and "sourcing complexity"; Other prioritization tools - e.g. Spider web tool, Analytical Hierarchy Process (AHP), Hazard totem pole (HTP) which prioritizes risks based on several parameters; Use of internal historical data to estimate probability and impact - e.g. cost KPIs, delivery reliability etc.; Scenario analysis - e.g. Bayesian analysis, Monte Carlo simulations to model uncertainties and/or dependencies between risks with; Game Theory analysis - can be used for risks with two opponents included in order to estimate probability and impacts of different outcomes; Ranking systems - categorizing risks into ranges of frequency and impact-levels relative to each other without having absolute values of respective parameter; KPIs - measurement of KPIs which can be used to detect disruptions, identify potential risks and/or monitor specific risks;	

	Alert system/Early warning signals - indicators set up to notify once risks deviate from accepted levels of risk; Training and simulation-practices in crisis management or similar; We don't use any tools; I don't know; Open ended question;															
Disruption detection	How does your company detect events occurring in the world that might cause disruptions in your supply chain? Multiple choice	19														
	<table><tr><td>ReaDetect</td><td>Directly communicated from suppliers and logistics partner; Real-time news / social media monitoring; Real time tracking systems (e.g. sensors, GPS tracking); Track regulatory developments; Monitor the weather and natural disaster warnings; We only identify disruptions once they have already impacted our operations; I don't know; Open-ended question</td></tr></table>		ReaDetect	Directly communicated from suppliers and logistics partner; Real-time news / social media monitoring; Real time tracking systems (e.g. sensors, GPS tracking); Track regulatory developments; Monitor the weather and natural disaster warnings; We only identify disruptions once they have already impacted our operations; I don't know; Open-ended question												
ReaDetect	Directly communicated from suppliers and logistics partner; Real-time news / social media monitoring; Real time tracking systems (e.g. sensors, GPS tracking); Track regulatory developments; Monitor the weather and natural disaster warnings; We only identify disruptions once they have already impacted our operations; I don't know; Open-ended question															
IT Methods & Tools	<u>Adopted from Norrman 2025</u> IT-capabilities can support the development of SCRM. To what degree do the statements apply to your company? [7-point scale: 1) Does not apply at all – 4) Applies moderately – 7) Highly applicable]	22														
	<table><tr><td>ITCapIntegrated</td><td>We have an integrated IT system which automatically links sales forecasts, product structures (B-o-M), and supplier data (location, components)</td></tr><tr><td>ITCapMap</td><td>We use IT tools for automatic visual mapping of SC risks (instead of manual mapping)</td></tr><tr><td>ITCapGeoMap</td><td>We have an IT system which connects geo-mapping with supplier data, allowing us to understand risks related to the supplier locations</td></tr><tr><td>ITCapEarlyW</td><td>We use a system which provides "early warnings"</td></tr><tr><td>ITCapTrack</td><td>We use IT for tracking material flows in real-time</td></tr><tr><td>ITCapSocialMedia</td><td>We have an IT system that monitors social media to detect potential risks</td></tr><tr><td>ITCapReport</td><td>We use IT-based risk reporting systems</td></tr></table>	ITCapIntegrated	We have an integrated IT system which automatically links sales forecasts, product structures (B-o-M), and supplier data (location, components)	ITCapMap	We use IT tools for automatic visual mapping of SC risks (instead of manual mapping)	ITCapGeoMap	We have an IT system which connects geo-mapping with supplier data, allowing us to understand risks related to the supplier locations	ITCapEarlyW	We use a system which provides "early warnings"	ITCapTrack	We use IT for tracking material flows in real-time	ITCapSocialMedia	We have an IT system that monitors social media to detect potential risks	ITCapReport	We use IT-based risk reporting systems	
ITCapIntegrated	We have an integrated IT system which automatically links sales forecasts, product structures (B-o-M), and supplier data (location, components)															
ITCapMap	We use IT tools for automatic visual mapping of SC risks (instead of manual mapping)															
ITCapGeoMap	We have an IT system which connects geo-mapping with supplier data, allowing us to understand risks related to the supplier locations															
ITCapEarlyW	We use a system which provides "early warnings"															
ITCapTrack	We use IT for tracking material flows in real-time															
ITCapSocialMedia	We have an IT system that monitors social media to detect potential risks															
ITCapReport	We use IT-based risk reporting systems															

ITCapSCPartner	We and our SC partners have integrated databases and information systems to share risk information	
<u>Adapted from Norrman 2025</u> <i>To what degree do you believe IT-tools are or could be valuable for your organization?</i> <i>[7-point scale: 1) Not valuable at all – 4) Moderately valuable– 7) Highly valuable]</i>		23
ITValIntegrated	Having an integrated IT system which automatically links sales forecasts, product structures (B-o-M), and supplier data (location, components)	
ITValMap	Having IT tools for automatic visual mapping of SC risks (instead of manual mapping)	
ITValGeoMap	Having an IT system which connects geo-mapping with supplier data, allowing us to understand risks related to the supplier locations	
ITValEarlyW	We use a system which provides "early warnings"	
ITValTrack	We use IT for tracking material flows in real-time	
ITValSocialMedia	We have an IT system that monitors social media to detect potential risks	
ITValReport	We use IT-based risk reporting systems	
ITValSCPartner	We and our SC partners have integrated databases and information systems to share risk information	
<i>There are different kinds of IT software / platforms which can be used in SCRM. What type of IT tool does your company use?</i> <i>Multiple choice</i>		24
IT Tools	We don't use any IT-software; Excel or similar; A Governance-, Risk-, and Compliance (GRC) platform; A Risk Management (RM) platform; A Business Continuity Management (BCM) platform; A Supplier Risk Management (SRM) / Third Party Risk Management platform; A Resilience platform; A Supply Chain Planning platform; I don't know	

Second order construct: Organizational practices			
	<u>Adapted from Norrman 2025:</u> <u>Eryarsoy et al. 2021; Manuj, Herburger & Adana 2021</u> <i>Various organizational capabilities can contribute to the development of SCRM. To what degree do the statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all – 4) Moderately applicable – 7) Highly applicable]</i>	25	
Formalization	FoCommunicationInt	Ensure clear and effective internal communication	
	FoCommunicationExt	Ensure clear and effective communication with external partners	
	FoProcess	We have a well-defined SCRM process that is clearly understood through standardized procedures, tools, and methods.	
	FoRoles	We have well-defined roles with clear responsibilities	
	FoDocument	We have clearly documented SCRM practices (e.g. role descriptions, routines)	
	FoFreq	The mean of IdFreq, AsFreq, MitFreq and MoEffective.	
Resources	ResHuman	We have the necessary human resources (e.g., employees with sufficient experience).	
	ResFin	We have the necessary financial resources (e.g., an allocated budget)	
	ResTech	We have sufficient technical resources (e.g., IT tools, information systems)	
Scope	<u>Adapted from Norrman 2025</u> <i>SC risk identification is the proactive step of recognizing and understanding risks within your supply chain. To what degree do the following statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i>		10
	ScTier1	We identify risks related to our 1st tier suppliers	
	ScTier2	We identify risks related to our 2nd tier suppliers	
	ScTier3	We identify risks related to our 3rd tier suppliers	

	ScSumDepartments	Handled according to methodology explained in Section 4.5.1.4. Categorization of data <i>Which departments or parts of the organization are involved in Supply Chain Risk Management (SCRM)?</i>	8
	ScSumMitStrat	Handled according to methodology explained in Section 4.5.1.4. Categorization of data <i>Companies adopt various risk mitigation approaches to different extents. To what extent does your company apply the following strategies?</i>	13, 14
Learning & Culture	<u>Adapted from Norrman 2025; Eryarsoy et al. 2021; Manuj, Herburger & Adana 2021</u> <i>Various organizational capabilities can contribute to the development of SCRM. To what degree do the statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all – 4) Moderately applicable – 7) Highly applicable]</i>		25
	LCHorizont	We have integrated SCRM into our company culture horizontally (between departments)	
	LCVert	We have integrated SCRM into our company culture, vertically (between hierarchical levels).	
	LCTraining	We conduct training sessions related to SCRM at least once a year	
	LCAreas	We have training sessions covering multiple relevant areas	
Emphasis	EmBenefits	We perceive working with SCRM as a strategic tool generating more benefits than just cost reductions	
	EmGoals	We have clearly defined and measurable goals related to SCRM	
	EmHierAlign	We incorporate input from all hierarchical levels, ensuring alignment from top management to operational staff	
Leadership	Leadership	We have strong top management engagement (prioritization, long-term commitment, effective top-down decision making)	
Involvement	Involvement	We have external supply chain partners involved in our company's SCRM process	
Governance	Governance	We take initiatives to improve the risk management processes of other supply chain partners	

Performance Measurement	<i>Evaluation of the efforts made and the proactive SCRM process can help companies identify improvement potential. To what degree do the following statements apply to your company?</i> <i>[7-point scale: 1) Not applicable at all– 4) Moderately applicable – 7) Fully applicable]</i>		16
	PMPProEva	We evaluate our proactive SCRM process at planned occasions at least once a year	
	PMPProImprove	We try to improve our practices of proactive SCRM process	
	<u>Adapted from Norrman 2025</u> <i>Reactive SCRM focuses on responding to and recovering from the impact of disruptions after they have occurred. To what degree do the statements apply to your company?</i>		18
	ReaStep5Eva	In our crisis response and recovery we conduct "lessons learned" session to evaluate the response	
	ReaStep5Integrate	In our crisis response and recovery we integrate findings into future plans	

Second Order Construct: SC Resilience			
Potential First Order Construct	Item	Question & Potential Source	No
	<u>Adopted from El Baz & Ruel 2020; Um & Han 2021; Eryarsoy et al. 2021; Manuj, Herburger & Adana 2021</u> <i>Finally, we would like to understand how well you perceive that your company's SCRM efforts contribute to the following outcomes.</i> <i>[7-point scale:</i> <i>1) Not achieved at all – 4) Moderately achieved – 7) Fully achieved]</i>		27
	SCResAwareness	We are able to maintain high situational awareness at all times, e.g. by continuously monitoring key SC data and tracking external risk indicators	
	SCResPrepare	We are able to anticipate and prepare for potential disruptions	
	SCResQuickReponse	We provide a quick response to disruptions	
	SCResInitiate	We are able to provide an adequate response to disruptions	
	SCResQuickRecover	Can quickly recover from disruptions	

	SCResCost	Recover from a disruption with minimal financial impact	
	SCResEmerge	Able to strengthen long-term stability rather than just recover to the initial state	

Second Order Construct: Challenges			
Potential First Order Construct	Item	Question & Potential Source	No
Proactive SCRM Process Challenges	<u>Adopted from Norrman & Näslund 2016</u> <i>There can be challenges in effectively managing proactive SCRM within your company. How challenging do you find it to address the following aspects?</i> <i>[7-point scale:</i> <i>1) Not challenging at all – 4) Moderately challenging – 7) Highly challenging]</i>		17
	ChaPro1	Defining and limiting the scope of our SCRM efforts (e.g. limiting to 1st, 2nd, or 3rd tier suppliers)	
	ChaPro2	Ensuring sufficient supply chain visibility to identify relevant risk areas	
	ChaPro3	Grasping the complexity in our supply chains	
	ChaPro4	Identifying potential new risks not previously experienced	
	ChaPro5	Accessing data to estimate risk probability and impact	
	ChaPro6	Analyzing data to estimate supply chain risk probability and impact	
	ChaPro7	Comparing and prioritizing risks	
	ChaPro8	Understanding interdependencies between risks (how mitigating one risk can affect other risks)	
	ChaPro9	Selecting appropriate risk mitigation strategies	
	ChaPro10	Aligning mitigation strategies with company goals	
	ChaPro11	Monitoring and maintaining control over supply chain risks	
Reactive SCRM process challenges	<u>Adopted from Norrman & Näslund 2016</u>		20

	<i>There can be challenges in effectively managing reactive SCRM within your company. How challenging do you find it to address the following aspects?</i> <i>[7-point scale: 1) Not challenging at all – 4) Moderately challenging – 7) Highly challenging]</i>		
	ChaReaDisting	Distinguish disruptions from normal supply chain variations	
	ChaReaCause	Identify the root cause of the disruption	
	ChaReaComInt	Have a clear and effective internal communication	
	ChaReaComExt	Have a clear and effective external communication	
	ChaReaAssessArea	Assess impacted areas across the supply chain	
	ChaReaTeam	Assemble a response team with key stakeholder	
	ChaReaDefActions	Define necessary post-disruption actions	
	ChaReaExecute	Execute recovery measures effectively	
	ChaReaEva	Evaluate and analyze the response effectiveness	
Organizational Challenges	<u>Adopted from Norrman & Näslund 2016</u> <i>There can be challenges incorporating organizational capabilities into your company. How challenging do you find it to achieve the following aspects?</i> <i>[7-point scale: 1) Not challenging at all – 4) Moderately challenging – 7) Highly challenging]</i>		26
	ChaOrg1	Clear and defined SCRM procedures	
	ChaOrg2	Well-defined responsibilities	
	ChaOrg3	Ensure a consistent frequency of the procedures	
	ChaOrg4	Employees with sufficient experience in SCRM	
	ChaOrg5	Adequate financial resources	
	ChaOrg6	Sufficient technical resources	
	ChaOrg7	SCRM process involving cross-departmental collaboration	
	ChaOrg8	Educational activities to ensure employee knowledge on SCRM	
	ChaOrg9	SCRM embedded into the company culture	
	ChaOrg10	Formulate SCRM-related goals	

	ChaOrg11	SCRM process involving people across all hierarchical levels	
	ChaOrg12	Support from top management	
	ChaOrg13	Involving external supply chain partners into your company's SCRM process	
	ChaOrg14	Support external supply chain partners to improve their SCRM process	
	ChaOrg15	Continuous evaluation and improvement of SCRM processes	

Appendix B

Gap analysis, comparing proactive process practices with the corresponding perceived difficulties.

Gap analysis: selecting relevant scope of risk identification

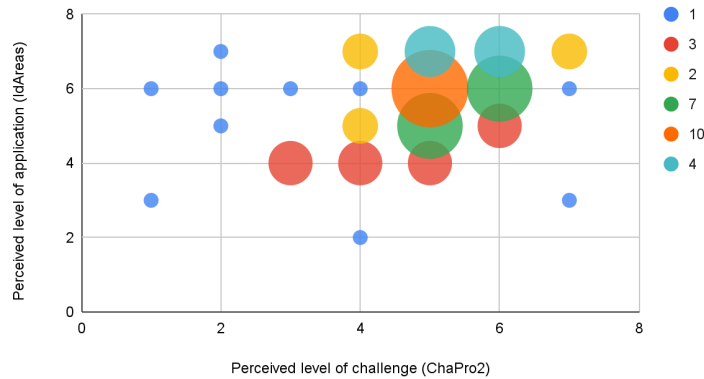


Figure B1: A gap analysis presenting the challenge of *defining and limiting the scope of SCRM* efforts compared to perceived application of *selecting relevant areas for identifying SC risks*.

Gap analysis: understand the complexity in the SC

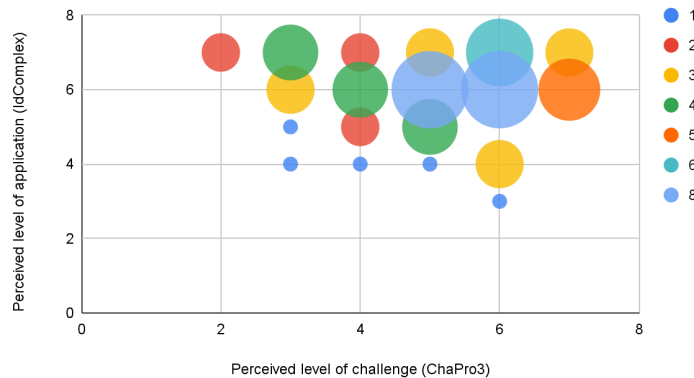


Figure B2: A gap analysis presenting the challenge of *grasping the complexity in the SC* compared to perceived application level of *understanding the complexity in the SC*.

Gap analysis: Identifying new, unexperienced risks

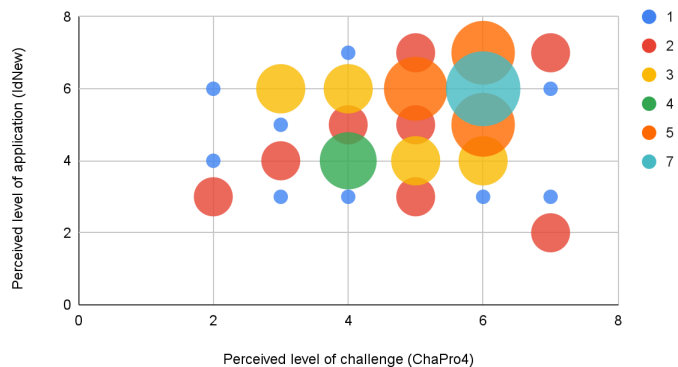


Figure B3: A gap analysis presenting the challenge of *identifying potential new, unexperienced risks* compared to perceived application level of *trying to identify potential new risks, not previously experienced*.

Gap analysis: accessing data for assessment

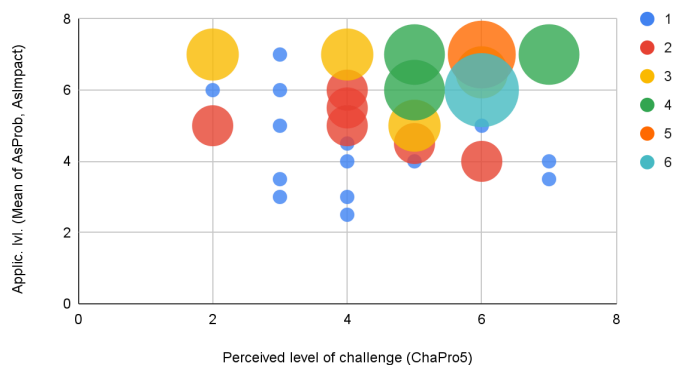


Figure B4: A gap analysis presenting the challenge of *accessing data to estimate risk probability and impact* compared to the *mean value of perceived application level of assessment of risk probability and impact*.

Gap analysis: Analyzing probability and impact data

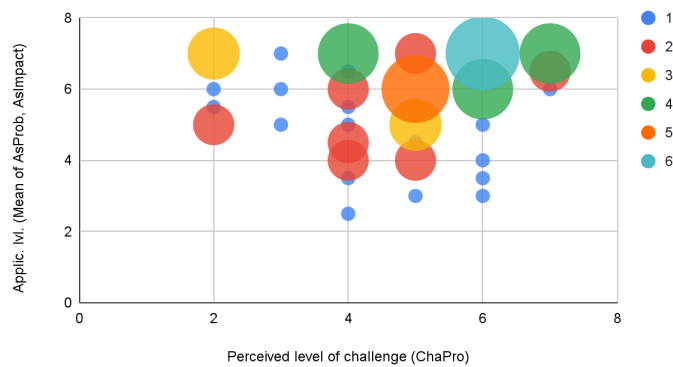


Figure B5: A gap analysis presenting the challenge of *analyzing data to estimate risk probability and impact* compared to the *mean value of application level of assessment of risk probability and impact*.

Gap analysis: prioritizing risks

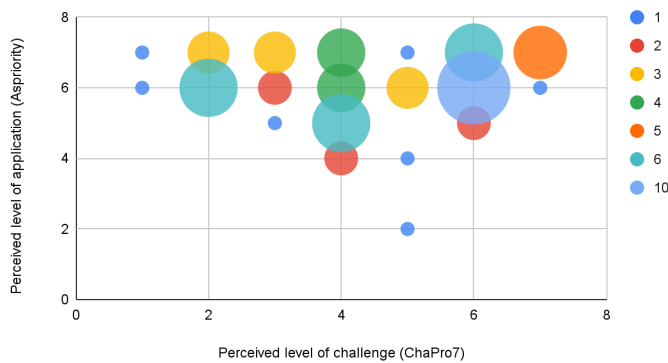


Figure B6: A gap analysis presenting the challenge of *prioritizing risks* compared to the *perceived application level of prioritizing risks*.

Gap analysis: aligning mitigation strategies with company goals

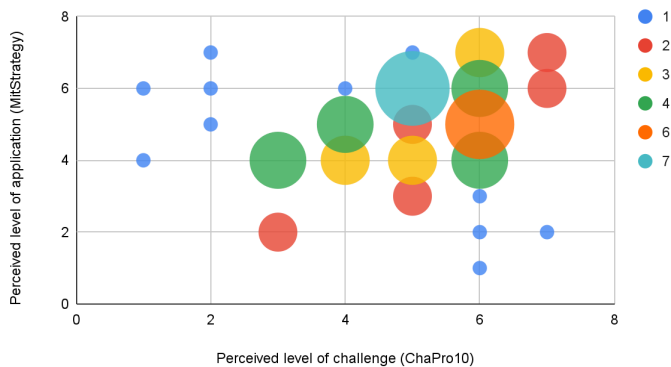


Figure B7: A gap analysis presenting the challenge of *aligning mitigation strategies with company goals* compared to *perceived application level of basing mitigation decisions on the SC strategy of the company*.

Gap analysis: Monitoring risks

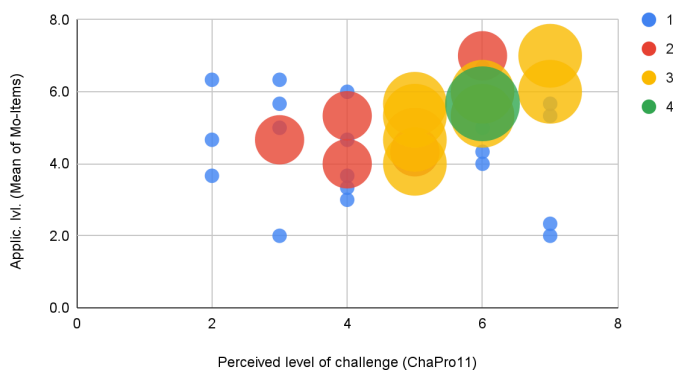


Figure B8: A gap analysis presenting the challenge of *monitoring and maintaining control over SCRs* compared to the *mean of monitoring mitigated risks, monitor unmitigated risks and monitoring SC partners*.

Appendix C

Gap analysis, comparing reactive process practices with the corresponding perceived difficulties.

Gap analysis: Detecting risks

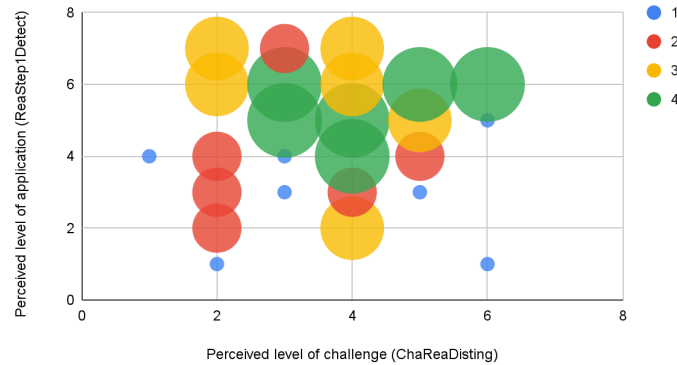


Figure C1: A gap analysis presenting the challenge of *distinguishing disruptions from normal SC variations* compared to the application of *having a structured process to detect events which could lead to disruptions*.

Gap analysis: Identify root cause of risks

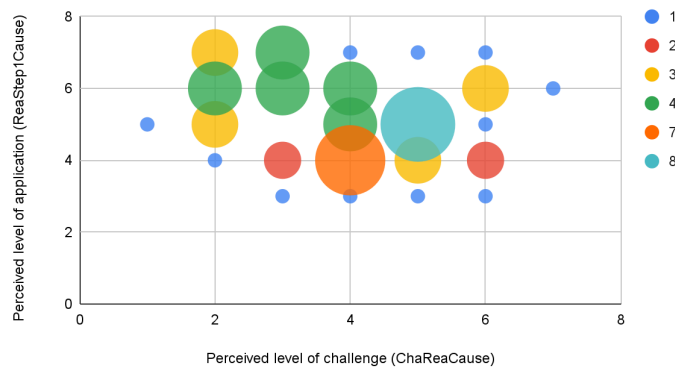


Figure C2: A gap analysis presenting the challenge of *identifying the root cause of the disruptions* compared to the application level of *identifying the root cause of disruptions*.

Gap Analysis: Assess impacted areas across SC

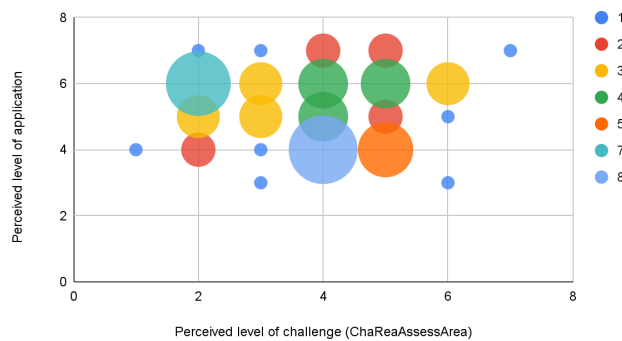


Figure C3: A gap analysis presenting the challenge of *assessing impacted areas across the SC* compared to the application level of *assessing impacted areas across the SC during a disruption*.

Gap analysis: assemble team during disruption

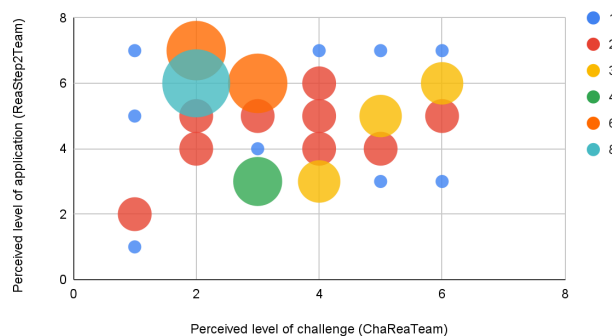


Figure C4: A gap analysis presenting the challenge of *assembling a response team with key stakeholders during a disruption* compared to the application level of *having a dedicated cross-functional team in place to quickly assess and make decisions on reported disruptions*.

Gap analysis: defining necessary post-disruption actions

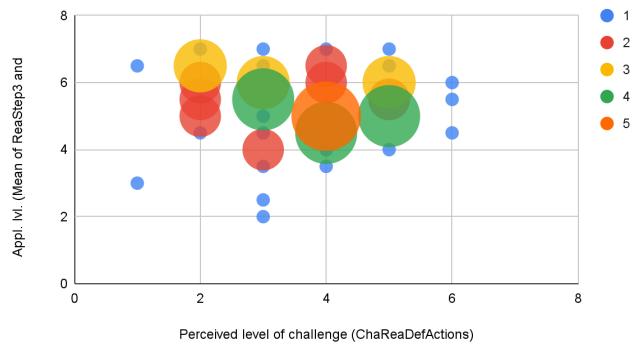


Figure C5: A gap analysis presenting the challenge of *defining necessary post-disruption actions* compared to the mean of *having established contingency plans to maintain operations during disruptions and refine operational adjustment after new information is received*.

Gap Analysis: evaluation of disruptions responses

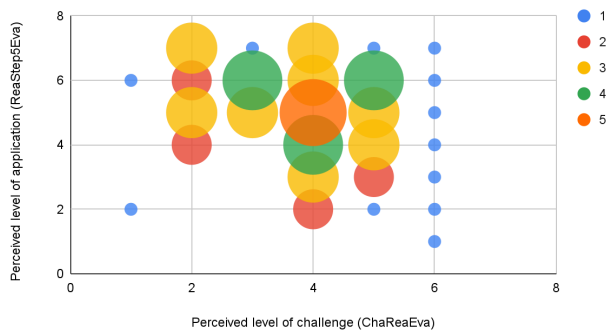


Figure C6: A gap analysis presenting the challenge of *evaluating and analyzing the response effectiveness* compared to the application level of *conducting “lessons learned” sessions to evaluate the responses*.

Appendix D

Gap analysis, comparing organizational practices with the corresponding perceived difficulties.

Gap Analysis: clear and defined procedures

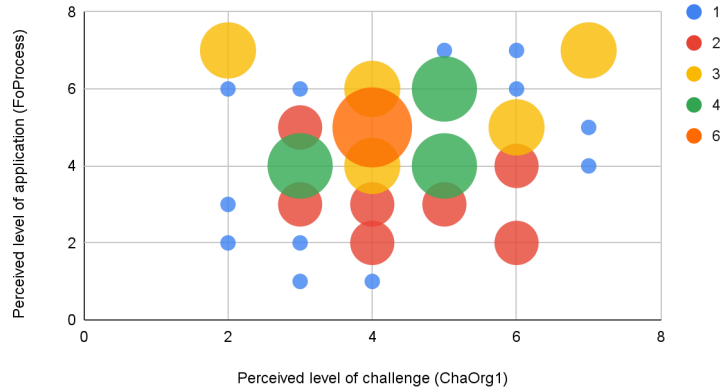


Figure D1: A gap analysis presenting the challenge of *having clear and defined SCRM procedures* compared to the application level of *having a well defined process that is clearly understood through standardized procedures, tools and methods*.

Gap Analysis: well-defined responsibilities

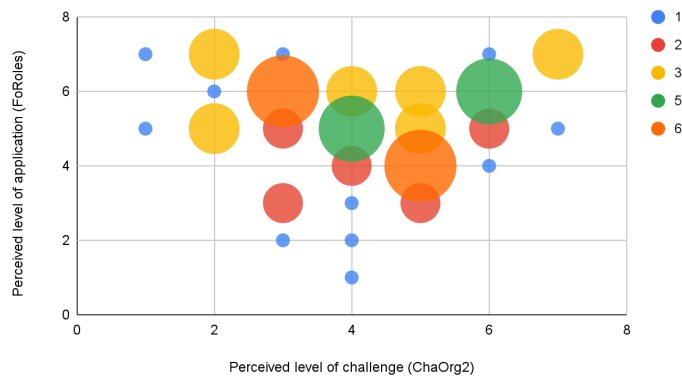


Figure D2: A gap analysis presenting the challenge of *having well-defined responsibilities* compared to the application level of *having well-defined roles and clear responsibilities*.

Gap Analysis: Consistent frequency of procedures

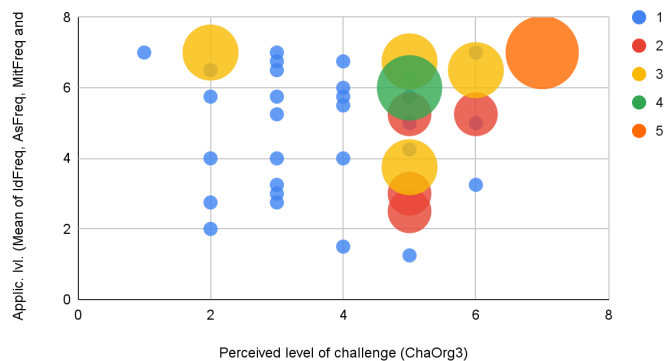


Figure D3: A gap analysis presenting the challenge of *having a consistent frequency of procedures* compared to the mean of the *frequency of the proactive steps of identification, assessment, mitigation and monitoring*.

Gap Analysis: internal communication in reactive SCRM

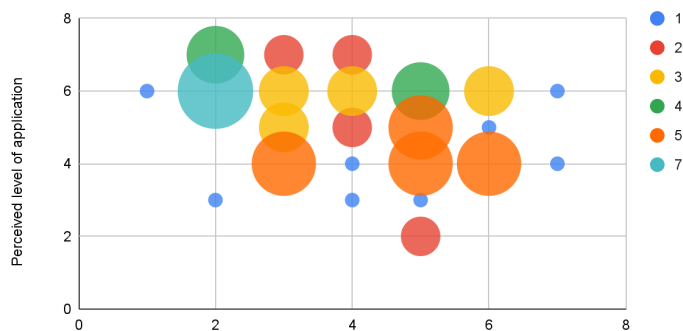


Figure D4: A gap analysis presenting the challenge of *internal communication in reactive SCRM* compared to application level of *having clear and effective internal communication so critical disruption related information reaches the right person*.

Gap analysis: External communication in reactive SCRM

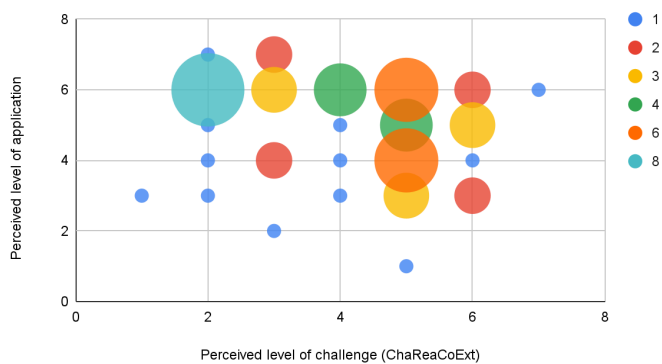


Figure D5: A gap analysis presenting the challenge of *external communication in reactive SCRM* compared to application level of *having clear and effective external communication with SC partners during a crisis*.

Gap Analysis: having sufficient experience of SCRM

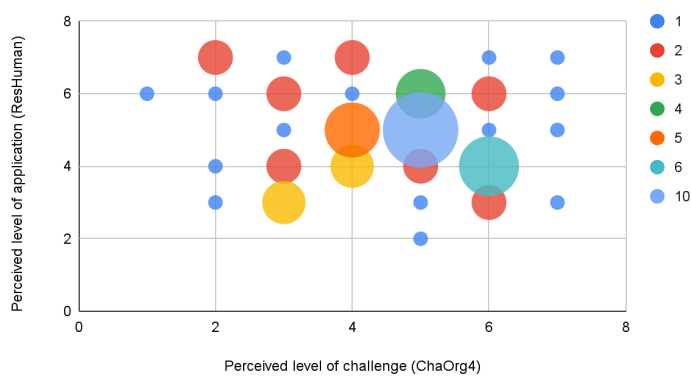


Figure D6: A gap analysis presenting the challenge of *having sufficient experience amongst employees regarding SCRM* compared to the application level of *having the necessary human resources*.

Gap Analysis: Sufficient financial resources

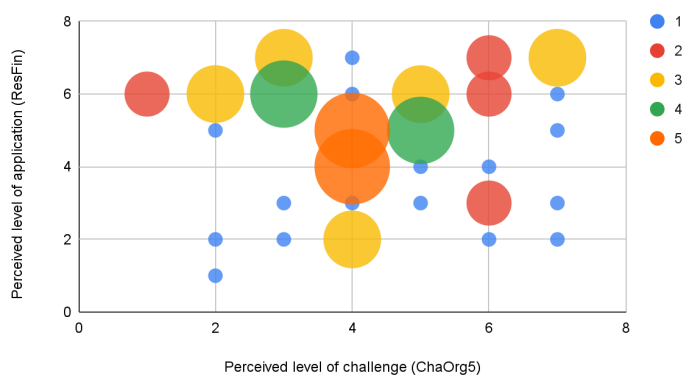


Figure D7: A gap analysis presenting the challenge of *having sufficient financial resources for SCRM* compared to the application level of *having sufficient financial resources for SCRM*.

Gap Analysis: Sufficient technical resources

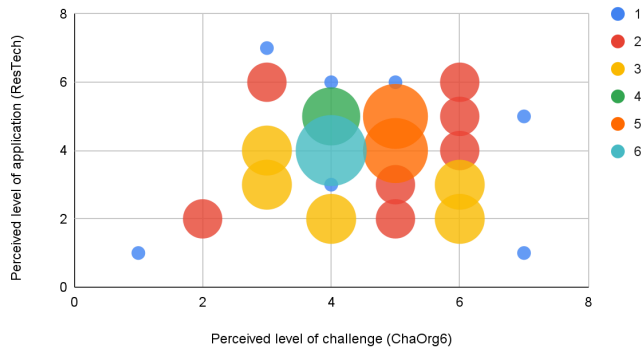


Figure D8: A gap analysis presenting the challenge of *having sufficient technical resources for SCRM* compared to the application level of *having sufficient technical resources for SCRM*.

Gap Analysis: cross-functional collaboration

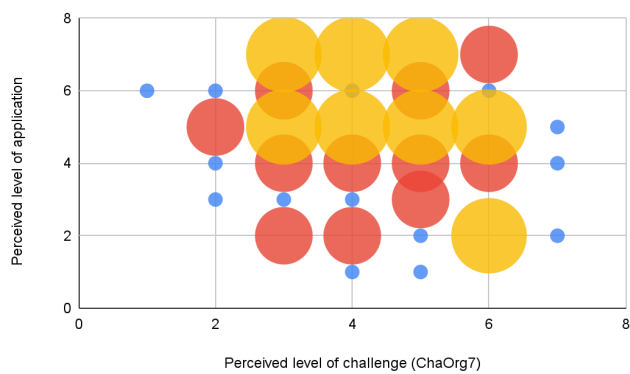


Figure D9: A gap analysis presenting the challenge of *achieving cross-functional collaboration in the SCRM process* compared to the variable *ScSumDepartment* which is calculated according to procedure explained in Section 4.5.1.4.

Gap Analysis: training activities

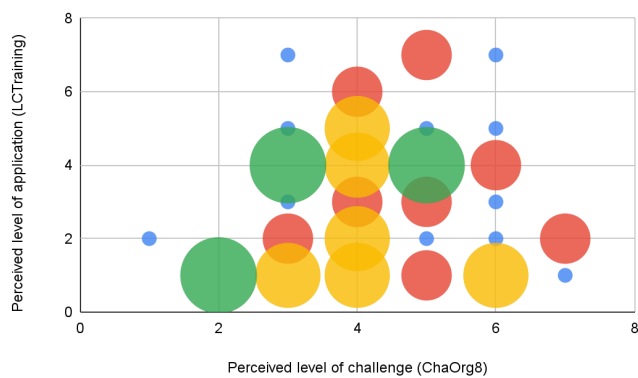


Figure D10: A gap analysis presenting the challenge of *conducting educational activities to ensure that employees have sufficient knowledge on SCRM* compared to the application of *conducting training sessions related to SCRM at least once a year*.

Gap Analysis: integration of SCRM into company culture

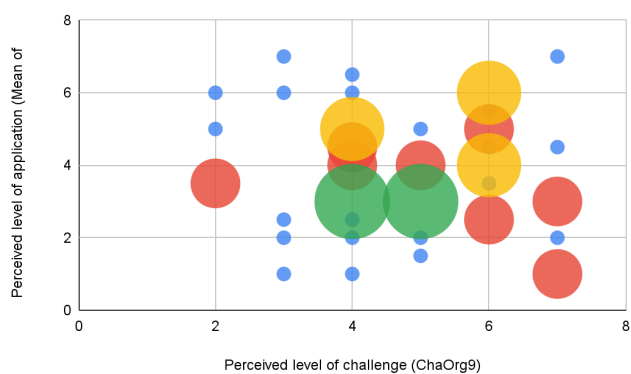


Figure D11: A gap analysis presenting the challenge of *integrating SCRM into the company culture and make employees engaged* compared to the mean of the items *having integrated SCRM into company culture both horizontally and vertically*.

Gap Analysis: Formulation of SCRM-related goals

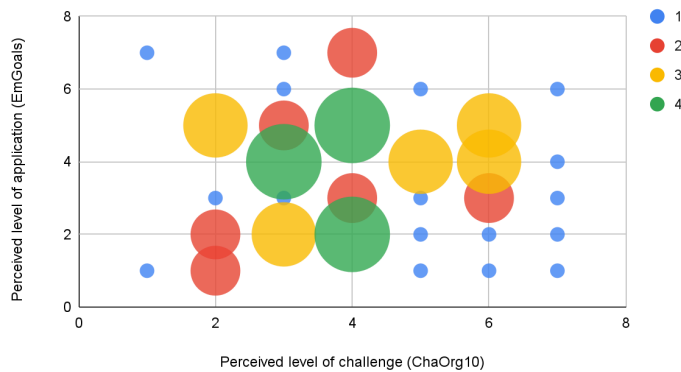


Figure D12: A gap analysis presenting the challenge of *formulating SCRM related goals* compared to the application level of *having clearly and measurable goals related to SCRM*.

Gap Analysis: Involvement of people across hierarchical levels

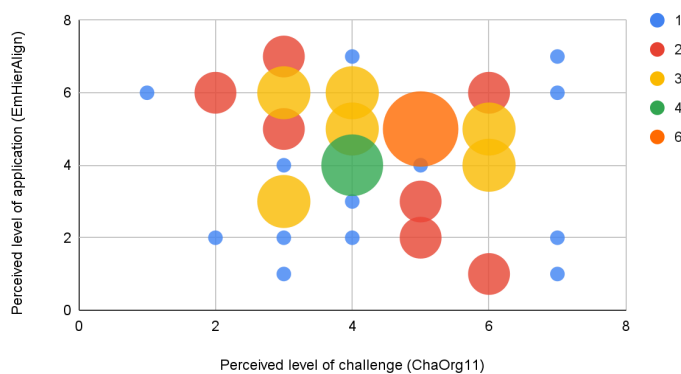


Figure D13: A gap analysis presenting the challenge of *involving people across different hierarchical levels into the SCRM process* compared to the application of *incorporating input from all hierarchical levels, ensuring alignment*.

Gap Analysis: Top management support

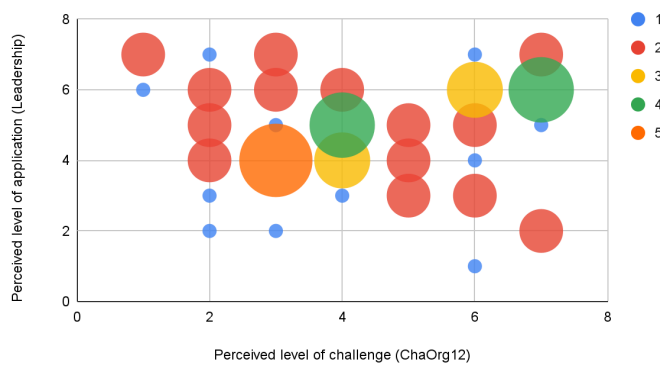


Figure D14: A gap analysis presenting the challenge of *obtaining top management support* compared to the application level of *having strong top management engagement*.

Gap Analysis: Involvement of external SC partners

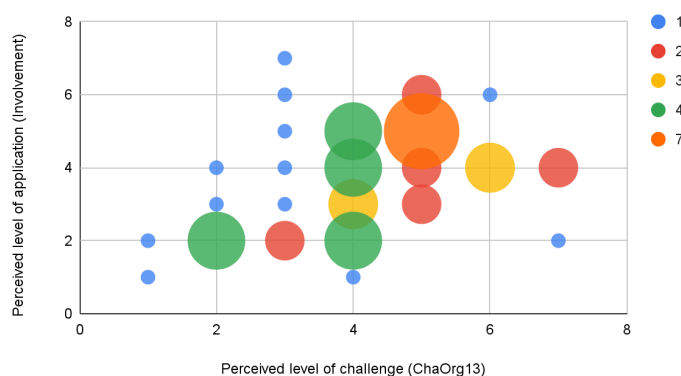


Figure D15: A gap analysis presenting the challenge of *involving external SC partners in the SCRM process* compared to the application of *having external SC partners involved in the SC process*.

Gap Analysis: Governance, support external SC partners

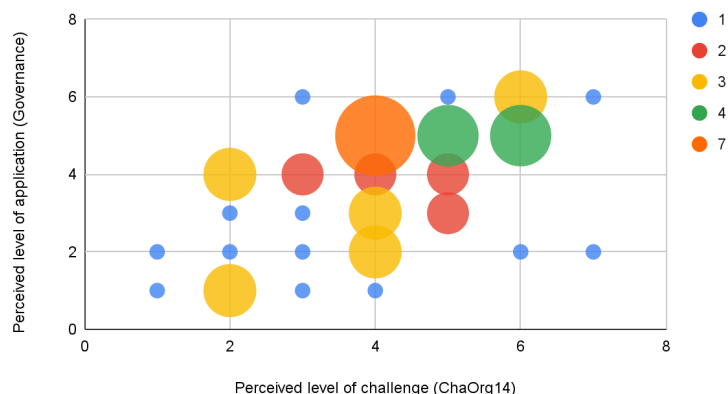


Figure D16: A gap analysis presenting the challenge of *supporting external SC partners in their SCRM process* compared to the application level of *taking initiatives to improve SCRM processes of other SC partners*.

Gap Analysis: Performance measuring

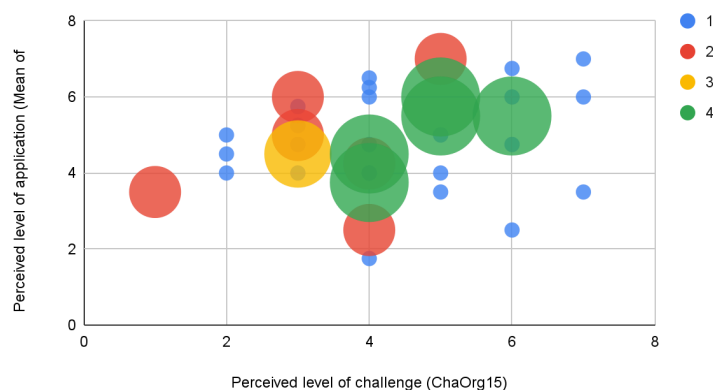


Figure D17: A gap analysis presenting the challenge of *continuously evaluate and improve the SCRM processes* compared with the mean of *trying to improve the practices of proactive SCRM process, evaluate our proactive SCRM process at planned occasions at least once a year, integrate reactive evaluation findings into future plans, conduct lessons learned sessions to evaluate our reactive responses*.