Development of a Proactive Supply Risk Management Model

A multiple case study in the Swedish agrifood industry

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Abstract

Supply risk management (SRM) is a well-established aspect in the field of supply chain management (SCM) that has gained even more relevance due to the ongoing covid-19 pandemic. Many articles have been published relating to the topic, such as Norrman and Jansson (2004) and Zsidisin (2003a). To ensure the academic contribution of this thesis, the authors specifically focused on SRM for companies present in the agrifood industry, which addresses the need for industry-specific research highlighted by Hoffman, Schiele, and Krabbendam (2013). In theory, SRM is typically centered around the steps (1) risk identification, (2) risk assessment, and (3) risk mitigation. In addition to these steps, the elements of (4) risk monitoring and (5) risk organization were also considered.

The purpose of this master's thesis was to develop a proactive SRM model for Company Alpha, a medium-sized company present in the Swedish agrifood industry. The purpose was defined jointly with the practitioners at the company to address the perceived issues caused by lacking transparency in their upstream supply chain. Five research questions were stated, relating to how Company Alpha should work with the different elements of the SRM process.

This thesis has been a complete elaboration between the two authors. Each author has been involved in every part of the process and contributed equally. The model was developed following a constructive research method inspired by Kasanen, Lukka, and Siitonen's (1993) article. In this thesis, the authors adopted an abductive research approach with a system view, where the different aspects of the SRM process were viewed as elements of a complete system. To allow for more rigorous conclusions, a multiple case study including four case companies was conducted. The case companies were selected based on literal replication in a screening process with certain predefined selection criteria.

The analysis indicated similar patterns across the case companies. All companies had a mature process for quality and food safety-related risks, driven by regulatory requirements, but were not considering more general supply risks as thoroughly. To varying degrees, a lack of structure, documentation, conceptual tools, regularity, and consistency were observed at different aspects of all companies' SRM processes. In some cases, there were also a lack of cross-functionality. The practical implication of this finding might be that SRM is an area where many small and medium-sized companies in general are struggling with and would benefit from a more structured process. While this model was developed specifically for Company Alpha, the authors argue that it can still be useful for other similar companies with minor modifications.

The recommended model was presented in accordance with the research questions and developed based on theoretical findings, takeaways from the analysis, and input from the stakeholders at Company Alpha. A primary process performed on an annual basis was suggested, with some complementary elements conducted in a more continuous manner throughout the year. Moreover, the authors identified certain enablers that Company Alpha should get in place to enhance their SRM and also enable positive effects on their general purchasing work, i.e. an upstream supply chain mapping and a Kraljic segmentation.

In the risk identification step, the authors recommended a thorough identification part of the annual process, where cause-effect diagrams and brainstorming are utilized to list relevant risks. Moreover, risks should be identified from supplier contact and internal meetings continuously. In the risk assessment step, it is proposed to evaluate the identified risks in terms of their probability of occurrence and potential impact, prioritize them based on a risk score, and visualize the output in matrix format. In the risk mitigation step, a comprehensive framework of potential mitigation actions was presented. The authors suggested that relevant actions are determined and pursued based on their (1) alignment with overall company strategy, (2) alignment with product strategy, (3) costs and/or issues, and (4) benefits. In the risk monitoring step, the authors proposed that a risk owner and monitor date are determined for each risk. On the monitor date, the risk owner should evaluate (1) whether there have been any changes to the risk source, and (2) the performance of the pursued mitigation action. Moreover, the monitoring step also includes an evaluation form that all process participants should complete to allow for an element of continuous improvement. Lastly, the risk organization contains two aspects: (1) risk culture and (2) process governance. In terms of risk culture, the authors identified six cultural levers that the company should consider to ensure a strong culture, i.e.: (1) cross-functional participation, (2) formalized risk training, (3) top management prioritization, (4) proactive mindset, (5) continuous improvement, and (6) documentation. In terms of process governance, it was advised that the management team fulfills the role of a governing body to monitor the performance of the process. It was suggested that they discuss the risk topic on (at least) a quarterly basis.

Key words: Supply Risk Management; SRM; Supply Chain Management; Swedish Agrifood Industry; Multiple Case Study; Constructive Research

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Abbreviations

AFSC	Agrifood Supply Chain
AHP	Analytical Hierarchy Process
BU	Business Unit
BIV	Business Interruption Value
BRC	British Retail Consortium
BRT	Business Recovery Time
CCP	Critical Control Point
CPFR	Collaborative Planning, Forecasting, and Replenishment
CRP	Continuous Replenishment Program
CSR	Corporate Social Responsibility
ERMET	Ericsson Risk Management Evaluation Tool
ETA	Event Tree Analysis
FMEA	Failure Modes and Effects Analysis
FSSC	Food Safety System Certification
FTA	Fault Tree Analysis
GFSI	Global Food Safety Initiative
HACCP	Hazard Analysis and Critical Control Points
IS	Information System
QESH	Quality/(safety), Environment, Social, and Heritage
RDD	Relevance Diamond Diagram
RPN	Risk Priority Number
RQ	Research Question
SCM	Supply Chain Management
SCRM	Supply Chain Risk Management
SRM	Supply Risk Management
SWOT	Strenghts, Weaknesses, Opportunities, Threats
TACCP	Threats Assessment and Critical Control Points
UoA	Unit of Analysis
VACCP	Vulnerability Assessment and Critical Control Points

1 Introduction

This chapter provides the context of the thesis. Firstly, a general background to risk management in supply chains and some basic understanding of the agrifood industry will be provided. The chapter also presents an introduction of the principal case company, Company Alpha, the purpose of the study, and the concrete research questions that will be addressed. Lastly, some delimitations are presented, followed by a clarification of the target audience and an outline for the thesis' structure.

1.1 Supply chain risk management

According to research conducted by the consulting company McKinsey & Company, companies with global supply chains are exposed to major challenges in terms of both risk, cost, and time (Diedrichs & Leopoldseder 2008). The vulnerability and risk of operating globally have recently gained even more attention during the global covid-19 outbreak, as companies not only need to protect their workers' safety, but also safeguard their operational viability (Alicke, Azcue, & Barriball 2020). Even before covid-19, Zsidisin and Ritchie (2009) mentioned that the risk aspect is becoming an established aspect in the area of supply chain management (SCM). Supply chain risk management (SCRM) now contributes to the decision-making process in most functional areas within an organization. The growing importance of SCRM was also highlighted by Norrman and Jansson (2004, p. 436), who used the following definition to describe the topic: "Supply chain risk management is to [collaborate] with partners in a supply chain apply risk management process tools to deal with risks and uncertainties caused by, or impacting on, logistics related activities or resources".

Even though the SCRM processes in literature are slightly different and use varying terminology, the overall themes are similar and the steps resemble each other. This conclusion was highlighted by Kern, Moser, Hartmann, and Moder (2012), who argue that SCRM processes seen in the literature are commonly organized around the following three steps: (1) risk identification, (2) risk assessment, and (3) risk mitigation. In addition, some articles touch upon the importance of also including an element of risk monitoring to make the process dynamic (Kern et al. 2012; Fan & Stevenson 2018), while others point to the importance of considering the organizational aspect (Jüttner, Peck, & Christoper 2003). A conceptual overview of the SCRM process is visualized in Figure 1.1.

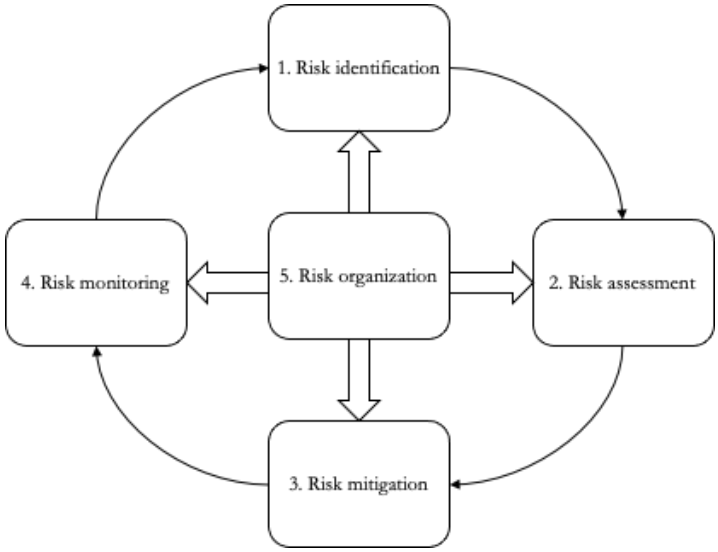

Figure 1.1: A conceptual overview of the SCRM process, developed by the authors.

To get an overview of risks within a supply chain, the classification by Manuj and Mentzer (2008) (illustrated in Figure 1.2) can be used. Supply risks occur in the upstream material flow, from suppliers' suppliers to the focal firm. Operational risks consider events that affect the ability of the focal firm to produce goods and services. Lastly, demand risks are associated with the downstream supply chain and consider events that affect the overall demand variability. A distinction can thus be made between SCRM, which focuses on the full supply chain, whereas supply risk management (SRM) only considers the upstream aspect of it.

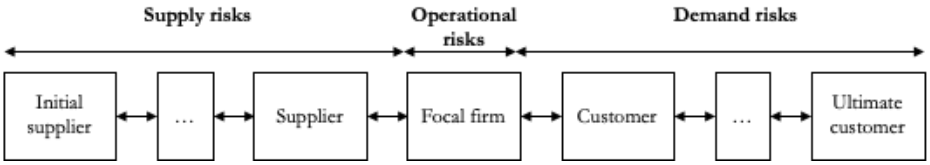

Figure 1.2: An overview of how supply chain risks can be categorized, adapted from Manuj and Mentzer (2008).

Furthermore, a distinction can be made between proactive and reactive risk management (Grötsch, Blome, & Schleper 2013; Norrman & Wieland 2020). Proactive risk management considers actions taken *before* a risk occurs, while reactive risk management handles actions taken *after* a risk occurs. Even though the majority of literature mostly consider proactive risk management, Norrman and Jansson (2004) highlight the importance of also focusing on the reactive aspect, as they mention that a company can never be fully prepared for all potential risks regardless of how much effort is put into proactive risk management.

1.2 The agrifood industry

The agrifood industry is one example of an industry that has been affected by the global covid-19 pandemic (Wyns 2020). Naik and Suresh (2018) mention that the term agrifood supply chains (AFSC) consider supply chains of both fresh agricultural products as well as processed agrifood products. They further mention that AFSCs traditionally have consisted of autonomous and independent actors, which have become increasingly interconnected in complex global systems in recent years.

Tsolakis, Keramydas, Toka, Aidonis, and Iakovou (2014) mention that AFSCs have several unique characteristics that distinguish them from other traditional supply networks. To name a few, they highlight the often short product life-cycles, high product differentiation, seasonality in harvesting and production operations, and specific requirements regarding transportation, storage conditions, quality, and material recycling. Another unique characteristic mentioned by Tsolakis et al. (2014) is the need to comply with national and international regulations, requirements, and directives regarding food safety, quality, and environmental issues. Moreover, as mentioned by Joshi and Rahman (2015), consumer demand is becoming increasingly complex, as factors related to environmental and social performance are also considered in the buying decision, which is something companies need to keep in mind and comply with to ensure sales.

To enable an improved trust from consumers towards the products they buy, the Global Food Safety Initiative (GFSI) was established in 2000, focused on improving global food safety management practices (GFSI 2020). Since it was founded, GFSI has grown into a global multi-stakeholder movement including e.g. food safety experts, upstream suppliers, international organizations, governments, and academia. GFSI does not provide a certification themselves, instead, they recognize a number of certificates that fulfill their requirements. One such example is FSSC 22000, focusing on food safety management systems and quality management systems (FSSC 22000 2020).

1.3 Company Alpha

Company Alpha is a medium-sized, family-owned company present in the Swedish agrifood industry. The company was founded in the late nineteenth century as it became the first commercial fruit farm in Sweden, primarily focusing on apples. Since then, the company has leveraged on the accumulated expertise of five generations to refine the growth, harvest, and production processes that produce juices, wines, and chutneys from high-quality fruits and berries. As of 2019, they have an annual turnover of 685 MSEK and employ 190 people. In their operations, they maintain much flexibility with a high degree of product development and a broad assortment. (Sustainability & Product Development Manager at Company Alpha 2020)

The company can be divided into three main business units (BUs). The first BU consists of products they produce and sell using their own brand. The second BU produces private label products that are sold by external companies. The third BU focuses on wines and is sold under their own wine brand. Company Alpha produces products for all market segments, with a focus on premium products. An overview of the BUs and their total revenue share as of 2019 is shown in Figure 1.3. (Sales Manager Own Brand at Company Alpha 2020)

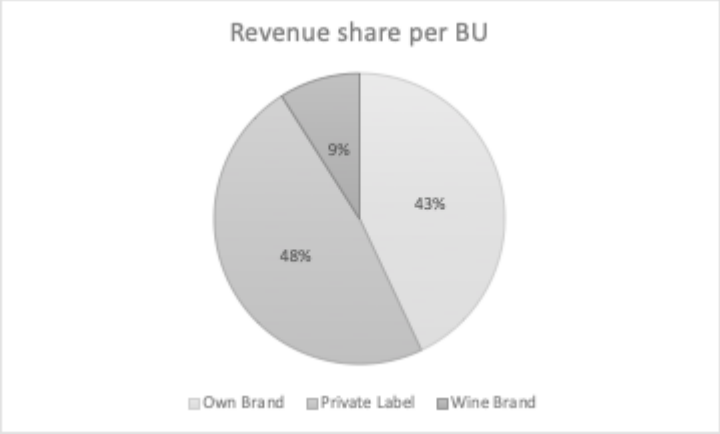

Figure 1.3: Revenue share per BU as of 2019 (Sales Manager Own Brand 2020).

The company operates from four facilities. The main facility is located in Kivik, where they plant and harvest, produce, and provide an opportunity for company visits through their shop and restaurant. This is also the location of the main office. The second facility was established in 2014 in Stenhamra as a secondary production site. Moreover, in 2015 the company acquired Solnäs Gård close to Lund, where they plant and harvest apples, as well as allowing for additional company visits. Lastly, the office of the wine brand BU is located in Stockholm. An overview of the company's supply chain is shown in Figure 1.4. (Sustainability & Product Development Manager at Company Alpha 2020)

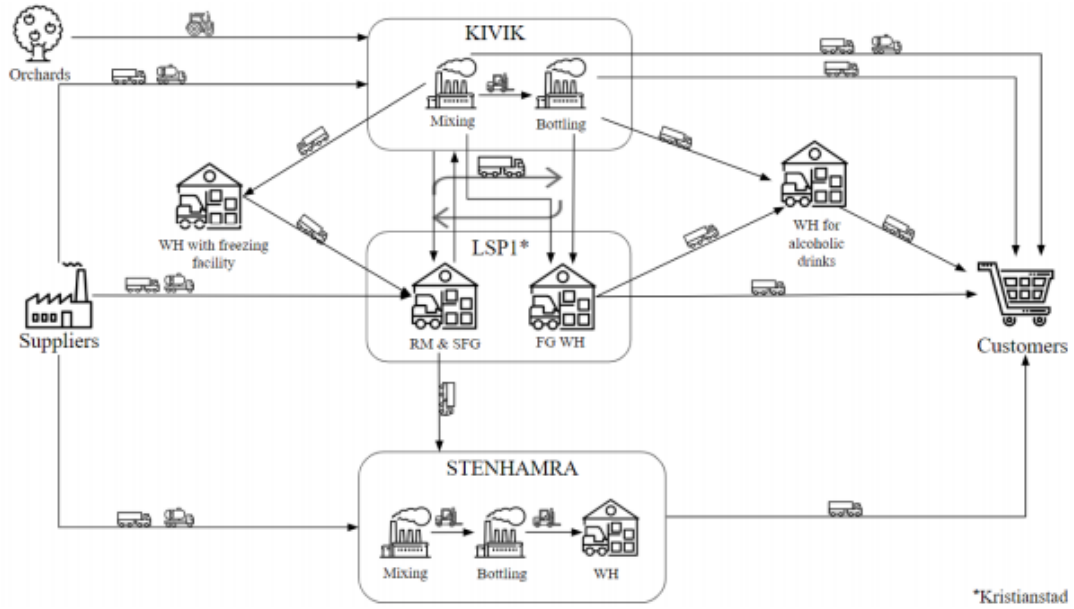

Figure 1.4: Overview of Company Alpha's supply chain, developed by Özer and Lantto (2020).

1.4 Problem formulation

Despite Company Alpha's heavy reliance on their own and other local apple orchards for many of their products, they also need to source raw materials globally. As the company is certified by FSSC 22000, there are explicit requirements on the upstream actors in their supply chain. As a consequence, a lack of transparency in the supply chain can be a significant problem. Company Alpha's management team has identified this lack of awareness and visibility as a concern to the

company and would therefore like to develop a formal SRM process. (Sustainability & Product Development Manager at Company Alpha 2020)

1.5 Purpose and research questions

To address the lack of awareness and visibility in Company Alpha's upstream supply chain, the purpose of the thesis was to develop a proactive SRM model, which the company could implement in their organization and daily operations. The following research questions (RQs) were stated:

1. How should supply risks be identified at Company Alpha?
2. How should identified supply risks be assessed and prioritized at Company Alpha?
3. How should identified supply risks be mitigated at Company Alpha?
4. How should Company Alpha work with risk monitoring to assure a dynamic SRM model?
5. How should process governance and risk culture be considered in the risk organization at Company Alpha?

1.6 Delimitations

The following delimitations were made:

- The project scope only included the supply of raw materials such as fruits, berries, and additives, thus neglecting packaging material.
- Supplies specific to the wine brand were not considered due to the end-products' unique regulatory requirements.
- The thesis was limited to develop a conceptual model. Hence, implementation of the model was not in scope.
- The developed model was limited to *proactive* risk management, thus neglecting the *reactive* aspect.
- The thesis had a time constraint of 20 weeks which impacted methodological decisions.

1.7 Target audience

Three main target groups have been identified. Firstly, it is aimed towards practitioners at Company Alpha, who presumptively find the developed model useful and implement it into their operations. Secondly, it is addressed towards academic colleagues, particularly with an interest in SCM and risk management. Thirdly, it is the authors' intention that the developed model will be possible to implement at other companies in the agrifood industry with minor adjustments. Thus, making practitioners at other similar companies, who wish to improve their SRM process a potential audience.

1.8 Report outline

Chapter 2: Literature review

This chapter covers the theoretical findings, which are mainly based on research articles and books related to the thesis' topic. It contains a clarification of some key concepts and definitions and a thorough review of the different elements of the proactive SRM process, i.e. (1) risk identification,

(2) risk assessment, (3) risk mitigation, (4) risk monitoring, and (5) risk organization. Lastly, the findings from the literature review are summarized in a conceptual SRM framework.

Chapter 3: Methodology
This chapter focuses on the different methodological choices made by the authors. More concretely, the overarching methodology, research approach, and research strategy are presented and argued for. In addition, some tactics adopted to ensure the research credibility of the thesis are discussed.

Chapter 4: Empirical findings
This chapter covers the empirical findings of the case study. It commences with a tabular overview of some characteristics of the case companies to provide some context. Thereafter, the empirical findings of Company Alpha are covered, structured in accordance with the investigation model. To limit the page number of the main report, the empirical findings of the other cases are placed in Appendix C.

Chapter 5: Analysis
This chapter aims to analyze the empirical findings. Firstly, a within-case analysis from Company Alpha is presented, structured in accordance with the investigation model. To limit the page number of the main report, only one within-case analysis is presented in this chapter, and the reader is referred to Appendix D for the secondary cases. Thereafter, the cross-case analysis is presented, where similarities and dissimilarities between cases are discussed, conclusions drawn, and takeaways summarized.

Chapter 6: Developed SRM model
This chapter presents the authors' recommendation in the form of a developed SRM model. Firstly, some general remarks are discussed, followed by the actual model, which is divided into elements of (1) risk identification, (2) risk assessment, (3) risk mitigation, (4) risk monitoring, and (5) risk organization. Lastly, a tabular overview details how the takeaways from the analysis were considered in the model development.

Chapter 7: Conclusion
This chapter aims to summarize and conclude the thesis. Firstly, a summary of the findings is provided, which details how all of the research questions (RQs) were answered and incorporated into the supply risk management (SRM) model. Thereafter, practical implications, generalizability, and contribution of the study is covered. Lastly, some limitations and potential areas for future research are discussed.

2 Literature review

This chapter covers the theoretical findings, which are mainly based on research articles and books related to the thesis' topic. It contains a clarification of some key concepts and definitions and a thorough review of the different elements of the proactive SRM process, i.e. (1) risk identification, (2) risk assessment, (3) risk mitigation, (4) risk monitoring, and (5) risk organization. Lastly, the findings from the literature review are summarized in a conceptual SRM framework.

2.1 Terminology and concepts

To define a *supply chain*, the definition from Mentzer et al. (2001, p. 4) will be used, where a supply chain is seen as "a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer". The reason this definition is used is that it takes a holistic perspective of the supply chain (by including the perspectives of both products, services, finances, and information), while also being concrete, thus reducing the risk for misinterpretations.

The next terminology relates to the concept of *risk*. Manuj and Mentzer (2008) discuss various interpretations of the term, which varies depending on the context. Regardless of the perspective and definition used, the concept typically contains the following three components: (1) potential losses if a risk occurs, (2) probability of occurrence, and (3) significance of the potential losses. To capture all of these elements, this thesis will use the risk definition proposed by Mitchell (1995), who states that risk is a product of the probability of occurrence and the potential impact if the risk occurs. By using this quantitative definition, the authors of this thesis argue it will be easier to view risk assessment through an objective lens.

As this thesis intends to develop a model focused on *supply risks*, only risks concerning the upstream material flow will be considered. More concretely, Zsidisin's (2003a, p. 222) supply risk definition will be used: "Supply risk is defined as the probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety". A summary of the discussed definitions is shown in Table 2.1.

Table 2.1: A summary of key definitions used in the thesis.

Terminology	Definition
Supply chain	"A set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer" - Mentzer et al. (2001, p. 4)
Risk	"The risk concept contains different types of loss and the risk of any particular type of loss is a combination of the probability of that loss, $P(Loss_n)$, and the significance of that loss to the individual or organization, $I(Loss_n)$. Therefore: $Risk_n = P(Loss_n) \cdot I(Loss_n)$" - (Mitchell 1995, p. 116)
Supply risks	"Supply risk is defined as the probability of an incident associated with inbound supply from individual supplier failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to customer life and safety." - (Zsidisin 2003a, p. 222)

2.2 Risk identification

The purpose of the risk identification step is to discover all relevant risks and uncertainties (Fan & Stevenson 2018), and due to companies' limited resources, it is necessary to have a structured approach (Kern et al. 2012). As risk identification lays the foundation for all subsequent steps of the risk management process (Kern et al. 2012; Cagliano, De Marco, Grimaldi, & Rafele 2012; Fan & Stevenson 2018), it is an essential step in order to ensure risk management effectiveness (Tchankova 2002). The importance of excellence in the identification step is highlighted by Tchankova (2002, p. 290), who argues that "if managers do not succeed in identifying all potential losses or gains that challenge the organization, then these non-identified risks will become non-manageable". Similarly, Cagliano et al. (2012) mention that an accurate understanding and classification of supply chain risks is needed to enable tailored risk reduction approaches.

In terms of the risk scope, Kern et al. (2012) highlight the importance of having a holistic approach to risk identification and mention that companies regularly must screen for early indications of potential risks in the supply chain and their environment. This viewpoint is shared with Manuj and Mentzer (2008), who further emphasizes that companies with global supply chains must have global scope when identifying risks, considering various supply chain partners and how the environment in their countries might differ from the environment the focal firm is active in.

This section will be split into two main topics. First, focus will be on understanding the potential sources of supply risks. Thereafter, techniques and tools for identifying risks will be discussed.

2.2.1 Risk sources

To get an understanding of potential supply risk sources, 13 articles regarding the topic were reviewed. Some articles were of more general nature, focused on SCRM (Jüttner et al. 2003), risk identification (Adhitya, Srinivasan, & Karimi 2009; Tchankova 2002), supply risk analysis (Wu, Blackhurst, & Chidambaram 2006; Cagliano et al. 2012), and supply risks (Zsidisin 2003a; Zsidisin 2003b). Others were applied in the specific context of AFSCs, focused on risk identification (Yeboah, Feng, Oppong-Sekyere, & Nyamaah 2014), risk sources (Zhao, Liu, & Lopez 2017), risk

analysis and assessment (Zhao, Liu, Lopez, Chen, Lu, Mangla, & Elgueta 2020; Jaffee, Siegel, & Andrews 2010), and risk management for AFSCs in broad (Bachev 2012). Lastly, Giannakis and Papadopoulos (2016) was reviewed to add additional depth and cover sustainability-related risks. While some of the articles mentioned non-supply related risks, only risks in scope of Zsidisin's (2003a, p. 222) supply risk definition were considered.

By reviewing these articles, a classification of three overarching supply risk sources could be made by the authors: (1) macro risks, (2) network risks, and (3) supplier risks. This is comparable to the categorization made by Jüttner et al. (2003), who distinguishes between (1) environmental, (2) network, and (3) organizational supply risks. Another similar classification is provided by Zsidisin (2003a), who argues that supply risks are either caused by (1) individual supplier failures or (2) market characteristics. The relationship between the risk sources is illustrated in Figure 2.1, where it is apparent that supplier risks take the least holistic scope, as it is centered around specific suppliers, whereas macro risks are the most holistic category among the three.

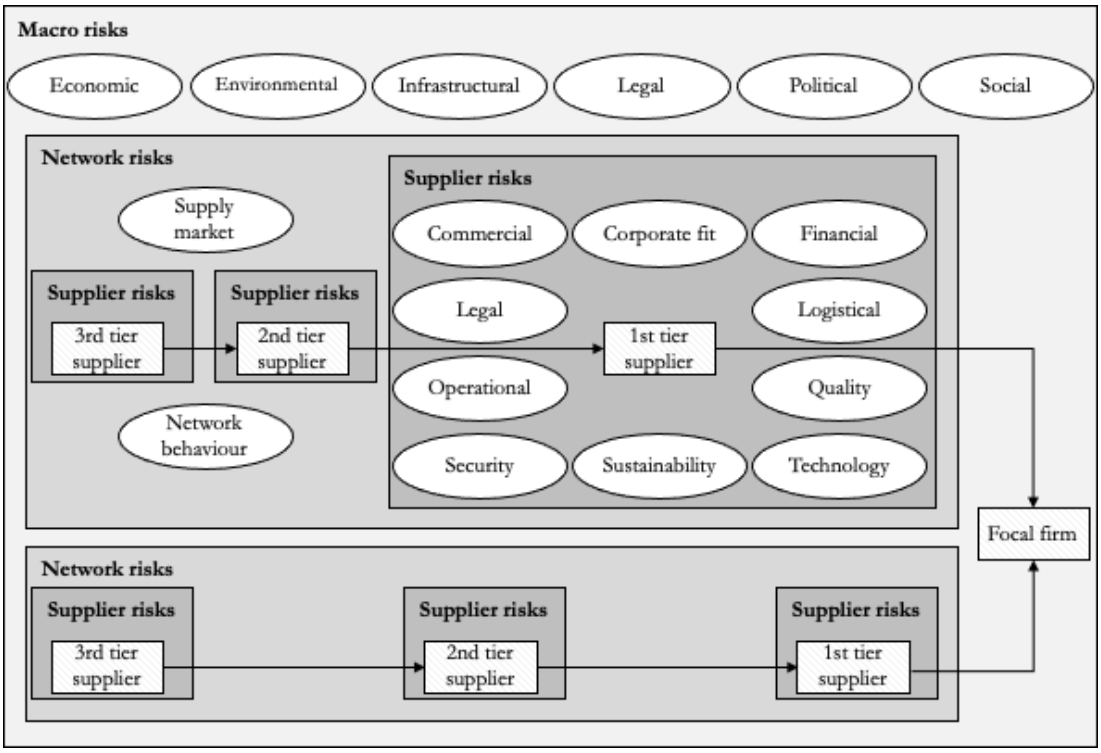

Figure 2.1: Conceptual framework of the supply risk sources identified in literature.

2.2.1.1 Macro risks

Macro risks take a holistic perspective and focus on risks that the focal firm and/or suppliers (often) have no impact on. The authors have categorized macro risks into the following six sub-categories: (1) economic, (2) environmental, (3) infrastructural, (4) legal, (5) political, and (6) social. An overview of these were derived from literature is shown in Table 2.2.

Table 2.2: Macro supply risks identified in literature review.

Macro risks			
Code	**Risk types**	**Risk factors**	**References**
MEC	Economic	(1) Exchange rate fluctuations; (2) Changes in interest rate; (3) Changes in the overall economic situation	Cagliano et al. (2012); Tchankova (2002); Wu et al. (2006); Zhao et al. (2020)
MEN	Environmental	(1) Natural disasters; (2) Man-made disasters; (3) Weather; (4) Pandemics	Bachev (2012); Cagliano et al. (2012); Giannakis & Papadopoulos (2016); Jaffe et al. (2010); Jüttner et al. (2003); Wu et al. (2006); Yeboah et al. (2014); Zhao et al. (2017); Zhao et al. (2020); Zsidisin (2003a)
MIN	Infrastructural	(1) Poor infrastructure; (2) Port congestion; (3) Customs delays; (4) Security check delays; (5) Changes in transportation network; (6) Infrastructure security	Cagliano et al. (2012); Jaffee et al. (2010); Yeboah et al. (2014)
MLE	Legal	(1) Uncertainty in external legal environment; (2) (Potential) new regulations	Jaffee et al. (2010); Tchankova (2002); Wu et al. (2006); Yeboah et al. (2014)
MPO	Political	(1) Changes in government policies; (2) Changes in export or import regulations; (3) Tariff changes; (4) Administrative and bureaucratic issues; (5) Political instability	Bachev (2012); Cagliano et al. (2012); Jaffee et al. (2010); Tchankova (2002); Wu et al. (2006); Yeboah et al. (2014); Zhao et al. (2017); Zhao et al. (2020)
MSO	Social	(1) Changing social demands; (2) Labor strikes, boycotts, and social riots	Bachev (2012); Cagliano et al. (2012); Giannakis & Papadopoulos (2016); Jaffee et al. (2010); Tchankova (2002)

2.2.1.1.1 Economic

Macroeconomic risks refer to the economic environment and context in which the focal firm and its suppliers operate. The risk factors are on a macro level and affect society as a whole. Examples could be an economic regression (Wu et al. 2006; Tchankova 2002; Zhao et al. 2020), changes in interest rates, or fluctuations in exchange rates (Cagliano et al. 2012).

2.2.1.1.2 Environmental

Environmental risks refer to the physical external environment of a company's supply chain. One sub-category within environmental risks relates to natural disasters, which can e.g. be floods, extreme drought (Jaffe et al. 2010), hurricanes, earthquakes (Wu et al. 2006), fires, or explosions (Giannakis & Papadopoulos 2016). Another sub-category considers man-made disasters and refers to disruptions caused by humans, such as terrorist attacks or fuel protests affecting society (Bachev 2012; Jüttner et al. 2003). A third sub-category considers weather. To exemplify, a periodic deficit in rainfall or temperature could result in a drastically reduced yield, while big thunderstorms could destroy greenhouses overnight (Jaffee et al. 2010; Zhao et al. 2020). Lastly, the authors of this

thesis make a remark and add pandemics as another highly relevant environmental risk, given the current covid-19 outbreak.

2.2.1.1.3 Infrastructural

The next risk category relates to physical infrastructure. Examples of concrete risks are degraded or undependable transport, communication, and energy infrastructures (Jaffee et al. 2010), but also poor agricultural infrastructure that lacks channels, routes, and transportations for rural farmers can be considered (Zhao et al. 2020). Port congestion and customs delays where e.g. security checks result in queues and limit the movement of goods (due to crossing of international borders) might be other risk factors (Yeboah et al. 2014). Moreover, a company has to consider the risk of potential major infrastructural changes in the transportation network (Cagliano et al. 2012).

2.2.1.1.4 Legal

The legal environment with its laws and regulations generates risks for a business (Wu et al. 2006; Yeboah et al. 2014). In a global supply chain context, the complexity and uncertainty increase due to the variation of legal standards in different markets, which may lead to conflicts between actors (Tchankova 2002). Furthermore, Jaffee et al. (2010) highlight the risk of changing requirements and regulations.

2.2.1.1.5 Political

Several authors mention the political environment in broad as a risk factor (Cagliano et al. 2012; Zhao et al. 2020; Yeboah et al. 2014; Jüttner et al. 2003; Tchankova 2002; Zhao et al. 2017; Jaffee et al. 2010; Bachev 2012). As an example, risks from changes to overarching governmental policies, export and import regulations, and tariffs were mentioned by Cagliano et al. (2012). This is also exemplified by Tchankova (2002), who argues that the ruling party in a country can heavily affect the companies operating there by e.g. cutting aid to specific industries. The party can also implement strict rules about e.g. environmental factors which companies must oblige (Tchankova 2002). Moreover, Jaffee et al. (2010) discuss political risks related to monetary, fiscal, and tax policies, and the ethical dilemma of operating in areas with corruption. Zhao et al. (2020) further discuss the risk of operating in areas with political instability. Lastly, some authors discuss risks related to administration and bureaucracy (Yeboah et al. 2014).

2.2.1.1.6 Social

Social risks refer to the social and cultural environment in which the company operates. As an example, changes in overall social demands (Bachev 2012), e.g. regarding the public opinion of using child labor, unfair wages (Giannakis & Papadopoulos 2016), and contamination or degradation of natural resources (Jaffee et al. 2010). It also includes direct actions, such as labor strikes or disputes (Cagliano et al. 2012; Jaffee et al. 2010), boycotts (Giannakis & Papadopoulos 2016), and other social riots (Tchankova 2002).

2.2.1.2 Network risks

Network risks are not linked to individual suppliers but rather considers a specific section of a company's supply chain (e.g. the supply chain for a specific component). In Jüttner et al.'s (2003) classification, network-related risk sources relate to the structure, flow, operational dynamics, and

complexities of the supply network. It is thus a relatively holistic risk category, as the risks are related to general supply chain or market characteristics. In this thesis, the authors have categorized network risks into the following two sub-categories: (1) supply market and (2) network behavior. An overview of these were derived from literature is shown in Table 2.3.

Table 2.3: Network supply risks identified in literature review.

Network risks			
Code	**Risk types**	**Risk factors**	**References**
NNB	Network behavior	(1) Chaos in system; (2) Opportunistic behavior; (3) Lack of ownership; (4) Supply chain inertia	Bachev (2012); Jüttner et al. (2003); Yeboah et al. (2014)
NSM	Supply market	(1) Production/capacity constraints on supplier market; (2) Limited available suppliers; (3) Market failures; (4) Commodity price fluctuations; (5) Geographic concentration of suppliers	Bachev (2012); Cagliano et al. (2012); Giannakis & Papadopoulos (2016); Jaffee et al. (2010); Jüttner et al. (2003); Wu et al. (2006); Yeboah et al. (2014); Zhao et al. (2020); Zsidisin (2003a); Zsidisin (2003b)

2.2.1.2.1 Network behavior

Network behavior risks are consequences of the way the supply chain partners interact and behave towards each other, and towards a changing environment. One concrete example is mentioned by Yeboah et al. (2014), who highlight the danger of chaos in the system, e.g. in the form of the bullwhip effect. As mentioned by van Ackere, Larsen, and Morecroft (1993), the bullwhip effect leads to increased demand volatility in the upstream supply chain and is caused by e.g. lack of information sharing. The consequences can be an overall sub-optimal supply chain (e.g. in the form of stockouts), where all actors try to maximize their performance with limited understanding of the overall situation (van Ackere et al. 1993). Another mentioned risk is opportunistic behavior among the supply chain actors, e.g. in the form of adverse selection and moral hazard (Bachev 2012). The root cause for opportunistic behavior can be an overall discontent in the supply chain (e.g. due to misaligned incentives and incongruent strategic objectives).[1]

Another risk source mentioned by Jüttner et al. (2003) is the lack of ownership in supply chains which emerges from the blurring of boundaries between the supplying and the buying actors. Trends such as outsourcing and the increased use of third-party services have contributed to this complexity and risk source. The risk can often lead to increased inventory costs due to stockouts, markdowns, or product obsolescence. Jüttner et al. (2003) also mention supply chain inertia risks, referring to the lack of responsiveness to environmental changes and market signals. In global supply chains, it is common to sacrifice flexibility for a cost reduction. This can lead to the inability to respond to unpredicted events related to organizational or environmental risks, e.g. shift in customer demand or aggressive competitor moves.

[1] The interested reader is referred to Simatupang and Sridharan (2005) for a more in-depth discussion regarding the topic.

2.2.1.2.2 Supply market

This category relates to the general characteristics of the supply market for a certain product or component. One example is general capacity constraints on the supply market, causing a mismatch between supply and demand (Yeboah et al. 2014). Another example is the risk of having limited suppliers available for a certain product (Zsidisin 2003a; Zsidisin 2003b), e.g. in the form of monopolistic or oligopolistic markets. Furthermore, supply market risks also consider general market price fluctuations which affect the entire supply market (Wu et al. 2006; Jaffee et al. 2010). Other examples are general market failures (Bachev 2012), underlying commodity price volatility (e.g. fuel and energy costs) (Giannakis & Papadopoulos 2016; Yeboah et al. 2014; Zhao et al. 2020; Cagliano et al. 2012), and changes in general requirements regarding e.g. food safety (Jaffee et al. 2010). Lastly, Zsidisin (2003a) highlights the risk of having too geographically concentrated suppliers for a certain product, which means any aerial incidents (e.g. caused by extreme weather or a natural disaster) could affect the entire supply market.

2.2.1.3 Supplier risks

Supplier risks are defined as risks linked to specific suppliers and is thus the least holistic category. The authors have categorized supplier risks into the following ten sub-categories: (1) commercial, (2) corporate fit, (3) financial, (4) legal, (5) logistical, (6) operational, (7) quality, (8) security, (9) sustainability, and (10) technology. An overview of these were derived from literature is shown in Table 2.4.

Table 2.4: Supplier supply risks identified in literature review.

Supplier risks			
Code	**Risk types**	**Risk factors**	**References**
SCO	Commercial	(1) Supplier-specific price escalations	Zsidisin (2003b)
SCF	Corporate fit	(1) Cultural differences; (2) Poor communication; (3) Reluctance to share information; (4) Poor alignment and coordination; (5) Relationship issues	Adhitya et al. (2009); Cagliano et al. (2012); Zhao et al. (2020); Zsidisin (2003a)
SFI	Financial	(1) Supplier's financial health; (2) Credit risk; (3) Tax evasion	Tchankova (2002); Wu et al. (2006); Yeboah et al. (2014); Zhao et al. (2020); Zsidisin (2003b)
SLE	Legal	(1) Contracts and agreements regarding liability; (2) Bribery; (3) False claims; (4) Patent infringements; (5) Antitrust claims; (6) Price fixing accusations	Giannakis & Papadopoulos (2016); Zhao et al. (2020); Zsidisin (2003a); Zsidisin (2003b)
SLO	Logistical	(1) Delivery reliability issues; (2) Problem with unloading facilities	Adhitya et al. (2009); Wu et al. (2006); Yeboah et al. (2014); Zhao et al. (2020); Zsidisin (2003a); Zsidisin (2003b);
SOP	Operational	(1) Breakdown in equipment(s); (2) Improper product handling and storage; (3) Internal accidents; (4) Skills of workforce; (5) Poor forecasting, planning, and inventory management; (6) Supplier stockouts	Bachev (2012); Cagliano et al. (2012); Jaffee et al. (2010); Jüttner et al. (2003); Tchankova (2002); Wu et al. (2006); Zhao et al. (2020); Zsidisin (2003b);
SQU	Quality	(1) Product quality do not conform to specifications; (2) Lack of quality control	Bachev (2012); Jaffee et al. (2010); Wu et al. (2006); Yeboah et al. (2014); Zsidisin (2003a); Zsidisin (2003b)
SSE	Security	(1) Security breaches	Bachev (2012); Jaffee et al. (2010); Manuj & Mentzer (2008); Wu et al. (2006)
SSU	Sustainability	(1) Poor product material, design, and safety; (2) Contamination and degradation of resources; (4) Unhealthy, unsafe, and unhygienic working environment; (5) Excessive labor worktime; (6) Unfair wages; (7) Child labor; (8) Discrimination; (9) Exploitive hiring policies; (10) Unethical treatment of animals; (11) Biological risks	Bachev (2012); Giannakis & Papadopoulos (2016); Jaffee et al. (2010); Zsidisin (2003a); Zsidisin (2003b)
STE	Technology	(1) Incompatible IT/IS systems for information sharing; (2) Unreliable IT systems; (3) Unfinished transformation initiatives; (4) Inability to follow rapid technological development	Cagliano et al. (2012); Wu et al. (2006); Yeboah et al. (2014); Zhao et al. (2020); Zsidisin (2003b)

2.2.1.3.1 Commercial

Commercial risks are risks that are derived from the commercial decisions of specific suppliers. While there can be general market price fluctuations in a given supply market, there is also a risk from price escalations from individual suppliers (Zsidisin 2003b).

2.2.1.3.2 Corporate fit

This category considers risks that are related to how the company interacts with a specific supplier. One aspect of this is the cultural fit, as any cultural differences between companies is a potential risk source mentioned by Cagliano et al. (2012). Another risk source can be poor communication with the supplier causing misunderstanding (Adhitya et al. 2009), or a general reluctance of sharing information (Zhao et al. 2020). Further, Zhao et al. (2020) mention the risk of poor alignment in plans between actors, which can also be categorized as a corporate fit risk. To exemplify, they mention the risk of farmers having limited discussions and agreements on how much to produce to match the demand. Lastly, Zsidisin (2003a) highlights that general relationship issues can be a source of risk.

2.2.1.3.3 Financial

The next category relates to financial risks. One aspect of this considers the overall financial health of the supplier (Wu et al. 2006; Yeboah et al. 2014; Zsidisin 2003b). When doing business with suppliers with financial instability there is an inherent credit risk (Tchankova 2002), which is also exemplified by Zhao et al. (2020), who mention that due to poor financial situation some suppliers might not be able to cover their expenses. Lastly, Zhao et al. (2020) mention the risk of tax evasion from suppliers not paying their required taxes. They exemplify with some farmers who did not pay the required labor taxes as the control system was not strict enough.

2.2.1.3.4 Legal

In contrast to the macro legal risk factor, which takes a more holistic perspective, this factor considers the legal obligations between the focal company and its suppliers. In their article, Giannakis and Papadopoulos (2016) list several risks that can be considered as legal issues, such as patent infringement, antitrust claims, false claims, price-fixing accusations, and bribery. In addition, several authors discuss contractual and liability issues in general (Zsidisin 2003a; Zsidisin 2003b; Zhao et al. 2020).

2.2.1.3.5 Logistical

A logistical risk frequently mentioned is delivery service issues (Yeboah et al. 2014; Wu et al. 2006; Adhitya et al. 2009; Zsidisin 2003a; Zsidisin 2003b). In broad terms, this relates to delivering the right product, in the right quantity, at the right time (Yeboah et al. 2014). Some authors put emphasis on the timing aspect, and mention the risk of deliveries arriving either too early or too late (Wu et al. 2006; Adhitya et al. 2009; Yeboah et al. 2014), whereas others highlight the quantity aspect, as shipment inaccuracies can also be a major problem (Yeboah et al. 2014; Zsidisin 2003b). In addition, another mentioned logistical risk is potential problems with unloading facilities (Adhitya et al. 2009).

2.2.1.3.6 Operational

This risk factor relates to the operational aspect of the suppliers' business. As an example, Jaffee et al. (2010) mention the risk of breakdown in equipment, which can negatively harm the throughput capacity. A major sub-category among the operational risks considers internal accidents. To exemplify, both Wu et al. (2006) and Jüttner et al. (2003) mention the risk of fire accidents.[2] Moreover, internal accidents can also relate to employee safety (Wu et al. 2006) and other man-made accidents in general (Cagliano et al. 2012).

Other operational risks relate more to the general capabilities of the supplier. As an example, Tchankova (2002) explains that a lack of skills among the workforce can be a potential risk source. In this context, it is viewed as a lack of skills at a specific supplier site, but the same risk could of course also be considered as a general supply market risk if no suppliers are able to meet the demanded requirements. The implications of a workforce which lacks sufficient skills can e.g. be improper material handling and storage (Bachev 2012). At a managerial level, operational risks can also take the form of poorly executed forecasting, planning (Jaffe et al. 2010), and inventory management (Zsidisin 2003b), which might lead to stockout situations (Adhitya et al. 2009).

2.2.1.3.7 Quality

Several authors emphasize the risk of having suppliers that are not able to deliver products that meet the requirements demanded by the company (Wu et al. 2006; Yeboah et al. 2014; Zsidisin 2003a; Zsidisin 2003b). It is a severe risk source where the consequences can harm the company's reputation (Wu et al. 2006), and, in worst case, even make the end-product dangerous and threaten the lives of the end-customers (Zsidisin 2003a). Another quality risk of more proactive nature was highlighted by Jaffe et al. (2010), who mention a lack of (or flawed) quality control system at a supplier site can also be considered as a risk.

2.2.1.3.8 Security

Security risks are risks that relate to the threat caused by external criminal parties. Jaffee et al. (2010) define this risk category as threats to property and/or life. Wu et al. (2006) exemplify with piracy attacks from shipping using certain routes, whereas Bachev (2012) mentions the risk of general criminal intrusion.

2.2.1.3.9 Sustainability

Supplier sustainability issues can be categorized as being of either environmental or social nature. In terms of environmental risks, Zsidisin (2003b) states the risk of having a supplier who does not use appropriate product design and material. An example of this can be a supplier that uses excessive or unnecessary packaging (Giannakis & Papadopoulos 2016). Further, suppliers with excessive product waste can also be a risk source from an environmental perspective (Giannakis & Papadopoulos 2016). The general risk of suppliers that contaminate or degrade resources was also highlighted by Jaffee et al. (2010) and Bachev (2012).

[2] For the interested reader, a practical example of the impact a fire accident can have at a supplier site in Ericsson's supply chain is detailed by Norrman and Jansson (2004).

As the article by Giannakis and Papadopoulos (2016) is focused on social risks, they, unsurprisingly, mention several important aspects to consider in this category, including excessive labor worktime, having unfair wages, using child labor, discriminating employees, and using exploitive hiring policies in requirement.

2.2.1.3.10 Technology

Two major themes were observed in technology risks, either being related to IT/IS systems or more to the general technological maturity of the supplier. Relating to IT/IS systems, there is a need for compatibility between the company's and supplier's systems, which will otherwise serve as a potential risk source (Zsidisin 2003b). Several authors also highlighted the need for sophistication and reliability in these systems (Zsidisin 2003b; Yeboah et al. 2014; Jüttner et al. 2003; Cagliano et al. 2012). In terms of more general technology, a potential risk can be suppliers with a lack of responsiveness to the environment (referred to as *inertia* by Jütttner et al. 2003) who consequently lags behind major technological innovations and breakthroughs (Yeboah et al. 2014; Zhao et al. 2020).

2.2.2. Risk identification tools and techniques

According to Fan and Stevenson (2018), there exist numerous methods developed by researchers and practitioners for the purpose of identifying risks. While researchers typically favor analytically complex methods, practitioners tend to prefer methods that are simple and established (Fan & Stevenson 2018). In this section, nine risk identification methods with varying complexity will be briefly described, i.e. (1) supply chain mapping, (2) Kraljic matrix, (3) cause-effect diagrams, (4) FTA, (5) ETA, (6) SWOT analysis, (7) brainstorming, (8) supplier audits and scorecards, and (9) HACCP.

The tools were primarily selected from the articles by Garrido, Ruotolo, Ribeiro, and Naked (2011) and Jüttner (2005), where the practical usage of different identification tools was analyzed. To determine what tools to provide an in-depth description of in this literature review, the authors considered both the survey results and to what extent the tools also appear in other articles. Moreover, the authors also added two other tools, i.e. Kraljic matrix and HACCP. The Kraljic matrix was added as it, in the authors' opinion, is essential for general purchasing strategy which is closely related to SCRM/SRM. HACCP was added as the initial empirical findings indicated it to be widely used in practice by companies in the (agri)food industry.

2.2.2.1 Supply chain mapping

According to a survey by Jüttner (2005), 60 %[3] of companies include supply chain mapping in their risk management process. A supply chain map is a simplified representation of a supply chain, considering both entity relationships and flows, which intends to capture the essence of the environment it operates in (Barroso, Machado, & Cruz-Machado 2011). Developing a supply chain map that clearly shows suppliers, their contribution, and material flows can lead to more effective decision making (Barroso et al. 2011).

[3] 23 % of the surveyed companies include supply chain mapping in their risk analysis "Sometimes", whereas 37 % of the companies include it "Often/always".

In their article, Gardner and Cooper (2011) list several benefits companies can experience from mapping the supply chain. One benefit which is of particular relevance in the context of risk identification is the map's ability to "catalog and distribute key information for survival in a dynamic environment" (Gardner & Cooper 2011, p. 39). They continue by describing how a proper map can alert companies of problems in their supply chain, e.g. from having too few suppliers for critical components or improper waste handling of toxic goods. Nevertheless, while mapping the supply chain can guide the focus to potential risk areas in the supply chain, it will probably not identify concrete risks on its own. This viewpoint can also be observed in the SRM model developed by Harland, Brenchley, and Walker (2003), where mapping is included as an essential first step prior to commencing the actual risk identification.

Norrman and Jansson (2004) mention that supply chain mapping is also involved as the commencing activity in Ericsson's SRM process, which is conceptually visualized in Figure 2.2. They explain how Ericsson maps the upstream supply chain for all their products to verify the flows and identify critical parts and risk sources, such as specific product components or sites. To structure the process, each component is classified as either:

1. Two or more approved sources are used for the component (e.g. two or more suppliers, or one supplier with two or more sites)
2. The component is sourced from one approved supplier, with other approved sources available but not used
3. The component is sourced from one approved supplier, with other approved sources available but not used as required tools, equipment, and/or masks are not in place
4. The component is sourced from one supplier, with no other manufacturer available

Thereafter, they make a similar assessment on the business recovery time (BRT), i.e. assessing how long it would take to get deliveries from an alternative source[4].

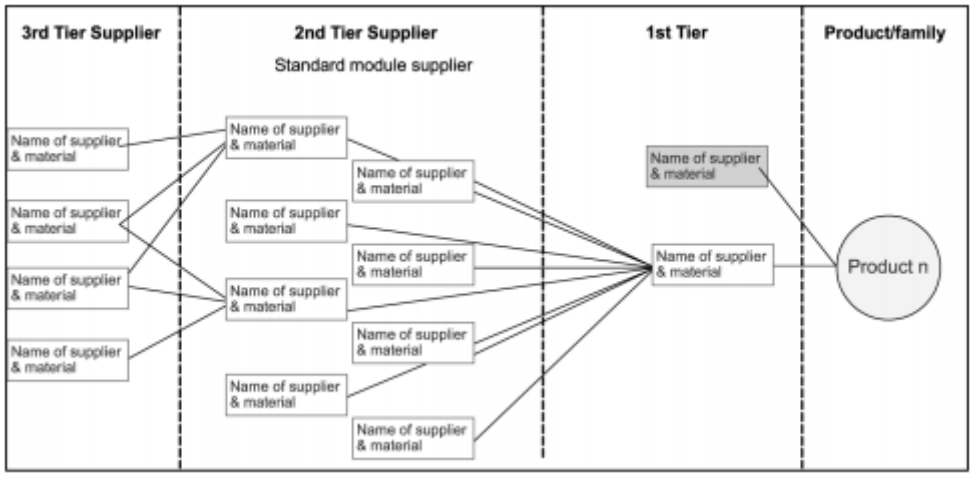

Figure 2.2: Conceptual example of how Ericsson maps their supply chain, from Norrman and Jansson (2004, p. 445).

[4] (1) It takes less than three months to get deliveries from an alternative source, (2) it takes three to eight months to get approval and deliveries from an alternative source, (3) it takes nine to 12 months, redesign unit/product being the only option, or (4) it takes more than 12 months, redesign unit/product of high complexity.

Furthermore, Norrman and Wieland (2020) describe how a supply chain map in the form of a graphical visualization can be helpful to identify risks. Ericsson has an internally developed online tool that integrates geo-mapping using Google Earth and a database including component, manufacturing, and supplier site data. By entering an incident's position, the tool can quickly generate a visual map with plants and offices at risk, which enables Ericsson to gain insights on potential risks and impacts on their products.

2.2.2.2 The Kraljic matrix

The purchasing portfolio matrix, or the Kraljic matrix, was developed by Kraljic (1983) and is used to develop purchasing strategies. The matrix can be used for both individual suppliers and products (van Weele 2014), and Kraljic (1983) argues there are primarily two factors determining what purchasing strategy to deploy: the strategic or financial importance of the purchase (e.g. in terms of raw material cost and added value from the component) and the complexity of the supply market (e.g. in terms of supply scarcity, number of available suppliers, and entry barriers). Based on these dimensions, van Weele (2014) defines four product types in the matrix, visualized in Figure 2.3: (1) leverage products, (2) strategic products, (3) routine products, and (4) bottleneck products.

For *leverage products*, with high financial importance but low supply risks, van Weele (2014) suggests implementing a strategy of competitive bidding between available suppliers, in an attempt to reduce the purchasing spend. Regarding *strategic products*, i.e. products with high financial importance and high supply risks, a strategy of building a long term performance-based partnership is proposed, due to the critical nature of the products and the high dependency on the limited available suppliers. Moreover, for *routine products*, with low importance and low supply risks, it is advocated to make the purchasing processes as simple and efficient as possible, e.g. through systems contracting and e-commerce solutions. Lastly, *bottleneck products* relate to products with low financial impact and high supply risks, and it is proposed to secure supply and actively search for alternative potential solutions of supply. (van Weele 2014)

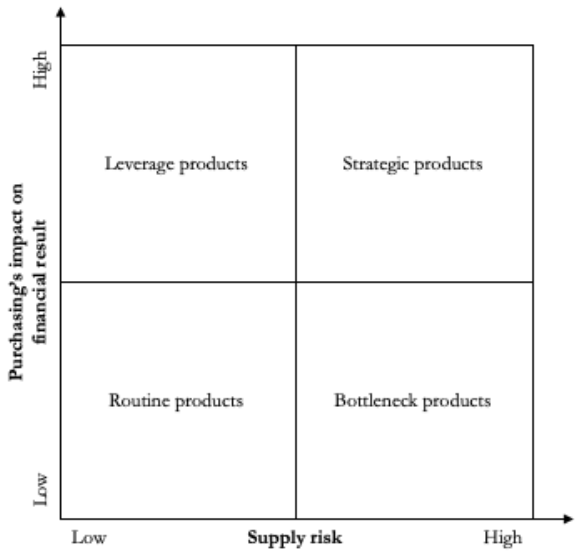

Figure 2.3: The Kraljic matrix, adapted from van Weele (2014, p. 164).

Although the matrix does not serve the purpose of identifying specific risks, the authors of this thesis argue that it can still provide a helpful overview of a company's supplier situation, and highlight where potential risks are more likely (e.g. among bottleneck products).

2.2.2.3 Cause-effect diagram

The cause-effect diagram, also known as the fishbone or Ishikawa diagram (Law 2016; Lin & Zhou 2011; Garrido et al. 2011), is one of few risk identification methods which is actively used by both practitioners and researchers (Fan & Stevenson 2018). A cause-effect diagram is designed to show the effects to the right and its causes to the left (Garrido et al. 2011). More specifically, the method starts with a specific problem (i.e. effect) and works its way back to identify a detailed list of potential root causes (Garrido et al. 2011). The following four steps are typically involved (Law 2016): (1) identifying the problem to be investigated, (2) identifying the main categories of potential causes, (3) identifying detailed causes for each category, and (4) illustrate causes and effects in diagram format to enable discussions and clarifications. An exemplifying cause-effect diagram for a generic problem is shown in Figure 3.7. Another practical example, applied in the specific context of supply chain risks, can be found in the article by Lin and Zhou (2011). In their application, they use a slightly more complicated diagram containing an additional level compared to Figure 2.4, showing the usefulness of the diagram when trying to identify "root cause risks" in a structured manner.

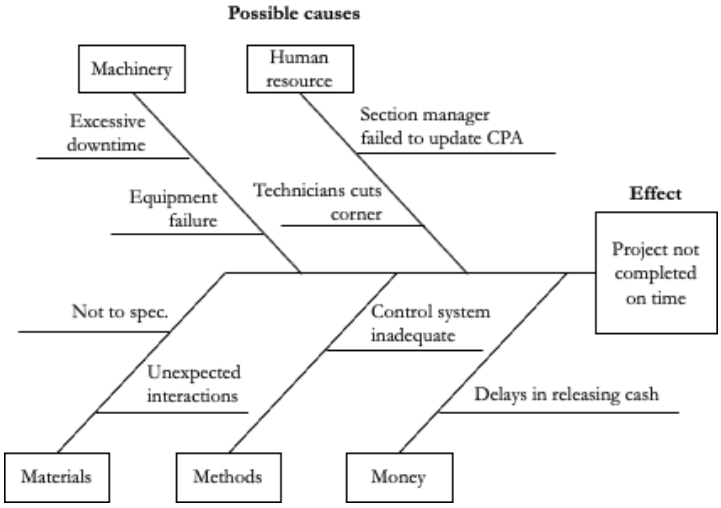

Figure 2.4: An example of how a cause-effect diagram can be applied to a generic problem, adapted from Law (2016, p. 104).

2.2.2.4 Fault tree analysis

Another risk identification tool is fault tree analysis (FTA) (Norrman & Jansson 2004)[5]. A fault tree is a graphical representation of how a specific event can occur in different ways (Hyun, Min, Choi, Park, & Lee 2015). The fault tree includes a top event, gates, sub-gates, and events, and the relationships between these elements are usually clarified with symbols using an AND or OR logic (Hyun et al. 2015). Based on a given top event, FTA uses deductive reasoning to systematically identify all possible sequential events which cause the top event to occur, separated by different

[5] The authors view FTA as a form of root cause identification, compared to Garrido et al.'s (2011) investigated tools.

branches (Hyun et al. 2015). Once the fault tree is constructed, the probability of the top event can be estimated by defining probabilities to all underlying components and use Boolean algebra (Hong, Lee, Shin, Nam, & Kong 2009). A conceptual illustration of a fault tree for underlying reasons for a dark room is illustrated in Figure 2.5.

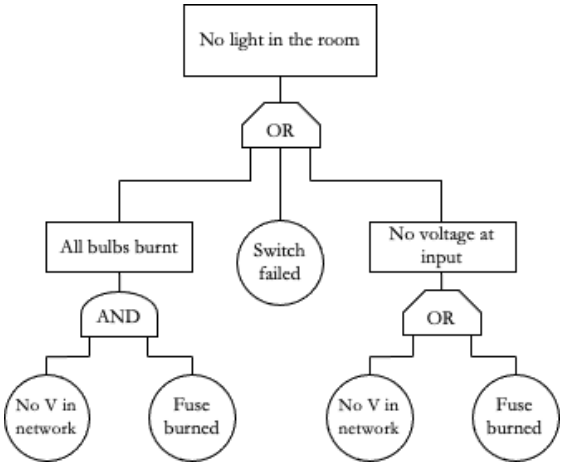

Figure 2.5: An example of how FTA can be used to understand the root causes of a dark room.

2.2.2.5 Event tree analysis

Event tree analysis (ETA) is another tool that can be used for the purpose of identifying risks (Norrman & Jansson 2004)[6]. The technique is focused on identifying the predicted sequential outcomes from a specific initial event, and the event tree includes an initiating event, probable sequent events, and final outcomes caused by specific sequences of events (Hong et al. 2009). Thus, in contrast to FTA, the method looks at potential outcomes based on an identified event rather than identifying its root causes. However, similarly to FTA, it is possible to assign probabilities to the elements in the tree to investigate the likelihood of certain events (Hong et al. 2009). A visualization of an event tree is presented in Figure 2.6.

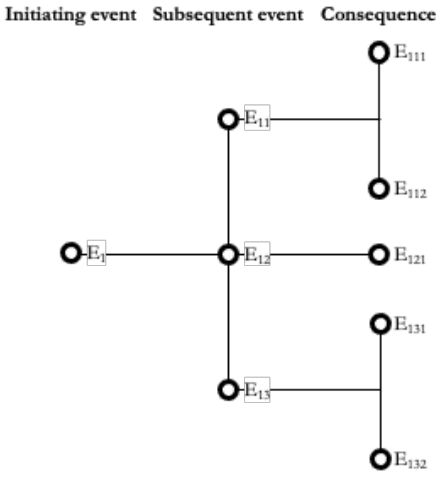

Figure 2.6: A conceptual overview of how ETA is used, adapted from Hong et al. (2009, p. 271).

[6] The authors view ETA as a form of scenario building/planning, compared to Garrido et al. (2011) and Jüttner's (2005) investigated tools.

2.2.2.6 SWOT analysis

SWOT is an abbreviation for strengths, weaknesses, opportunities, and threats, and is a strategic planning tool used to evaluate projects, businesses, or any other situation which involves decisions (Garrido et al. 2011). According to Garrido et al. (2011), the tool can also be used for the purpose of identifying risks. More concretely, each of the four areas of a business (or similar) is evaluated, and the analysis presented in matrix form with four quadrants, which is exemplified in Figure 2.7.

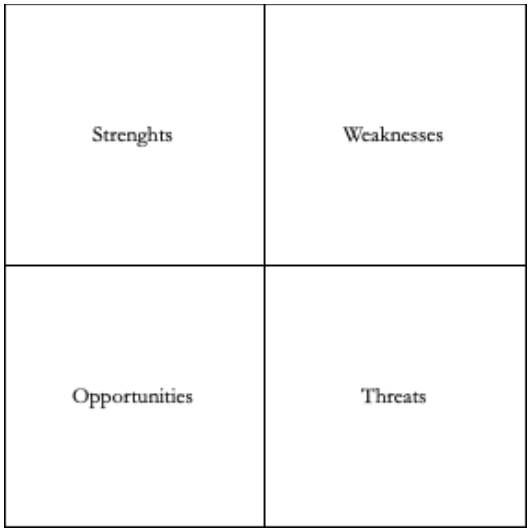

Figure 2.7: An illustration of the SWOT analysis in a matrix format, developed by the authors.

2.2.2.7 Brainstorming

Another method used in practice is brainstorming (Jüttner 2005), which is helpful to identify high-level risks (Coyle, Novack, & Gibson 2015). Garrido et al. (2011) argue that group brainstorming typically includes two phases. The first phase is referred to as the idea generation phase, where all participants are encouraged to generate as many potential risks as possible. The second phase is referred to as the idea selection phase, where all identified ideas are filtered to only include the risks which are commonly accepted by the group. Moreover, Garrido et al. (2011) mention the benefits of incorporating technology, such as the Internet, to transform traditional brainstorming into electronic brainstorming. As an example, electronic brainstorming can preserve anonymity, which means individual participants cannot influence and/or dominate the group solely on the basis of having more professional experience or belonging to a higher hierarchy level, which allows for an enhanced brainstorming exercise.

2.2.2.8 Supplier audits and scorecards

Another identification tool is the usage of supplier audits and scorecards. Although Kumar, Himes, and Kritzer (2014) state it as a risk mitigation tool, they also mention it as a useful way to gauge risks associated with specific suppliers. According to Kumar et al. (2014), the usage of audits and scorecards does not focus on risk disruptions in the macro-environment (e.g. disasters and political instability), but rather on supplier risks, such as financial performance and environmental practices of specific suppliers. Contrarily, Norrman and Jansson (2004) mention that audits can take many different risk sources into account, also including external environmental risk sources. Kumar et al. (2014) further propose conducting initial supplier audits, followed by continuously using scorecards to follow the progress.

A practical example of a supplier survey is discussed by Norrman and Wieland (2020), who mention how Ericsson uses a *secure supply survey* for their suppliers. The suppliers conduct self-assessments regarding their sites, their general supply chain capabilities, and code of conduct, which are summarized in a supplier risk card. The supplier risk cards are later being followed up with the suppliers, and potential warning signals granted further assessments and audits.

2.2.2.9 Hazard analysis and critical control point analysis

The National Food Administration (2005) describes Hazard analysis and critical control point analysis (HACCP) as a standardized method for systematically mapping, identifying, assessing, and controlling risks in the food industry, with the purpose of ensuring food safety towards the end-consumers. Companies operating in the food industry in the EU are legally required to use HACCP. The method is centered around the following seven principles: (1) conduct a hazard analysis, (2) identify the critical control points (CCPs), (3) establish critical limits, (4) monitor the CCPs, (5) establish corrective action, (6) verification, and (7) recordkeeping. Evidently, it does relate to all of the stages of SRM and not only the identification stage. Furthermore, to concretize the HACCP-principles and enable implementation, the following 12 steps are described by the National Food Administration (2005).

1. **Assemble the HACCP team:** The company should assemble a cross-scientific team that possesses the necessary product knowledge and expertise to develop an effective HACCP plan. If such expertise does not exist internally, they should leverage external advice from e.g. industry organizations, independent experts, authorities, and HACCP literature.
2. **Describe the product:** An extensive description including relevant safety information such as compositions, physical/chemical structure, treatments used to prevent microorganisms, packaging, expiration and storage characteristics, and distribution methods. It might be appropriate to group products according to their overall characteristics.
3. **Identify the intended use and customers:** The intended users among the end-consumers are identified.
4. **Construct flow diagram to describe the process:** A flow diagram of all stages the product passes through in production is developed. For product groups with similar flows, the same flow diagram can be used.
5. **On-site confirmation of flow diagram:** The flow diagram is validated with a person with necessary knowledge of the production process conditions.
6. **Conduct a hazard analysis (Principle 1):** First, the HACCP group identifies all relevant risks that might occur during the production process, based on the flow diagram. The following four risk categories are considered: (1) microbiological, (2) chemical, (3) physical, and (4) allergens. Next, a risk assessment is conducted, considering aspects such as the probability of occurrence and potential safety impact (compare with the risk assessment matrix discussed in section 2.2.2.1).
7. **Determine the CCPs (Principle 2):** In order to determine what processes should be considered as critical (i.e. CCPs), it is advocated to use a decision tree as visualized in Figure 2.8.

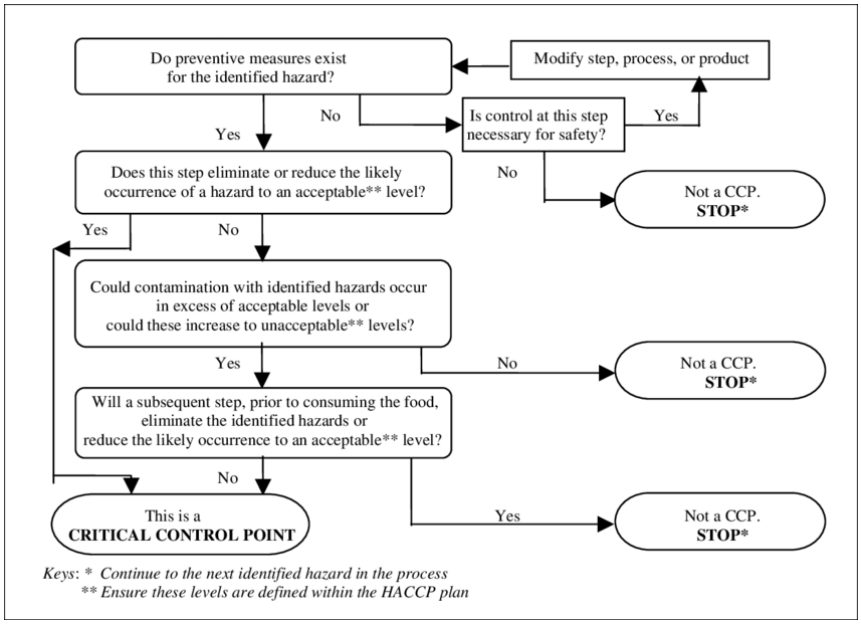

Figure 2.8: A decision tree to help identify CCPs, adapted from Nathai-Balkissoon and Arumugadasan (2005, p. 34).

8. **Establish the critical limits for each CCP (Principle 3):** Critical limits are defined for each CCP, often including aspects such as temperature, moisture content, pH, water activity, and sensory parameters. It is important that the critical limits are measurable, to enable monitoring.
9. **Establish a monitoring system for each CCP (Principle 4):** The monitoring system should contain scheduled measurements or observations of the CCP to detect potential risks of lost control. Ideally, the monitoring should provide information in sufficient time to enable corrective actions before the critical limits are reached.
10. **Establish corrective actions (Principle 5):** Corrective actions must be developed for each CCP, to pursue once the monitoring system identifies deviations.
11. **Establish verification procedures (Principle 6):** Verifications, routines, and testings should be pursued to ensure that the HACCP system functions as desired.
12. **Establish documentation and recordkeeping (Principle 7):** Effective and thorough documentation is essential when implementing HACCP. Some examples of activities that require documentation are the hazard analysis, the defined CCPs, and critical limits.

2.3 Risk assessment

The main purpose of the risk assessment step is to determine the criticality of the identified risks and prioritize risks that require additional attention (Manuj & Mentzer 2008). Bailey, Barriball, Dey, and Sankur (2019) emphasize the importance of having a consistent methodology that is applied to all identified risks. This allows for prioritization and enables an understanding of the products and value chain nodes with highest risks.

After reviewing ten articles on the subject, Kern et al. (2012) conclude that almost every definition of risk assessment contains one element of the probabilistic likelihood of occurrence and another element of potential business impact. Kern et al. (2012) further mention the generalizability of the

risk assessment methods, stating there is no difference in assessment upstream supply risks versus more general supply chain risks. Thus, all SCRM assessment methods should be relevant in the SRM context as well.

According to Coyle et al. (2015), risk assessment techniques can be of either qualitative or quantitative nature. However, in a survey including 21 respondents, Rangel and Leite (2015) investigated the nature of risk assessment approaches, which concluded that mainly qualitative assessment methods are used in practice. Moreover, the outcome of the assessment is typically on risk level, rather than supplier or supply chain level (Rangel & Leite 2015). Similar results were found by Jüttner (2005, p. 128), who noted that "all traditional risk assessment processes/tools are being adopted more widely than the supply chain-specific processes", and that there is a "trend towards the less formalized and "softer" tools".

Next, five assessment methods of varying complexity and nature will be explained in more detail: (1) risk assessment matrix, (2) Delphi technique, (3) failure modes and effects analysis, (4) analytical hierarchy processes, and (5) Ericsson's assessment and risk management tool. Method (1) was selected as several authors mention it being the most popular ones in both practice and theory (e.g. Coyle et al. 2015). Method (2) was chosen as it is a good example of a structured qualitative assessment methodology, which, as previously mentioned, is being practically preferred ahead of quantitative ones. Method (3) and (4) were chosen as it appears to be the most popular quantitative tools, based on the review provided by Trần, Dobrovnik, and Kummer (2018). Lastly, method (5) was included as it provides the perspective of how a best-in-class company works with risk assessment.

2.3.1 Risk assessment matrix

One of the simpler tools used is the risk assessment matrix. Fan and Stevenson (2018), who refers to the matrix as the "probability-impact matrix", concludes that it is the most popular method by both researchers and practitioners. Several variations of the matrix can be identified in literature. One such example is found in Manuj and Mentzer's (2008) article, who mentions that risks can be assessed in terms of severity (insignificant, minor, serious, or catastrophic) and probability (very unlikely, improbable, probable, or very probable). Another application of the risk assessment matrix is described by Coyle et al. (2015). They suggest that knowledgeable persons within the company should assess each risk (as either low, medium, or high) in both dimensions. This provides an overview and categorization of the identified risks as being either minor, moderate, or major, and can thus serve as a prioritization tool for subsequent steps of the risk management process. An example of an assessment in the transportation industry is shown in Figure 2.9, in which the risks of packaging failures, theft, and unauthorized channels were shown to be especially critical.

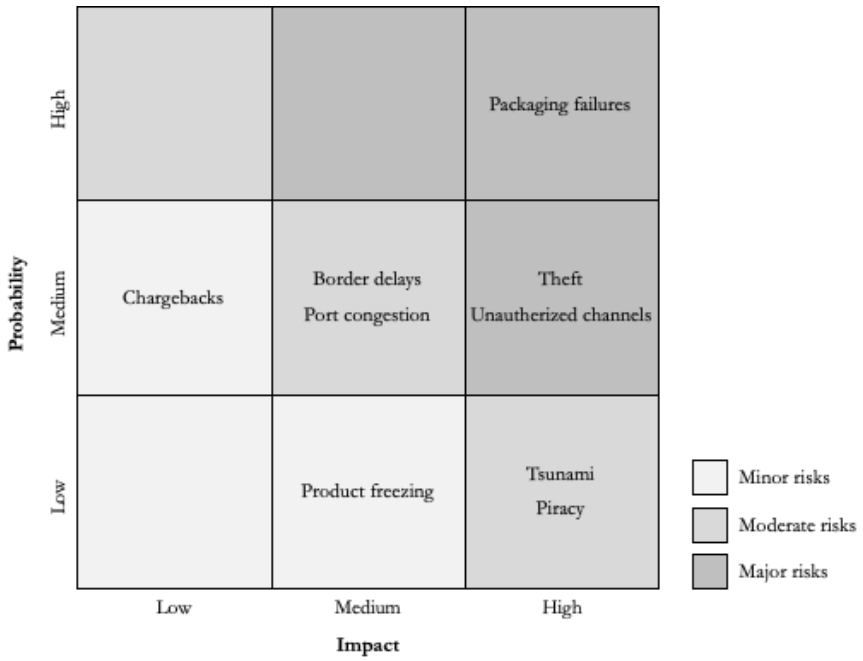

Figure 2.9: A practical example of how the risk assessment matrix can be used in the transportation industry, adapted from Coyle et al. (2015, p. 307).

2.3.2 Delphi technique

Delphi is a technique that is used to build reliable consensus among a group of experts (Garrido et al. 2011; Okoli & Pawlowski 2004). Garrido et al. (2011) mention it as a tool used in practical risk management and that the technique uses questionnaires to systematically gather information from physically isolated participants. The technique also utilizes feedback derived from previous responses (Garrido et al. 2011) and allows participants to revise their views and responses based on this. One of the key benefits is that it avoids direct confrontations between experts, as this e.g. can lead to a tendency of defending one's standpoint once taken, and hasty formulations of preconceived notions (Okoli & Pawlowski 2004).

2.3.3 Failure modes and effects analysis

Failure modes and effects analysis, or FMEA, is a systematic procedure of a system to identify potential failures (i.e. risks), and their effects on the overall system performance (Zeng, Tam, & Tam 2010). In the context of the SRM process, it can thus be related to both risk identification and risk assessment.

A key element of FMEA is the concept of RPN, i.e. risk priority number (Zeng et al. 2010; Lo & Liou 2018). RPN is a risk measurement that is used to rank and prioritize the risks and is computed by multiplying Severity, Occurrence, and Detection (Zeng et al. 2010). *Severity* relates to the seriousness of the potential impact if a risk occurs, *Occurrence* considers the probability of a risk to occur, whereas the *Detection* variable is the probability that a certain risk will be detected (Zeng et al. 2010). Zeng et al. (2010) mention the 11-step approach below to conduct FMEA. However, mainly step (1), (7), (8), (9), and (10) considers risk assessment, as the others are more related to risk identification.

1. Define the scale table of Severity, Occurrence, and Detection
2. Study intent, purpose, goal, and objective of a product/process; generally, it is identified by interaction among components/process flow diagrams followed by a task analysis
3. Identify potential failures of product/process; this includes problems, concerns, and opportunity for improvement
4. Identify consequence of failures to other components/next processes, operation, customers, and government regulations
5. Identify potential root causes of potential failures
6. First level method/procedure to detect/prevent failures of product/process
7. Severity rating: rank the seriousness of the effect of the potential failures
8. Occurrence rating: estimation of the frequency for a potential cause of failures
9. Detection rating: likelihood of the process control to detect a specific root cause of a failure
10. RPN calculation: product of the three input ratings; Severity, Occurrence, and Detection
11. Correction. It may need to go back to Step (2) if necessary

In step (1), when defining the scale for Severity, Occurrence, and Detection, Zeng et al. (2010) use a five-point Likert type scale[7]. In step (7) - (9), they use input from employees at the case company, who rank each identified risk using the defined scale for all three variables. Thereafter, in step (10), they derive average variable values and subsequently compute the RPN for each risk to get an understanding of their relative importance.

2.3.4 Analytical hierarchy process

The analytical hierarchy process (AHP) was developed in the early 70s as a method to help decision-makers prioritize alternatives in a systematic manner (Hyun et al. 2015). In addition to risk decisions, it can also be used in areas such as supplier selection, facility location, forecasting, technology choices, and product design issues (Gaudenzi & Borghesi 2006). Once a list of risks has been identified, a quantitative evaluation of their relative importance is conducted (Gaudenzi & Borghesi 2006). In the article by Hyun et al. (2015), this is done in a matrix structure, where the relative importance between all risks are estimated between one and five. Thereafter, they use the Eigenvector method to derive the weighted value of each risk's importance, which can be used as a relative risk prioritization (Hyun et al. 2015).

2.3.5 Ericsson's assessment tools

One example of a more sophisticated assessment tool used at Ericsson, called Ericsson risk management evaluation tool (ERMET), is described by Norrman and Jansson (2004). The tool is mainly focused on operational risks and how to avoid business interruptions and is applied to both internal and external suppliers. ERMET considers many risk categories in detail, e.g. business control, financial issues, natural and man-made hazards in the surrounding, and business interruption handling. To use the tool, corporate risk managers, supply chain risk managers, and representatives from sourcing thoroughly go through potential risk areas in detail, based on data gathered together with the suppliers. They try to quantify the risk in terms of probability of

[7] To exemplify in the context of the severity variable, five would translate to a risk of highest potential severity, whereas one would be considered of having the least potential severity.

occurrence and potential business impact (similar to Mitchell's (1995, p. 116) risk definition). The output of this assessment is a spider web diagram, where current and forecasted positions are highlighted in each risk area, as illustrated in Figure 2.10. (Norrman & Jansson 2004)

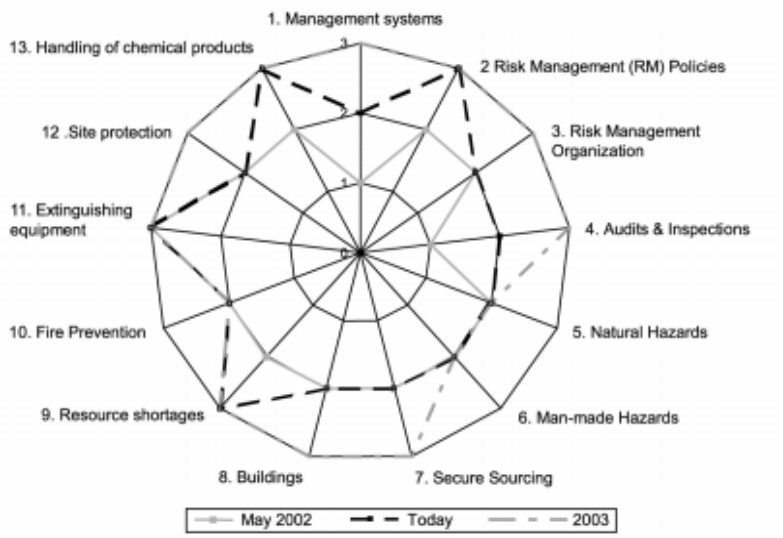

Figure 2.10: The spider web diagram used in ERMET, adapted from Norrman and Jansson (2004, p. 447).

Norrman and Jansson (2004) also mention that Ericsson previously tried to use a risk assessment matrix to map their risks and calculate risk values (probability times impact), but argue the lack of "understandability" of the risk value makes it difficult to use in practice. Therefore, they have instead developed a metric related to the financial impact on their business, called business interruption value (BIV). BIV is estimated by multiplying the gross margin with the business recovery time (BRT), and adding potential extra costs from e.g. idle capacity and inventory carrying. Based on the BIV, risks get classified as being either *severe* (>$100 M), *major* ($50 M - $100 M), *minor* ($10 M - $50 M), or *negligible* (<$10 M). Norrman and Wieland (2020) discuss that Ericsson still, at the time of their article, assesses BIV and BRT, while also including assessments of total maximum outage and components' recovery times. Furthermore, the company also leverages more sophisticated IS (information system) and overall more digitized and developed tools.

Moreover, Norrman and Wieland (2020) describe how the company, jointly with an external partner, has developed another survey tool known as Ericsson Blue. The tool is used to compare internal plants in terms of their risk management performance and is used on an annual basis. The tool contains detailed requirements, often rather technical ones such as how the sprinkler system in the plant is constructed. All factors are graded at four levels, and after a weighted average has been calculated the plants can be compared with each other.

2.4 Risk mitigation

Once the risks have been assessed and evaluated, the next step is to choose relevant strategies to manage the risks. Kern et al. (2012) describe risk mitigation as the step where the company addresses potential risks with the right countermeasures. Risk mitigation strategies are created with the purpose of reducing the probabilities of losses to an acceptable associated with risk events or

reduce the impact of the risk source (Manuj & Mentzer 2008; Adhitya et al. 2009; Norrman & Jansson 2004). Effective risk mitigation requires close collaboration between the supply chain actors and support from top management (Chen & Paulraj 2004; Kleindorfer & Saad 2009).

This section will be divided into two sections. First, a literature review of different mitigation strategies will be conducted. Thereafter, different considerations when choosing the appropriate mitigation action(s) will be presented.

2.4.1 Mitigation strategies

Classification of mitigation strategies differs between different authors. To exemplify, Jüttner et al. (2003) classify mitigation strategies into the following seven categories: (1) avoidance, (2) postponement, (3) speculation, (4) hedging, (5) control, (6) sharing/transferring, and (7) security. Another classification is proposed by Norrman and Jansson (2004), who use: (1) avoid, (2) reduce, (3) transfer, (4) share, and (5) accept. To create a similar categorization, the authors of this thesis reviewed 21 articles, from which five general overarching strategies (referred to as *mitigation strategies*) could be distinguished, namely: (1) avoid, (2) accept, (3) control, (4) reduce, and (5) transfer.

To *avoid* risk is equivalent to completely eliminating the type of event(s) which triggers a risk to occur (Norrman & Jansson 2004; Fan & Stevenson 2018). Risk *acceptance*, or a "do nothing strategy" as Kumar et al. (2014) phrases the concept, means to passively accept the risk with no mitigation action (Tomlin 2006). When *controlling* a risk, a company seeks to control the contingencies causing the risk rather than passively mitigating it (Jüttner et al. 2003). Risk *reduction* relates to actions that reduce the probability of occurrence and/or the potential impact of a certain risk (Norrman & Jansson 2004). Lastly, *transferring* a risk means to involve another external actor which absorbs the risk (Fan & Stevenson 2018), either fully or a proportion of it. A conceptual overview of the mitigation strategies is shown in Figure 2.11.

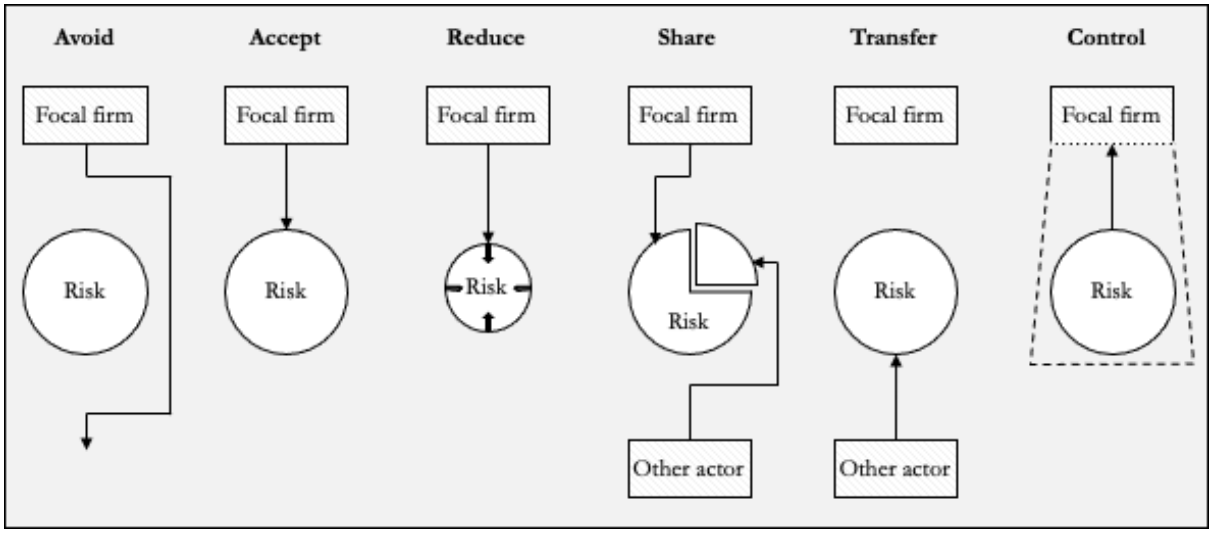

Figure 2.11: A conceptual overview of the risk mitigation strategies identified in literature, categorized by the authors.

In addition to the overarching mitigation strategies, eight concrete mitigation categories were identified: (1) accepting, (2) buffering, (3) collaborating, (4) contracting, (5) network designing, (6) planning, (7) securing, and (8) standardizing. Note that there is no direct relationship between the strategies and categories. While some categories are clearly linked to single, specific strategies, other categories are incorporating the logic of several strategies. In this section, each mitigation category will be elaborated in detail, with concrete actions on how it can be applied in practice, which is presented in Table 2.5-2.12.

2.4.1.1 Accepting

In the accepting category, only a single concrete action was identified, i.e. to simply *accept the risk* (ACC1). This can e.g. be the appropriate choice when the consequences of disruption are light, so it does not make any economic sense to invest in mitigating resources (Kumar et al. 2014). Another reason to accept a risk might be that the cost of mitigation is considered too high. The importance of finding the right trade-off between risk management cost and risk cost is e.g. discussed by Norrman and Jansson (2004). There are no general guidelines on what risks to accept, as Fan and Stevenson (2018) argue that the acceptable risk level is highly context-dependent. Naturally, this action is directly linked to the mitigation strategy *accepting*.

Table 2.5: Identified mitigation actions related to the accepting category.

Accepting actions			
Code	**Name**	**Description**	**References**
ACC1	Accept risk	"Do nothing strategy", to passively accept the risk with no mitigation strategy.	Fan & Stevenson (2018); Kumar et al. (2014); Norrman & Jansson (2004); Norrman & Lindroth (2004); Tomlin (2006)

2.4.1.2 Buffering

In the buffering category, two distinct actions can be observed. More specifically, to add buffers through either *excess inventory* (BUF1) or *excess capacity* (BUF2). To exemplify how buffer inventory can mitigate supply risks, Tomlin (2006) discuss Playmates Toys' decision to invest in additional inventory in early 2002. As a consequence, they were not impacted by the west-coast dock disruption later that year. In terms of buffering capacity, Rajesh, Ravi, and Rao (2015) mention how excess capacity can hedge against quick fluctuations in demand patterns. Both these actions are connected to the mitigation strategy of *reducing* risks.

Table 2.6: Identified mitigation actions related to the buffering category.

Buffering actions			
Code	**Name**	**Description**	**References**
BUF1	Excess inventory	Add extra inventory (e.g. by increasing safety stock levels) to reduce stockout risks.	Norrman & Jansson (2004); Jüttner et al. (2003); Oke & Gopalakrishnan (2009); Li & Gupati (2014); Stecke & Kumar (2009); Tang (2006); Tomlin (2006); Sharma & Bhat (2014); Zsidisin, Panelli, & Upton (2000); Chang, Ellinger, & Blackhurst (2015); Talluri, Kull, Yildiz, & Yoon (2013); Kumar et al. (2014); Chopra & Sodhi (2004); Norrman & Lindroth (2004); Manuj (2013)
BUF2	Excess capacity	Add excess capacity in production, storage, handling, and/or transport to make the company more flexible for unplanned changes.	Chang et al. (2015); Chopra & Sodhi (2004); Jüttner et al. (2003); Kleindorfer & Saad (2009); Rajesh et al. (2015); Sharma & Bhat (2014); Stecke & Kumar (2009); Talluri et al. (2013)

2.4.1.3 Collaborating

Relating to collaboration, several concrete actions were observed in the literature. The most frequently suggested action was to *share information* with the supply chain partners (COL1). One of the benefits of information sharing is that it reduces network risks, such as the bullwhip effect (Stecke & Kumar 2009). Moreover, as discussed by Tang (2006), the increased visibility from sharing information makes it easier for supply chain partners to coordinate their operations.

Given the impact suppliers have on companies' performance, some authors discuss *supplier development* as a way to mitigate certain risks (COL2). Sharma and Bhat (2014) argue that companies that invest in supplier development gain improvements in supply performance, especially for critical suppliers/components. As a concrete example, Oke and Gopalakrishnan (2009) mention that companies can implement quality management programs at supplier sites. Another mitigation action is to incorporate suppliers in the product design phase, which is referred to as *early supplier involvement* (COL3) and was suggested by both Sharma and Bhat (2014) and Manuj (2013). Moreover, Kumar et al. (2014) make a concrete suggestion to use *supplier audits and scorecards* to mitigate risks (COL4). This way, e.g. poor financial management and poor environmental performance can be identified (Kumar et al. 2014). Furthermore, *education of supply chain partners* can serve as another concrete mitigation action (COL5), e.g. mentioned by Norrman and Jansson (2004). Oke and Gopalakrishnan (2009) also discuss this concept in terms of the customer relationship, as the customer marketing decision can have serious effects on the company's short and medium-term demand.

Several authors discuss *coordinating with supply chain partners* as a way to mitigate risks (COL6). Kleindorfer and Saad (2009) further discuss the need for coordination from both an internal perspective (cross-functional coordination) and an intra-firm perspective. Lastly, *jointly develop mitigation strategies* with supply chain partners can also be viewed as a mitigation action (COL7). Zsidisin et al. (2000) discuss how companies can form alliance relationships to work together with risk mitigation, while Jüttner et al. (2003) mention the benefit of joint business continuity plans.

Most of the concrete collaboration actions are connected to the mitigation strategy of *reducing* risks. However, the usage of supplier audits can also be seen as a way to *avoid* certain risks, as it can warn the company before conducting business with a risky supplier.

Table 2.7: Identified mitigation actions related to the collaborating category.

Collaborating actions			
Code	**Name**	**Description**	**References**
COL1	Information sharing	Share key information with supply chain partners to increase visibility and enable more effective and efficient decision-making.	Chang et al. (2015); Chopra & Sodhi (2004); Faisal, Banwet, & Shankar (2006); Jüttner et al. (2003); Kleindorfer & Saad (2009); Li & Gupati (2014); Oke & Gopalakrishnan (2009); Rajesh et al. (2015); Sharma & Bhat (2014); Stecke & Kumar (2009); Talluri et al. (2013); Tang (2006); Zsidisin et al. (2000)
COL2	Supplier development	Invest in supplier development for critical suppliers/components to gain performance improvements.	Oke & Gopalakrishnan (2009); Sharma & Bhat (2014); Zsidisin et al. (2000)
COL3	Early supplier involvement	Include suppliers earlier in the product development process to avoid problems at later stages.	Manuj (2013); Sharma & Bhat (2014)
COL4	Supplier scorecard /audits	Use supplier audits and scorecards to gauge and monitor the development of supplier performance.	Kumar et al. (2014)
COL5	Supply chain partner education	Educate supply chain partners to make them aware of how their decisions have an impact on the overall supply chain.	Norrman & Jansson (2004); Oke & Gopalakrishnan (2009)
COL6	Supply chain coordination	Coordinate decisions and actions across company borders in the supply chain to improve overall supply chain performance.	Chang et al. (2015); Jüttner et al. (2003); Kleindorfer & Saad (2009); Oke & Gopalakrishnan (2009); Sharma & Bhat (2014); Stecke & Kumar (2009); Tang (2006)
COL7	Jointly developed mitigation strategies	Develop mitigation strategies jointly with supply chain partners to ensure alignment.	Jüttner et al. (2003); Zsidisin et al. (2000)

2.4.1.4 Contracting

Contracts and agreements are mentioned by several authors as mitigation which transfers parts of the risk to other actors. One concrete example is to share the risk with an *insurance* company (CON1). As an example, Fan and Stevenson (2018) mention how business interruptions risks can be transferred through business interruption insurances. Fan and Stevenson (2018) further argue that insurances are typically preferred for risks with small probability but large potential impacts, such as terrorism and natural disasters. A concrete example of how this kind of risk was mitigated using insurance was mentioned by Tomlin (2006), who claimed that Palm Inc. received $6.4 M in an insurance settlement after a fire at a supplier site.

Risks can also be transferred to supply chain partners using contracts. Both Norrman and Jansson (2004) and Fan and Stevenson (2018) mention *inventory liabilities* as one aspect which can be transferred (CON2). Furthermore, contracts can be used to enforce *delivery agreements* (Norrman & Jansson 2004), hence limiting the associated delivery reliability risk (CON3). Lastly, several authors discuss the usage of *dynamic contracts* to incentivize the desired behavior from the partners (CON4). The contract can either be dynamic to changes in the external environment (Manuj & Mentzer 2008) or have a more internal focus on the behavior of the involved actors, e.g. by having flexible quantity, a minimum order quantity, include a buyback option (Li & Gupati 2014), or including revenue sharing mechanisms (Faisal et al. 2006).

Chang et al. (2015) mention that currency fluctuation risk can be mitigated using *financial hedging/contracts* (CON5). Furthermore, Sharma and Bhat (2014) discuss *contract enforcement*, which specifies the parameters governing the buyer-supplier relationship, as a method of reducing transaction costs and supplier opportunism[8] (CON6). Lastly, Chopra and Sodhi (2004) mention *long-term contracts* to mitigate supplier price increases (CON7).

By definition, all of the discussed contracting actions are related to the mitigation strategy of *transferring* risks.

[8] I.e. when a supplier hides, steals, or distorts information in transactions.

Table 2.8: Identified mitigation actions related to the contracting category.

Contracting actions			
Code	**Name**	**Description**	**References**
CON1	Insurances	Use insurance contracts to transfer part of the risk to insurance companies.	Chang et al. (2015); Fan & Stevenson (2018); Manuj & Mentzer (2008); Norrman & Jansson (2004); Rajesh et al. (2015); Sharma & Bhat (2014); Stecke & Kumar (2009); Tang (2006); Tomlin (2006)
CON2	Inventory liabilities	Use contracts to transfer inventory liability to supply chain partners.	Fan & Stevenson (2018); Norrman & Jansson (2004)
CON3	Delivery agreements	Change delivery agreements to transfer part of the risk to supply chain partners.	Norrman & Jansson (2004)
CON4	Dynamic contracts	Make contracts dynamic to the external environment and behavior of the involved parties to share risk with the supply chain partners.	Fan & Stevenson (2018); Faisal et al. (2006); Li & Gupati (2014); Manuj & Mentzer (2008); Rajesh et al. (2015); Tang & Tomlin (2008); Tang (2006)
CON5	Financial hedging	Use financial contracts to mitigate currency fluctuation risk.	Chang et al. (2015)
CON6	Contract enforcement	Enforce contracts to reduce transaction costs and supplier opportunism.	Sharma & Bhat (2014)
CON7	Negotiate long-term contracts	Use long term contracts to mitigate price increases from suppliers.	Chopra & Sodhi (2004)

2.4.1.5 Network designing

Almost all of the reviewed articles mention the use of *multiple sourcing* as a mitigating action (NET1). As described by Li and Gupati (2014), having redundant sources of supply for the same components can serve as an effective way of dealing with supplier quality and reliability issues. Another related action is to use multiple, *geographically diversified suppliers* (NET2). Stecke and Kumar (2009) exemplify with the company Volkswagen, which has manufacturing in numerous countries, e.g. USA, Brazil, Mexico, and Germany. If one plant suffers from any disruption, they can simply switch some of the production capacity to other plants.[9] Another potential sourcing strategy discussed by e.g. Sharma and Bhat (2014) is to utilize *local sourcing* (NET3). As Jüttner et al. (2003) mention, the usage of local sourcing reduces lead times, which allows for improved supplier responsiveness.

As another mitigation action, some articles discuss certain supplier capabilities that companies should consider in their supplier selection process. Faisal et al. (2006) are some of several authors

[9] In other words, the mitigation strategy deployed by Volkswagen also requires an element of buffering through *excess capacity* (BUF2).

who argue that *choosing responsive suppliers* is one potential risk mitigation action companies could pursue (NET4). Moreover, Chopra and Sodhi (2004) mention that companies should consider the *creditworthiness of the suppliers* they conduct business with (NET5).

Furthermore, Manuj and Mentzer (2008) describe *outsourcing and offshoring* of activities as a way to transfer the control of risk to other supply chain partners (NET6). In contrast to outsourcing, several articles mention the concept of *vertical integration* as a means to take control of a supplier and their inherent risks (NET7). Evidently, vertical integration is strongly connected to the mitigation strategy *control*, and can in a sense be viewed as the opposite of outsourcing. Tang (2006) mentions some examples of companies that utilize a combination of the two concepts in make-buy strategies that offer them flexibility. As an example, HP used to make a proportion of their DeskJet printers at an outsourced facility in Singapore, while the remaining proportion was produced in house.

To *strategically choose the stocking points* in the supply chain network is proposed by some authors as another mitigation action (NET8). According to Tang (2006), this is preferred over increasing the general inventory levels of all stocking locations in the network due to the high cost of obsolescence and holding inventory.

Lastly, some authors discuss how a *flexible transportation* network can help mitigate certain supply risks (NET9). A concrete company example is discussed by Tomlin (2006) who mentions that New Balance was able to mitigate the west-coast dock disruption by changing their transport mode from ships to airfreight. Relating to transportation risks, Kumar et al. (2014) propose three generic mitigation actions: using multimodal transports, multicarrier transportation, and multiple routes.

The discussed mitigation actions relate to several of the mitigation strategies. To exemplify, local sourcing can be viewed as a way to *avoid* the risk of currency fluctuations. Further, sourcing from multiple suppliers hedges the company against delivery reliability issues, thus *reducing* the risk. Moreover, as already discussed, vertical integration relates to risk *control*, while outsourcing is more related to risk *transfer*.

Table 2.9: Identified mitigation actions related to the network design category.

Network designing actions			
Code	**Name**	**Description**	**References**
NET1	Multiple sourcing	Use multiple sourcing to hedge against risks from individual supplier performance.	Chang et al. (2015); Jüttner et al. (2003); Kleindorfer & Saad (2009); Kumar et al. (2014); Li & Gulati (2014); Manuj & Mentzer (2008); Manuj (2013); Norrman & Jansson (2004); Norrman & Lindroth (2004); Oke & Gopalakrishnan (2009); Rajesh et al. (2015); Sharma & Bhat (2014); Stecke & Kumar (2009); Talluri et al. (2013); Tang & Tomlin (2008); Tang (2006); Tomlin (2006); Zsidisin et al. (2000)
NET2	Geographically diversified sourcing	Use a geographically diversified sourcing network to hedge against location-specific risks.	Kumar et al. (2014); Manuj & Mentzer (2008); Sharma & Bhat (2014); Tang & Tomlin (2008); Tomlin (2006)
NET3	Local sourcing	Use local sourcing to e.g. minimize lead time risks.	Jüttner et al. (2003); Sharma & Bhat (2014)
NET4	Source from responsive suppliers	Source from responsive suppliers to maintain flexibility.	Faisal et al. (2006); Kleindorfer & Saad (2009); Oke & Gopalakrishnan (2009); Rajesh et al. (2015)
NET5	Source from creditworthy suppliers	Source from creditworthy suppliers to ensure the financial performance of suppliers.	Chopra & Sodhi (2004)
NET6	Outsourcing and offshoring	Outsource/offshore non-critical activities to transfer the risk to supply chain partners.	Manuj & Mentzer (2008); Norrman & Jansson (2004); Norrman & Lindroth (2004); Tang (2006)
NET7	Vertical integration	Take control over critical suppliers/activities to control the risk.	Chopra & Sodhi (2004); Jüttner et al. (2003); Kumar et al. (2014); Manuj & Mentzer (2008); Manuj (2013); Sharma & Bhat (2014); Tang (2006)
NET8	Choose strategic stocking locations	Locate the inventories wisely to minimize costs and increase service level.	Chopra & Sodhi (2004); Rajesh et al. (2015); Tang (2006)
NET9	Flexible transportation	Have a flexible transportation network, using multiple modes, carriers, and routes, to avoid mode/carrier/route specific risks.	Kumar et al. (2014); Kumar (2009); Li & Gupati (2014); Stecke & Rajesh et al. (2015); Tang (2006); Tomlin (2006)

2.4.1.6 Planning

One planning action described by several authors is the usage of *postponement* (PLA1), which refers to delaying the commitment of resources and costs to enhance the flexibility of a company (Manuj & Mentzer 2008). Jüttner et al. (2003) describe how postponement of decisions related to e.g. configuration, labeling, and transportation to particular destinations can reduce the company's dependence on forecasts and make them more flexible to demand variability. *Speculation* is sometimes referred to as the opposite of postponement and instead relates to the company acting

in anticipation of expected demand (Manuj & Mentzer 2008) (PLA2). A concrete example of this can be to focus the customer-service resources on products or services which are considered to constitute a company's competitive advantage (Manuj & Mentzer 2008).

Several authors discuss how *promotional and pricing activities* can be used to incentivize customers to act in the desired way (PLA3). To exemplify, both Tang (2006), Kumar et al. (2014), and Stecke and Kumar (2009) describe how Dell was able to influence the customer demand during the Taiwan earthquake 1999, which negatively impacted their supply availability. By using price mechanisms, Dell was able to steer the customer demand to the products they were still able to produce. In addition, pricing is not only useful for steering customer demands, as Chopra and Sodhi (2004) discuss how pricing and incentives can be used to mitigate network risks such as the bullwhip effect.

Another aspect of the planning category relates to decisions relating to the product assortment, i.e. *assortment planning* (PLA4). Tang (2006) refers to a previously conducted study where it was shown how retailers in the US were able to manipulate customers' buying decisions by e.g. reconfiguring products on display and their location in the store. This knowledge can be used to mitigate supply availability risks by steering away customer demand to other products (Tang 2006). Kumar et al. (2014), who refers to Tang's (2006) article, argues this is mainly applicable for companies that produce substitutable products. Another concrete planning action that can mitigate risks is known as *silent product rollover* (PLA5), which refers to "silently" introducing new products to the market without any formal announcement (Tang 2006). This way, customers are not as informed about the unique product features and less likely to desire specific products, and consequently, purchase what is available in-store (Tang 2006).

Some articles touch upon the topic of *aligning supply and demand* to mitigate supply risks (PLA6). As a concrete example, Oke and Gopalakrishnan (2009) mention how imports from Chinese suppliers every year are affected by a six-week shutdown, effectively causing a supply-demand mismatch during the period. However, by proactively planning for this event, companies can order the suppliers to build buffer inventory to cover the demand during the period (Oke & Gopalakrishnan 2009). Another aspect discussed by several authors is how an *improved forecasting* process can mitigate certain risks (PLA7). Concrete examples include CPFR[10] (Chang et al. 2015) and CRP[11] (Chopra & Sodhi 2004), where the forecasting accuracy is improved by incorporating other supply chain actors into the process. Oke and Gopalakrishnan (2009) further mention that the forecast can be improved by collaborating with retailers to incorporate any planned promotional activities.

Lastly, Oke and Gopalakrishnan (2009) and Sharma and Bhat (2014) mention that *contingency plans* should be developed to better prepare companies for certain incidents (PLA8). Contingency planning is also discussed by Norrman and Jansson (2004) as a part of a company's business continuity management to handle risks in general.

[10] Collaborative planning, forecasting, and replenishment.

[11] Continuous replenishment program.

Most of the discussed actions are primarily related to the mitigation strategy of *reducing* risks. However, certain aspects of assortment planning can also be related to risk *avoidance*, e.g. by removing certain risky products from the assortment to avoid the risk.

Table 2.10: Identified mitigation actions related to the planning category.

Planning actions			
Code	**Name**	**Description**	**References**
PLA1	Postponing	Delay actual commitment of resources and costs to maintain flexibility.	Chopra & Sodhi (2004); Jüttner et al. (2003); Kleindorfer & Saad (2009); Kumar et al. (2014); Li & Gupati (2014); Manuj & Mentzer (2008); Manuj (2013); Rajesh et al. (2015); Sharma & Bhat (2014); Stecke & Kumar (2009); Tang & Tomlin (2008); Tang (2006)
PLA2	Speculating	Take decisions based on anticipated customer demand to be better prepared.	Manuj & Mentzer (2008); Manuj (2013)
PLA3	Pricing and promotion planning	Incentivize customers to act in ways using pricing and promotions to limit supply risks of certain components and products.	Chopra & Sodhi (2004); Kumar et al. (2014); Li & Gupati (2014); Oke & Gopalakrishnan (2009); Rajesh et al. (2015); Tang & Tomlin (2008); Tang (2006)
PLA4	Assortment planning	Make assortment decisions with supply situation in mind to limit supply risks of certain components and products.	Jüttner et al. (2003); Kumar et al. (2014); Manuj & Mentzer (2008); Oke & Gopalakrishnan (2009); Rajesh et al. (2015); Stecke & Kumar (2009); Tang (2006)
PLA5	Silent product rollover	Avoid informing customers about new product launches to avoid specific product demand.	Rajesh et al. (2015); Sharma & Bhat (2014); Tang (2006)
PLA6	Supply-demand synchronization	Make supply and demand decisions jointly to avoid supply-demand-mismatch.	Oke & Gopalakrishnan (2009); Sharma & Bhat (2014); Stecke & Kumar (2009)
PLA7	Improved forecasting	Improve forecasting techniques to allow for better decision-making.	Chang et al. (2015); Chopra & Sodhi (2004); Faisal et al. (2006); Oke & Gopalakrishnan (2009)
PLA8	Develop contingency /security plans	Develop contingency/security plans to be better prepared and facilitate the recovery.	Norrman & Jansson (2004); Oke & Gopalakrishnan (2009); Sharma & Bhat (2014)

2.4.1.7 Securing

The mitigations actions described in this section are all aimed to mitigate security risks. First of all, Faisal et al. (2006) discuss the need to *improve the company's data security* to mitigate the risk of any data or information losses to external parties (SEC1). Furthermore, several authors discuss the need to *improve the routines by which companies inspect goods,* with many highlighting the benefits of incorporating new technology into the process (SEC2). Kleindorfer and Saad (2009) mention that RFID technology can both enhance security and reduce operating costs in the cargo ship industry.

Similarly, Tang (2006) describes the Container Security Initiative, which was launched by the US Customs in 2002 to leverage new technology for the purpose of identifying and screening high-risk containers.

Lastly, Stecke and Kumar (2009) argue that one way of mitigating security risks is to *select "safe locations"*, as the probability of security risks are more related to certain areas and locations (SEC3). As an example, they mention that Morgan Stanley considered the World Trade Center being too vulnerable to terrorism threats after the 1993 bombings, and consequently moved their operations outside of the building. In hindsight, this strategic choice saved the company from the 9/11 attack in 2001 (Stecke & Kumar 2009). This mitigation action is not limited to physical locations, as Chopra and Sodhi (2004) mention that companies should limit the flow of new intellectual property to countries with weak legal protections to ensure data security.

The described actions are primarily related to *reduce* and *avoid*, depending on the specific circumstances of the mitigation actions.

Table 2.11: Identified mitigation actions related to the securing category.

Securing actions			
Code	**Name**	**Description**	**References**
SEC1	Improve data security	Improve data security to protect against data and information losses from external threats.	Faisal et al. (2006)
SEC2	Improve inspection routines of goods	Improve inspection routines to easier identify security threats.	Kleindorfer & Saad (2009); Manuj & Mentzer (2008); Tang & Tomlin (2008); Tang (2006)
SEC3	Avoid risky locations	Avoid risky locations when choosing locations of suppliers, warehouses, offices, and information to avoid location-specific risks.	Chopra & Sodhi (2004); Stecke & Kumar (2009)

2.4.1.8 Standardizing

Some authors discuss how *standardized processes* can be utilized to mitigate certain risks (STA1). As an example, Stecke and Kumar (2009) and Li and Gupati (2014) describe how standardized and well-documented processes can enable relocation of employees if a specific facility is disrupted. Furthermore, Rajesh et al. (2015), mention that *standardization of products* can be applied in production and that using interchangeable product assemblies is beneficial (STA2). Related to this, Manuj (2013) mentions standardization of components and encourages the usage of common parts across products and brands in the product design. As a practical case example, Manuj (2013) mentions that a beauty product company was able to reduce cost, supplier capacity risk, inventory risk, and stockout risks by using *common* bottles rather than *similar* bottles in their product design.

The described actions are mainly connected to risk *reduction*, but standardization of components can also be viewed as *avoiding* certain component-specific risks.

Table 2.12: Identified mitigation actions related to the standardizing category.

Standardizing actions			
Code	**Name**	**Description**	**References**
STA1	Standardize processes	Standardize processes to remove complexity and allow more flexibility in operations.	Li & Gupati (2014); Stecke & Kumar (2009); Tang & Tomlin (2008)
STA2	Standardize products and components	Standardize products and components to remove complexity and allow more flexibility in operations.	Rajesh et al. (2015)

2.4.2 Choosing appropriate mitigation actions

Tang (2006) argues that companies are not limited to choosing a single mitigation action and that there in many circumstances might be appropriate to apply multiple actions to managing a single risk. Two aspects to consider when choosing appropriate mitigation actions are cost versus benefit and strategic fit (Tang 2006).

2.4.2.1 Cost versus benefit

Tang (2006) explains how the cost for a mitigation action can be seen as an insurance premium to safeguard the supply chain from major disruptions. Conceptually, the cost of this insurance could be compared to the "return" of the insurance premium to evaluate whether a mitigation approach is worth proceeding. However, it is difficult to evaluate the return of an insurance premium, especially if reliable data is not available (e.g. probability of disruption to occur and potential loss due to a disruption). As a practical example, the cost versus benefit is considered at Ericsson, as Norrman and Jansson (2004) mention how they try to compare the cost of different mitigation actions against the BIV.

2.4.2.2 Strategic fit

As mentioned by Tang (2006), not all mitigation actions are appropriate to adopt by all companies, as they need to be aligned with the overall strategy. Tang (2006) proceeds by mentioning that it does not make much sense for a company with an overall strategy based on a reduced product assortment to pursue a postponement strategy. Similarly, it might not be appropriate for a retailer that has positioned its products as "everyday-low-price" to pursue dynamic pricing and heavy promotions.

The strategic alignment aspect of choosing a mitigation strategy is also discussed by Manuj and Mentzer (2008). First of all, they make a distinction between supply and demand uncertainties. Supply uncertainties are increased by frequent breakdown in supply processes, unpredictable/low yields, poor quality, limited supply capacity, inflexible supply capacity, and evolving production processes, whereas demand uncertainties are increased by volatility in demanded quantities, short lead times to customers, wide product range, having many customer sales channels, high rate of innovation, and high required service levels (Chopra & Meindl 2007). Based on the nature of a company's supply and demand uncertainties, Manuj and Mentzer (2008) present four generic supply chain strategies, namely: (1) efficient, (2) responsive, (3) risk hedging, and (4) agile. An

efficient supply chain is feasible when both supply and demand uncertainties are low and focuses on overall cost-efficiency. A *responsive* supply chain is appropriate when demand uncertainty is high and supply uncertainty is low and is focused on responsiveness and flexibility. A *risk-hedging* supply chain focuses on pooling and sharing of resources and risks and is feasible when demand uncertainty is low and supply uncertainty high. Lastly, an *agile* supply chain focuses on responsiveness and hedging risks and is feasible when both demand and supply uncertainties are. The four supply chain strategies are illustrated in Figure 2.12 together with feasible risk mitigations.

		Demand Uncertainty	
		Low	**High**
Supply Uncertainty	**Low**	**Efficient Supply Chain** *Focus on Cost-efficiency* Postponement Single Sourcing	**Responsive Supply Chain** *Focus on Responsiveness and Flexibility* Postponement
	High	**Risk Hedging Supply Chain** *Focus on Pooling and Sharing Risks* Multiple Sourcing Transferring/Sharing Risk Hedging	**Agile Supply Chain** *Focus on Responsiveness and Hedging Risks* Hedging

Figure 2.12: Overview of how different mitigation actions are appropriate for different strategies, adapted from Manuj and Mentzer (2008, p. 146).

2.5 Risk monitoring

The importance of risk monitoring is highlighted by Kern et al. (2012), who argue that monitoring should be a part of any risk management process. One important element of risk monitoring is measurement of the performance of the risk management process, as discussed by Berg, Knudsen, and Norrman (2008). They discuss the difficulties of linking risk management efforts to results and exemplify by mentioning that an outcome without any accidents can be an effect of both proactive risk management work and pure luck.

A practical example of risk monitoring is mentioned by Norrman and Wieland (2020), who discuss how Ericsson recorded and analyzed both their reactive and proactive risk management activities after an earthquake and tsunami in Japan in 2011, including processes, competencies, and organizational interfaces, to allow for organizational learning. Through this assessment, it e.g. became evident that while some of their existing tools functioned well when assessing individual suppliers, there was a need to develop tools that could simultaneously handle the incidents which handled multiple suppliers.

Another practical example of risk monitoring at Ericsson is discussed by Norrman and Jansson (2004), who explain that monitoring is used for risks that are not reduced to an acceptable level. To keep track of who is responsible for each risk internally, Ericsson uses a risk template (illustrated in Figure 2.13). Moreover, by using spider web diagrams (recall Figure 2.10), they can track how the risk categories evolve over time for their different supply chain partners. This indicates the importance of structure and documentation in the monitoring step.

Template for risk assessment & treatment				
Identified Source:			No:	
Date:				
Event	Description			
	Cause			
Risk estimation	Probability			
	Source Impact			
	Probability			
	Ericsson/Unit Impact			
Mitigation strategies	No.	Description	Cost	Residual risk
	1			
	2			
	3			
	4			
	5			
	6			
Risk Control				
Responsible				
Date				
Status				

Figure 2.13: Template for risk assessment and treatment used in ERMET, adapted from Norrman and Jansson (2004, p. 448).

However, as highlighted by Norrman and Wieland (2020), Ericsson's risk monitoring has significantly improved since the paper in 2004. In the more recent paper, it is mentioned that Ericsson now frequently measures and follows up on SCRM process compliance, implementation plans for projects, and mitigation strategies. The expanded and improved risk monitoring process relates not only to supply, sourcing and security, but also to how different business areas collaborate with business continuity management and how risk is considered in R&D. The increased monitoring practices have led to suppliers and providers being monitored more extensively, often with help from third-party actors, insurance companies, and other external partners.

Despite the acknowledged importance, there still seems to be limited attention to risk monitoring in research, which was concluded by Fan and Stevenson (2018) who only identified the topic explicitly mentioned in 10 out of 354 reviewed papers. Fan and Stevenson (2018) further mention how some researchers have raised the need to develop data management systems for risk monitoring, developing monitoring capabilities and early-warning management processes, and designing tools to identify trends. In practice, monitoring is typically incorporated in already existing management processes, e.g. being a part of the assessment stage or by reviewing KPIs (Fan & Stevenson 2018).

Kern et al. (2012) briefly hypothesize regarding potential benefits of incorporating a monitoring and continuous improvement element into the "basic" three-step risk management process. First of all, Kern et al. (2012) argue that risk monitoring has a positive impact on the identification stage. This is also mentioned by Faisal et al. (2006) and Fan and Stevenson (2018), who argues that continuous monitoring of how risk sources and trends are developing is needed as risks are not a

static phenomenon. Persistent risk monitoring was also mentioned as one of the critical success factors to identify relevant risks in an article by McKinsey & Company (Bailey et al. 2019). They argue that the emergence of digital tools enables companies to track leading risk indicators in a more efficient way. A practical example of how risk monitoring of trends can be used is mentioned by Stecke and Kumar (2009), who explains how Toyota collaborates with WeatherData Inc. which monitors the weather conditions of all Toyota's 330 suppliers and transportation routes. It can also be argued that using regularly scheduled supplier surveys to capture their input on e.g. potential trends, e.g. using supplier scorecards as discussed in section 2.2.2.8, can be a way to routinely monitor risks.

Secondly, Kern et al. (2012) hypothesize that the risk assessment can be improved from an element of monitoring. As new types of risks evolve over time, techniques need to adapt to find new ways of appropriately performing the assessment. To achieve efficiency at this stage, it is thus advocated to include an element of continuous improvement. (Kern et al. 2012)

Thirdly, the mitigation stage is also positively affected by risk monitoring according to Kern et al. (2012). This was also highlighted by Fan and Stevenson (2018), who mention that changes in the environment might cause the chosen mitigation strategies to be inappropriate. Kern et al. (2012) argue that risk mitigation is highly dependent on effective inter-functional and inter-firm collaboration and that continuously improving the relationships and processes, the overall mitigation performance can be improved.

2.6 Risk organization

The organizational structure was mentioned by Manuj (2013) as one factor which can affect the risk management process in companies. Therefore, it will be explained in more detail in this section. First, governance will be discussed, which will be followed by a section covering how the corporate risk culture can affect the process.

2.6.1 Process governance

Both Kleindorfer and Saad (2009) and Berg et al. (2008) argue that risk management activities need to be highly prioritized, included in core management activities, and supported in the different functions in the company. To effectively govern the SCRM process, Bailey et al. (2019) argue that a cross-functional risk board with representatives from every node of the supply chain is needed. Bailey et al. (2019) further mention that the risk board members typically are line-managers with additional responsibilities as risk owners. In some examples, companies have central risk management functions, where experts can provide additional guidance and support to the risk board. The main tasks of the risk board are to periodically meet and review risks and define mitigation actions. To ensure execution, the ownership and responsibility should be taken by the board participant who represents the supply chain node where the risk originates.

The need for a cross-functional SCRM team was also highlighted by Christopher and Peck (2004), who argue that the team should regularly update the supply chain risk register and report to the main board on at least a quarterly basis. In addition to the risk board, Christopher and Peck (2004) argue that risk assessment should be formally included in the decision-making process at every

level of the business. They exemplify by highlighting the need to consider component availability issues already in product design.

A practical example of a governance body can be observed at Ericsson. Previously, Ericsson had a central corporate function to handle risk management (Norrman & Jansson 2004). However, in the years prior to Norrman and Jansson's (2004) article, the risk organization developed to also include other stakeholders. More concretely, they formed a risk management council which, in addition to the central corporate risk management function, included functional members from SCM/logistics (referred to as *core unit supply*) and purchasing (referred to as *core unit sourcing*). Moreover, the council also included members of the different business areas (i.e. SBAs). An illustration of the organization is shown in Figure 2.14. This council has similarities to the risk board discussed by Bailey et al. (2019), with the main difference being a more matrix-oriented organization in the Ericsson case.

In terms of responsibility in Ericsson's risk organization, the corporate risk management team has the overall ownership of risk management at the company, coordinates risk management activities in the group, and is in contact with insurance companies. The core unit supply is in charge of the more operational work daily contact with the suppliers. The core unit sourcing is the commercial interface with suppliers, e.g. conducting the supplier evaluations. Lastly, the SBA representatives provide a business perspective as they are the product owners. (Norrman & Jansson 2004)

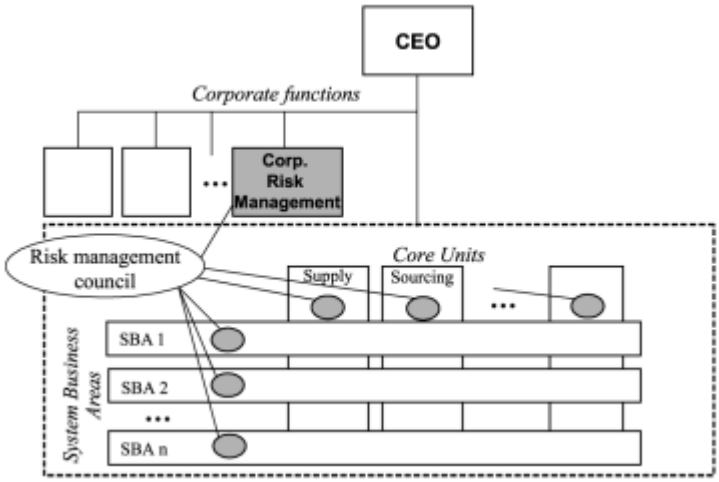

Figure 2.14: An overview of Ericsson's risk organization, adapted from Norrman and Jansson (2004, p. 443).

In Norrman and Wieland's (2020) more updated paper, they mention that both organizational and SCRM processes have become more formalized and cross-functional over time. As an example, they have appointed many operational positions, e.g. relating to a business continuity management implementation.

2.6.2 Risk culture

Another aspect of the risk organization relates to the corporate culture and general attitude towards risk management. McKinsey & Company defines risk culture as "the norms of behavior for individuals and groups within an organization that determine the collective ability to identify and understand, openly discuss and act on the organization's current and future risks" (Levy, Lamarre,

& Twining 2010, p. 3). In companies with a strong risk culture, these norms establish a common set of standards whose quality and discipline define the company's approach to risk-taking (Levy et al. 2010). Bailey et al. (2019) further argue that a risk-aware culture in a company both helps to build a solid defense against unknown risks, as well as enabling a quick response when unknown risks appear and threaten the company's operations. According to Levy et al. (2010), a strong risk culture should demonstrate the following six elements:

- A clear and well-communicated risk strategy.
- High standards of analytical rigor and information-sharing across the organization.
- Rapid escalation of threats or concerns.
- Visible and consistent role-modeling of desired behaviors and standards by senior managers.
- Incentives encouraging people to "do the right thing" and think about the overall health of the whole organization.
- Continuous and constructive challenging of actions and preconceptions at all levels of the organization.

In a study regarding risk management in 2009, KPMG found that the absence of a proper risk culture was ranked as the third most important driver (48 %) causing the credit crisis in 2008, only behind risk governance (50 %) and incentives (48 %). When asked about how to improve the risk management process, 20 % of the respondents deemed it necessary to improve the risk culture, 29 % management support, 35 % top-level awareness of risk, 40 % communications, and 45 % technical skills. However, out of respondents responsible for risk, 77 % were committed to creating a risk culture but had the impression that the process was externally driven by e.g. regulators rather than by senior management internally. This highlights a dilemma with risk culture because while most employees find it important, it is not necessarily driven by internal stakeholders. 76 % of the respondents argued that the risk management function as a support function was stigmatized in the organization. Risk managers were often looked upon as controllers rather than partners which created a "us versus them" mentality. To transform the risk manager role and perception to a more meaningful partner, 60 % of the respondents wanted the CRO function to have greater involvement in strategy, and 50 % wanted to allocate more responsibility to the function. Lastly, 45 % of the respondents argued that company board members had a lacking knowledge base of risk and risk matters, which is an issue when risk culture is supposed to be driven by top-level management. (Banks 2012)

2.7 Investigation model

To summarize the literature review, a graphical overview of the SRM process is shown in Figure 2.15, which will from hereon be referred to as the *investigation model*.

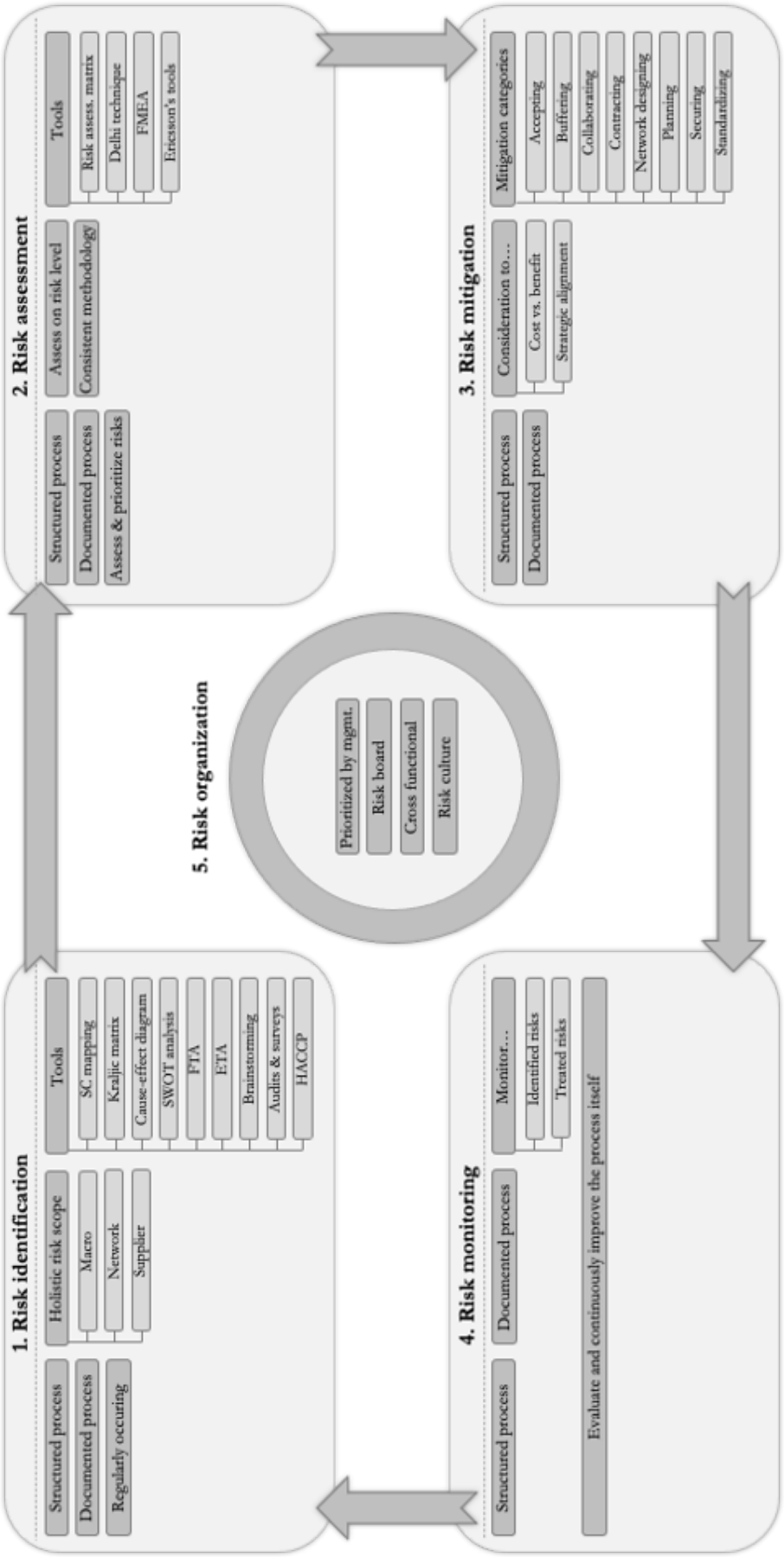

Figure 2.15: The investigation model in the form of a conceptual SRM process.

3 Methodology

This chapter focuses on the different methodological choices made by the authors. More concretely, the overarching methodology, research approach, and research strategy are presented and argued for. In addition, some tactics adopted to ensure the research credibility of the thesis are discussed.

3.1 Methodology framework

This chapter will follow the framework illustrated in Figure 3.1, which has been specifically tailored for the thesis. It is mainly inspired by frameworks developed by Saunders, Lewis, and Thornhill (2009) and Yin (2014), complemented with elements of research methodology and credibility, as they were considered relevant by the authors of this thesis.

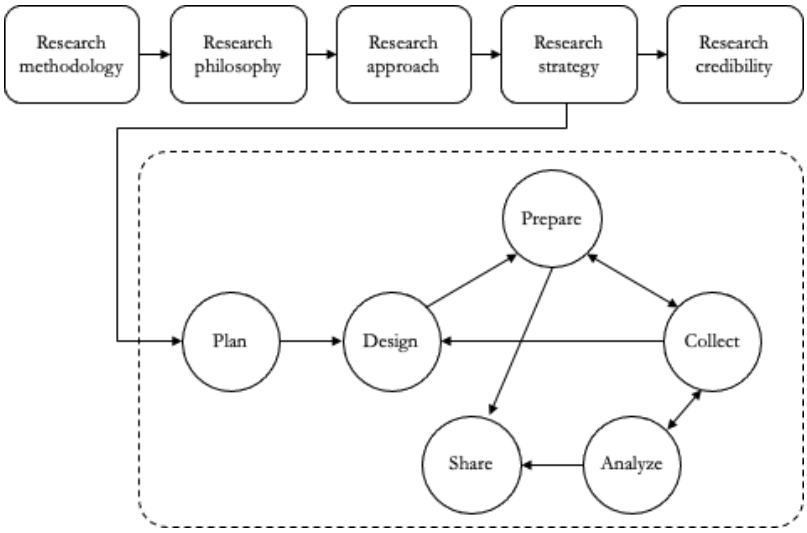

Figure 3.1: A conceptual framework of the methodology chapter developed by the authors, integrating methodology frameworks from Saunders et al. (2009) and Yin (2014).

3.2 Research methodology and method

The nature and goal of the RQs determine what methodology researchers should choose. Höst, Regnell, and Runeson (2006) mention four methodologies commonly used in research:

- **Exploratory:** The study of a new phenomenon, typically for broad and not specifically defined problems (Yin 2014) and seeks to gain an in-depth understanding of a topic with limited pre-existing knowledge (Höst et al. 2006).
- **Explanatory:** Explains how and/or why some condition occurs using cause-effect relationships (Höst et al. 2006; Yin 2014).
- **Descriptive:** An in-depth description of a phenomenon in its real-world context (Höst et al. 2006; Yin 2014).
- **Problem-solving:** Aims to find a solution to an observed problem, and contribute with both knowledge and analysis (Höst et al. 2006).

3.2.1 Constructive research

The authors argue that the purpose of the thesis was best described as problem-solving, as it aimed to find a solution to an observed problem (i.e. lack of risk awareness in Company Alpha's upstream supply chain). Constructive research is the concrete method, related to problem-solving, that was applied. As it is centered around creating constructs to serve human purposes (Dresch, Lacerda, & Antunes 2015), which was evidently the case in this thesis, it was deemed as an appropriate method. Furthermore, the authors argued that constructive research could be applied to all RQs, as they were all related to solution development.

In literature, the process in constructive research seems to vary between papers (see e.g. Kasanen, Lukka, and Siitonen (1993) and Lukka (2003)). This thesis will follow the process suggested by Kasanen et al. (1993), i.e.: (1) find a practically relevant problem which also has research potential, (2) obtain a general and comprehensive understanding of the topic, (3) innovate, i.e., construct a solution idea, (4) demonstrate that a solution works, (5) show the theoretical connections and the research contribution of the concept, and (6) examine the scope of applicability of the solution.

3.2.1.1 Find a practically relevant problem which also has research potential

The thesis' topic originates from a practical need, as Company Alpha has a lacking SRM process, and practitioners at the company experience it as problematic. Furthermore, Hoffman, Schiele, and Krabbendam (2013) highlights the need for further research considering industry specificities in SRM. Therefore, it can be argued that the research topic had both practical and theoretical relevance, which is highlighted by Lukka (2003) as essential in constructive research.

3.2.1.2 Obtain a general and comprehensive understanding of the topic

The authors aimed to get a comprehensive understanding of both practical and theoretical viewpoints, in line with Lukka (2003). To ensure a practical understanding, the authors conducted interviews and reviewed documentation. In terms of theoretical understanding, it was essential to be aware of already existing theory in the topic. Therefore, an extensive literature review was conducted, which prevented the authors from overlooking existing facts and knowledge within the subject, as recommended by Höst et al. (2006). To develop the literature review, the five-step approach developed by Rowley and Slack (2004) was followed, which includes: (1) scanning documents, (2) making notes, (3) structuring the literature review, (4) writing the literature review, and (5) building the bibliography.

3.2.1.2.1 Scanning documents

In this step, the authors got familiar with the available documentation on the topic. As suggested by Rowley and Slack (2004), the documentation was grouped according to its content and some initial insight was gained. All of the document types mentioned by Rowley and Slack (2004) were used to some extent (i.e. articles in scholarly and research journals, professional and practitioner journals, books, and websites). Of these, the scholarly and research journals were prioritized as they have typically been peer-reviewed prior to publication (Rowley & Slack 2004). For all sources used in the literature review, but especially critical for non-scholarly/research journals, the intention was to remain careful and make sure they were credible to not jeopardize the overall

trustworthiness of the study. The authors were also especially cautious before using websites and similar electronic sources, as Yin (2014) highlights it as a key principle when collecting data.

To identify relevant articles and books, mainly databases such as LUBsearch, Emerald Insight, ResearchGate, and Google Scholar were used. The database searches were primarily based on the following sixteen keywords: (1) *supply risk management*, (2) *SRM*, (3) *supply chain risk management*, (4) *SCRM*, (5) *supply chain management*, (6) *SCM*, (7) *risk*, (8) *identification*, (9) *assessment*, (10) *mitigation*, (11) *monitoring*, (12) *governance*, (13) *organization*, (14) *culture*, (15) *AFSC*, and (16) *agrifood*. The keywords were used separately and in different combinations to enable a representative overview of existing literature. In addition, physical books borrowed from the university library and articles from reputable consultancy firms and professional organizations were also used.

3.2.1.2.2 Making notes
In this step, the authors started to understand key themes and messages in the chosen documents. As suggested by Rowley and Slack (2004), the documents were annotated and marked up to easier remind the authors of their key messages when going back to the specific document at a later stage.

3.2.1.2.3 Structuring the literature review
As suggested by Rowley and Slack (2004), the first section of the literature review covered basic definitions (section 2.1). The rest of the structure emerged from reviewing the literature once the authors got familiar with the key themes in the topic.

3.2.1.2.4 Writing the literature review
Once the structure of the chapter was determined, the authors categorized the gathered literature accordingly, before commencing the writing of the review. In terms of content, the authors included the three types of materials mentioned by Rowley and Slack (2004): (1) distillation and understanding of key concepts, (2) quotations from the original author, and (3) distillation of findings from original authors in the own words of the author. Furthermore, to increase the reliability, the authors included tables to be transparent on how concepts were derived from the literature.

3.2.1.2.5 Building the bibliography
The creation of bibliography was an ongoing process that took place continuously, commencing during the literature search and ending upon the completion of the literature review (Rowley & Slack 2004). To avoid potential misconceptions and the risk of missing or incorrectly reference any source, the authors strictly applied correct referencing from the start. This was completely in line with Yin (2014), who emphasizes the benefits of not postponing the bibliography.

3.2.1.3 Innovate, i.e., construct a solution idea
The literature highlights the importance of not simply using previously designed constructs, as a pure application of constructive research is more innovation-oriented and requires the development of a new solution (Lukka 2003). To ensure this, the authors did not solely base the developed SRM model on theoretical findings but also considered the empirical findings from the case companies, which ensured the uniqueness of the solution.

3.2.1.4 Demonstrate that the solution works

To demonstrate that a solution is functioning, Kasanen et al. (1993) and Lukka (2003) propose three tests: a weak market test, a semi-strong market test, and a strong market test. However, the suggested tests require implementation of the solution, which made them unfeasible to consider in this thesis. The lack of usefulness and practical applicability of the market tests are also highlighted by Rautiainen, Sippola, and Mättö (2017), who instead propose the usage of the Relevance Diamond Diagram (RDD). RDD, illustrated in Figure 3.2, investigates the usefulness of a solution in terms of practical value relevance, academic value relevance, instrumental decision logic, and legitimative decision logic.

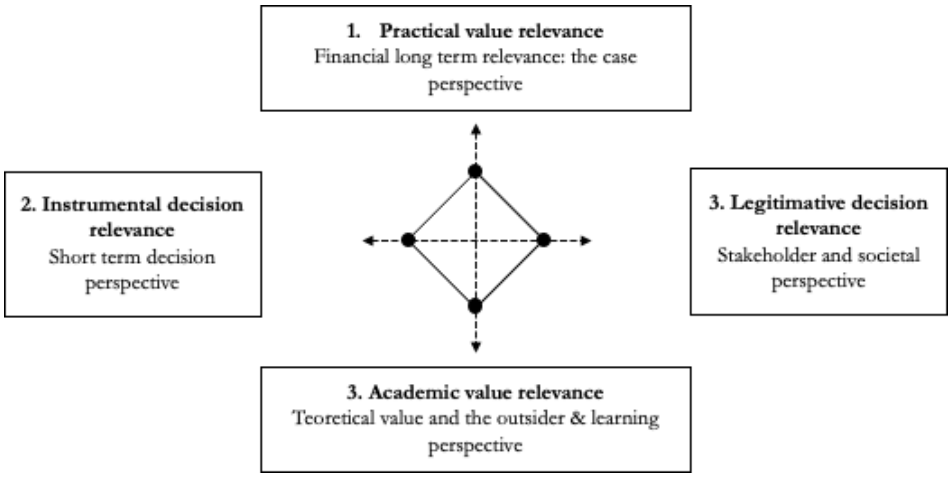

Figure 3.2: An overview of RDD, adapted from Rautiainen et al. (2017, p. 28).

3.2.1.4.1 Practical value relevance

The practical value relevance has similarities to the market tests discussed by Kasanen et al. (1993) and Lukka (2003), where a solution is considered to have practical value if the company adopts the developed solution. As implementation was excluded in this thesis, the practical value of the model was instead tested by:

1. Early in the process, the authors investigated (through unstructured interviews) what relevant stakeholders[12] considered important in an SRM model, which the authors kept in mind during the model development. More concretely, these criteria were (1) structured process, (2) user-friendly process, and (3) trustworthy output, from hereon referred to as the *stakeholder criteria*.
2. Once the model was developed, a workshop with relevant stakeholders[13] was conducted. The workshop had four primary purposes: (1) conceptually explain the model, (2) practically show the practitioners how to use it, (3) get concrete feedback to incorporate before the final deliverable, and (4) evaluate the process based on the stakeholder criteria.

[12] Purchasing Manager, Supply Chain Manager, and Sustainability & Product Development Manager.
[13] Purchasing Manager, Supply Chain Manager, and Sustainability & Product Development Manager.

3.2.1.4.2 Academic value relevance

To ensure academic value relevance, the three levels discussed by Rautiainen et al. (2017) were considered, i.e.: (1) indications of potential academic relevance, (2) publications, and (3) institutionalization of the scientific results. In constructive research, the first level can be argued of being achieved if the research has a practically relevant topic which is investigated together with practitioners, which was undoubtedly the case in this thesis. The second level can also be argued of being achieved, as the thesis was published upon completion. However, the third level, which relates to the generalizability and the publication getting citations, was only achieved to some extent. While it was the authors' intention to make the model generalizable and useful for other comparable companies, it is not realistic to expect it to get citations as it will not be published in any well-known journal or similar.

3.2.1.4.3 Instrumental decision relevance

Rautiainen et al. (2017) explain instrumental decision relevance as being related to short-term processes, more specifically to what degree the solution enables more efficient processes within the organization. This aspect could not be formally tested as the model was not implemented, but some indications were gained from the stakeholder workshop discussed in section 3.2.1.4.1.

3.2.1.4.4 Legitimative decision relevance

In accordance with Rautiainen et al.'s (2017) terminology, legitimative decision relevance is described as the relevance from the perspective of stakeholders at different hierarchical levels, which is relevant to consider as they argue that there might be varying perceived legitimacy for a solution. This was considered by including stakeholders from different hierarchy levels in interviews and the workshop.

3.2.1.5 Show the theoretical connections and the research contribution of the concept

To ensure the academic contribution of this thesis, the authors developed a functioning SRM model, which in accordance with Lukka (2003) served as a natural contribution itself.

3.2.1.6 Examine the scope of applicability of the solution

In the last phase, it is relevant to reflect on the possibility of generalizing the solution and analyze to what extent it can be transferable (Lukka 2003). This was considered in this thesis, as the model was developed to be useful for other comparable companies in the agrifood industry as well, with minor adjustments.

3.3 Research philosophy

The second element of the methodology framework (Figure 3.1) considers research philosophy, which is a term relating to the development and nature of knowledge (Saunders et al. 2009). As authors' research choices are influenced by their perception of reality (Arbnor & Bjerke 2009), it is of relevance to clarify the viewpoint of this thesis' authors before continuing with the research approach, strategy, and credibility.

Two viewpoints that are commonly discussed are positivistic versus relativistic/interpretivistic (Saunders et al. 2009; Arbnor & Bjerke 2009). At the positivistic extreme, the world is perceived as objective, tangible, and fragmentable (Gammelgaard 2004). At the relativistic extreme, objectivity is denied as facts and truths are argued to be relative in the specific context in which they are assessed (Baghramian 2004). Relating to this, Arbnor and Bjerke (2009) present three distinct scientific approaches: analytical approach, systems approach, and actors approach. Descriptions of the different approaches are presented below, followed by an illustration of how they relate to positivistic versus relativistic worldviews (Figure 3.3).

- **Analytical approach:** The world is viewed objectively, and causal relationships and patterns are investigated. The basic assumption in this approach is that each concept can be analytically decomposed and analyzed in silo. (Gammelgaard 2004)
- **Systems approach:** Emphasis is put on understanding the world in terms of mutually dependent components, which together constitute a system with parts, links, feedback, and goal mechanisms (Gammelgaard 2004).
- **Actors approach:** Reality is not considered to be objective but rather a result of social constructions. Moreover, knowledge is perceived to be socially constructed, which implies that knowledge creation is dependent on the interpretation of the researcher. (Gammelgaard 2004)

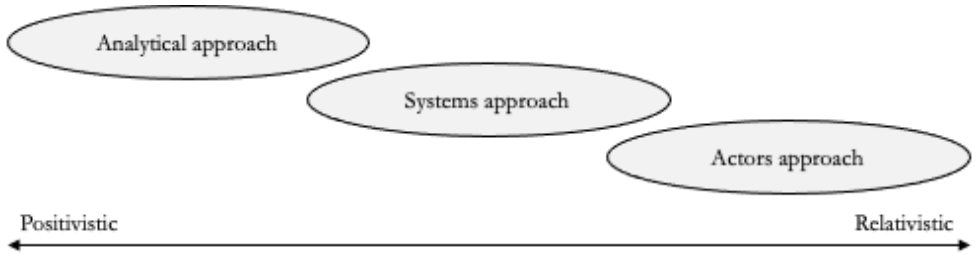

Figure 3.3: An overview of how Arbnor and Bjerke's (2009) scientific approaches relate to positivistic versus relativistic worldviews, developed by the authors.

3.3.1 Systems approach

The authors identified their worldview as being closest to the systems approach, especially given the purpose of the thesis, where subjective and contextual aspects were highly relevant and a more holistic view from a systems approach advocated. The authors viewed the SRM process itself as a system, which, in line with Baker and Maddux (2005), contains processes, a feedback loop, and an external environment. More concretely, risk identification, risk assessment, and risk mitigation were seen as processes that translated input to output. Risk monitoring was viewed as a feedback loop that provided new input to the processes, while the risk organization was seen as the external environment that defined the boundaries of the system. The system is illustrated in Figure 3.4.

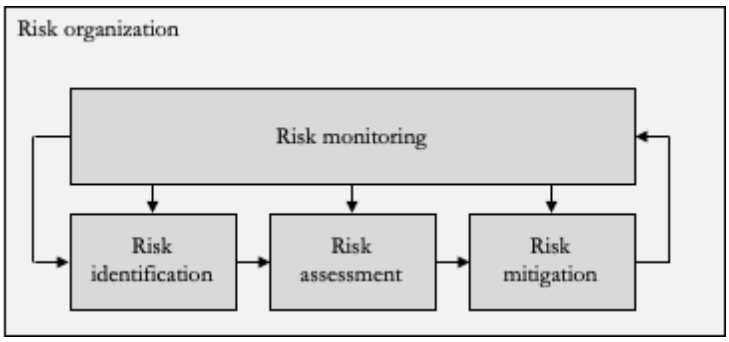

Figure 3.4: A conceptual overview of the SRM process, viewed as a system by the authors.

3.4 Research approach

The next part of the methodology framework (Figure 3.1) relates to research approach. Saunders et al. (2009) argue that there are two main approaches, inductive and deductive, which are illustrated in Figure 3.5. These are partly related to the philosophies discussed earlier, where deductive is connected to positivism and inductive related to relativism. In addition to these approaches, Spens and Kovács (2006) describe a balanced approach, which is sometimes referred to as the abductive approach.

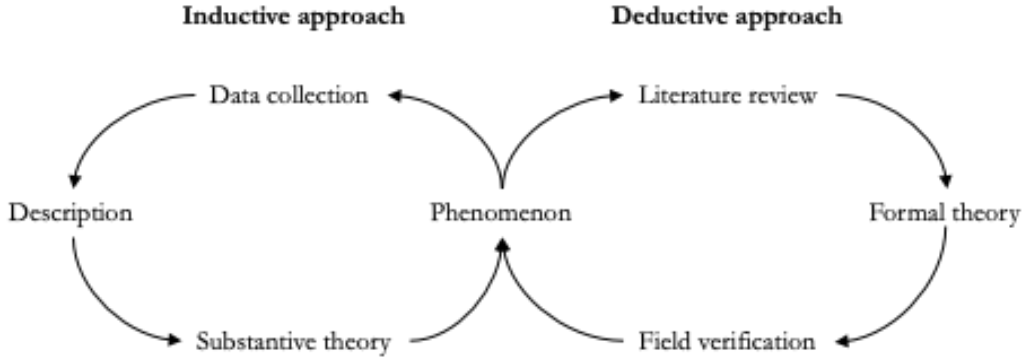

Figure 3.5: A conceptual overview of the two main research approaches, adapted from Woodruff (2003).

- **Inductive approach:** Centered around creating new theories (Saunders et al. 2009). The starting point is in specific empirical observations, from which results are generalized (Woo, O'Boyle, & Spector 2017). Hence, it is not necessary to have a theoretical foundation in place in the specific field before commencing the research. (Spens & Kovács 2006)
- **Deductive approach:** Focused on testing an already existing theory. It has the starting point in theory rather than empirics, thus requiring already existing theoretical contributions within the subject as opposed to inductive research. After reviewing literature and theory related to the subject, logical conclusions and hypotheses are derived and thereafter tested empirically (Woo et al. 2017). (Spens & Kovács 2006)
- **Abductive approach:** The main idea is to move between theory and reality, i.e. between a deductive and inductive approach (Kotzab, Seuring, Müller, & Reiner 2005). Spens and Kovács (2006) argue that the abductive approach can have two different starting points. Either from a puzzling observation which existing theory cannot explain, or the intentional application of an alternative theory to explain a phenomenon.

3.4.4 Abductive approach

An abductive approach was considered appropriate, as both inductive and deductive reasoning were needed to incorporate both theoretical and empirical findings in the developed model. The field of SRM is well-known with plenty of relevant literature available and by applying deductive reasoning, the authors were able to develop a comprehensive theoretical understanding of the topic. Moreover, the inductive aspect was needed to capture contextual elements that emerged during the interviews. As an example, the authors did not realize the importance of HACCP for companies present in the food industry until some initial interviews had been held. Consequently, some additional research within the topic was necessary, resembling the inductive way of conducting research.

3.5 Research strategy

The next part of the methodology framework (Figure 3.1) relates to research strategy. The five major research strategies[14] according to Yin (2014) are:

- **Experiment:** Studying causal links to find out whether a change in an independent variable produces a change in another dependent variable (Hakim 2000; Höst et al. 2006).
- **Survey:** Mapping the current situation of an object or problem, often in the form of a questionnaire, (Denscombe 2010) to collect a big amount of data from a sizable population in a cost-efficient way (Yin 2014).
- **Archival analysis:** Using documents and administrative records as the principal data source to find relevant information (Yin 2014). Despite the term archival, this strategy can be used for both historical and recent documents (Bryman 1989).
- **Historical:** The historical method is commonly used by historians when direct observations of the subject matter are impossible due to no relevant person or entity being alive to report what happened. Instead, primary and secondary documents and physical and cultural artifacts are used as the main source of evidence. (Yin 2014)
- **Case study:** Robson (2002, p. 178) defines a case study research strategy as "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence".

3.5.1 Case study

To choose a research strategy, three conditions proposed by Yin (2014) were considered: (1) type of RQs posed, (2) extent of control a researcher has over actual behavioral events, and (3) degree of focus on the contemporary as opposed to entirely historical events. An overview of how these conditions relate to different strategies is presented in Table 3.1.

[14] Yin (2014) uses the term "research method", whereas Saunders et al. (2009) use "research strategy" regarding the same concept. In this thesis, the terminology for the concept will be "research strategy", to be consistent with the methodological framework presented in Figure 3.1.

Table 3.1: Overview of when different research strategies are appropriate, adapted from Yin (2014).

Research strategy	Form of research question	Requires control of behavioral events?	Focuses on contemporary events?
Experiment	how, why?	yes	yes
Survey	who, what, where, how many, how much?	no	yes
Archival analysis	who, what, where, how many, how much?	no	yes/no
Historical	how, why?	no	no
Case study	how, why?	no	yes

As all RQs were stated in the form of "how" and the authors could only focus on contemporary events, as they had no control over behavioral events, a *case study* was deemed feasible to pursue. Gammelgaard (2004) also mentions case study as the ideal research strategy when the author has a systems approach, which further convinced the authors of the appropriateness in this thesis, given the authors' systems view (recall section 3.3.1). To describe how the case study was conducted, the six steps proposed by Yin (2014) are used: plan, design, prepare, collect, analyze, and share.

3.5.1.1 Plan

The planning phase mainly concerns the decision on whether a case study is a relevant strategy or not, which has already been discussed. However, in earlier versions of Yin's book there is also some emphasis put on researching theory in the early steps of the process to develop an investigation model, as this can guide the researcher in data collection and analysis (e.g. in Yin (2003)). For this reason, the authors conducted extensive literature, where the output was an investigation model in the form of a conceptual SRM process (recall section 2.7).

3.5.1.2 Design

Research design can be either explicit or implicit and is the logic that links the data to be collected and conclusions to be drawn to the RQs and objective (Yin 2014). Similar to Yin (2014), the authors evaluated four potential types of case studies, differentiated by the variables *holistic* (single unit of analysis) versus *embedded* (multiple units of analysis) and the usage of a *single* versus *multiple* cases, illustrated in Figure 3.6.

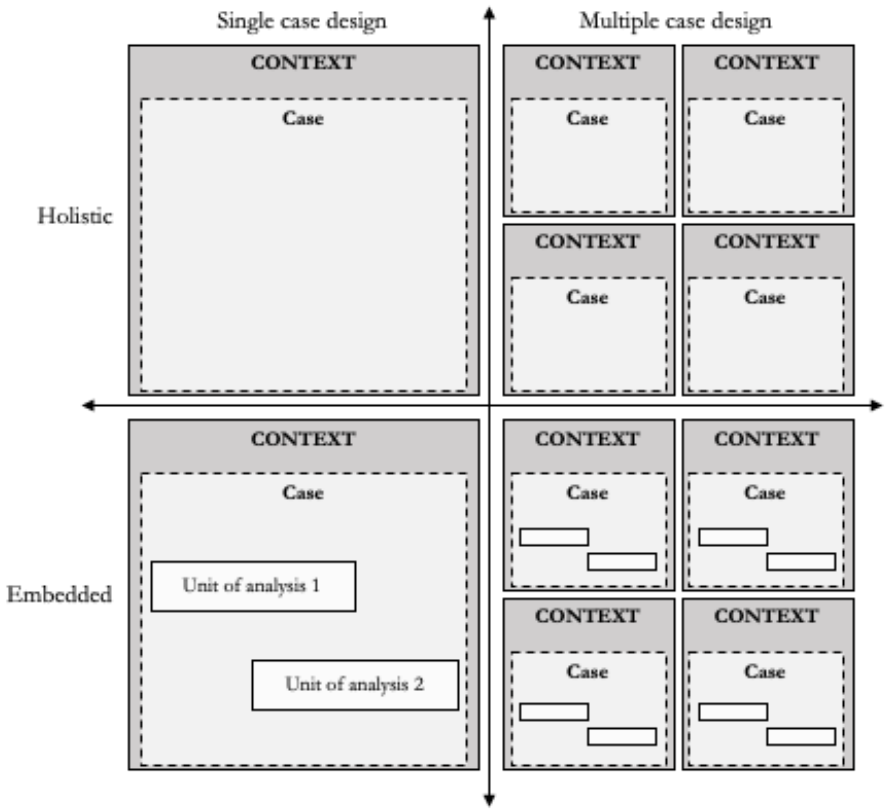

Figure 3.6: A matrix showing the four types of case studies, adapted from Yin (2014, p. 80).

The unit of analysis (UoA) states what individual, department, process, or similar that should be investigated and has to align with the RQs (Yin 2014). To align with the overarching purpose and RQs, the authors chose the UoAs: *risk identification*, *risk assessment*, *risk mitigation*, *risk monitoring*, and *risk organization*, each corresponding to a distinct RQ and elements of the SRM process. Concludingly, using Yin's (2014) terminology, an *embedded design* was chosen.

The next decision related to using single versus multiple cases, which is one of the most fundamental issues in case study analysis according to Ellram (1996). While using few cases (e.g. through a single case study) would allow the authors more depth in the observation (Voss, Tsikriktsis, & Frohlich 2002), the authors opted for a multiple case design to offer a robust study and more compelling evidence (Yin 2014). In addition, the authors argued that investigating multiple cases would (1) potentially identify best-practices that could be transferable to Company Alpha's SRM model, and (2) draw conclusions regarding general patterns/gaps for small and medium-sized companies in the agrifood industry, to consider and address in the model development. Despite being more resource-heavy, both Ellram (1996) and Yin (2014) emphasize the analytic benefits offered by using multiple independent cases, which also influenced the authors' choice. Thus, a *multiple case with embedded design* was chosen by the authors.

Company Alpha was considered as the *principal case* and when selecting the *secondary cases* the authors followed a literal replication, i.e. to predict similar results between cases (Yin 2014), as the supervisors at Company Alpha argued this would add more value to the thesis. More concretely, this translated to choosing case companies that were comparable to Company Alpha. Based on this, a list of criteria for selecting secondary cases was developed, shown in Table 3.2.

Table 3.2: Criteria for case selection.

Criteria	Rationale
Present in the agrifood industry	Due to the uniqueness in AFSCs, with context-specific risk sources, the authors argued it would make sense to only include companies in the agrifood industry.
Actively working with SRM	If the case company did not pursue any type of SRM work, it would not provide an as useful inspiration to the model development.
GFSI approved certification	As a major concern for Company Alpha was the requirements posed by their FSSC 22000 certification, it was deemed appropriate to include companies with similar food safety and quality regulations to make the cases more comparable.
Operating in Sweden	If the case companies were not subject to the same local regulations and requirements they would not be as comparable to Company Alpha.
Sourcing globally	As a company with local or regional sourcing is not exposed to the same types of risks, the author argued this to be a necessary criterion.
A maximum turnover of 5 000 MSEK	To be able to identify patterns specific for small and medium sized companies, the authors opted for an upper limit for the turnover.

When conducting a multiple case study, Ellram (1996) recommends using between six and twelve cases. However, due to the time and resource limitation, the authors only included four cases in this study. The cases were chosen in a screening process based on the posed criteria, which was in line with Eisenhardt (1989), who mentions that cases should not be chosen randomly and that spending some time identifying well-suited cases is advocated. The final list of selected cases and some of their characteristics are shown in Table 3.3, where all four case companies evidently meet the selection criteria.

Table 3.3: Case companies included in the study.

Company	HQ location	Industry	Products	Turnover	Sourcing scope	Certifications[15]
Company Alpha	Sweden	Agrifood	Juices, musts, ciders, lemonades, wines, and chutneys	685 MSEK	Global, with emphasis on Europe	FSSC 22000, ISO 14001, KRAV®, Fairtrade®, EU Ecolabel, Svenskt Sigill®
Company Beta	Sweden	Agrifood	Spices, starches, fibers, and customer-specific blends	750 MSEK	Global, with emphasis on Asia	BRC, ISO 9001, ISO 50001, KRAV®, EU Organic, Halal, Kosher, Fairtrade®
Company Gamma	Non-Swedish HQ, but operates in Sweden	Agrifood	Ingredients to food industry, helps customers with product innovations and general advisory	490 MEUR[16]	Global, with emphasis on Europe	FSSC 22000, ISO 14001, ISO 22000, EU Organic
Company Delta	Non-Swedish HQ, but operates in Sweden	Agrifood	Products in the food industry	3 200 MSEK	Global, with emphasis on Europe	FSSC 22000, KRAV®

3.5.1.3 Prepare

Due to the absence of well-documented procedures, case study research is one of the most difficult types of research to conduct, hence requiring sufficient preparation (Yin 2014). One recommendation from Yin (2014) was to conduct a pilot case study as part of the preparation. This was also done in this thesis, as Company Beta was seen as a pilot case, and "lessons learned" was incorporated to e.g. improve the interview guide to enable more accurate questions. Furthermore, as Yin (2014) mentions that a protocol is essential in a multiple case design including multiple researchers (which was the case in this thesis), the authors acknowledged its importance and developed a protocol to guide the data collection. The case study protocol followed the structure developed by Brereton, Kitchenham, Budgen, and Li (2008), and can be found in Appendix A.

3.5.1.4 Collect

The next stage of Yin's (2014) proposed process is data collection, which considers how the evidence is gathered and stored. In this case study, the authors stored all collected data in a case study database on Google Drive, as the usage of a case study database was mentioned by Yin (2014) as a key principle in data collection. In terms of data type, primarily qualitative data (Höst et al. 2006) from interviews were gathered.

[15] Certifications that are GFSI approved are underlined.

[16] ~4 944 MSEK.

The authors used multiple data sources, as Yin (2014) highlights it as a key principle when collecting data. This allowed the authors to use the principle of triangulation, which enhances the reliability of a study according to Voss et al. (2002). To exemplify, this principle was used by asking similar interview questions to multiple interviewees from Company Alpha. Three of the six potential sources Yin (2014) discusses were considered: (1) documentation, (2) archival records, and (3) interviews. Documentation and archival records primarily consisted of internal data provided from the case companies, e.g. organization charts and supplier evaluation documentation. This data was gathered through requests during the interviews at the companies.

As interviews are commonly seen as the most important source in a case study (Yin 2014) and played an essential part in enabling the authors to answer the RQs, it grants some further explanation. According to Höst et al. (2006) and Ellram (1996), a categorization of interview types can be made as follows:

- **Structured interviews:** Questions are determined beforehand and asked in a certain order (Höst et al. 2006).
- **Semi-structured interviews:** More open than structured interviews, as it contains both pre-determined and open questions. Does not follow the pre-defined order as strictly, which allows the interviewer to ask questions when considered feasible. (Höst et al. 2006)
- **Unstructured interviews:** Not as structured and more resembles an exploratory conversation. In contrast to the other alternatives, there are no predetermined questions, as questions are asked as they arise during the interview. (Höst et al. 2006)

To allow for both structure and flexibility, semi-structured interviews were used. The intention was to conduct most interviews in person at the facilities of the case companies, but this was not feasible given the ongoing covid-19 pandemic, hence requiring a remote interview setup using conference calls. Nevertheless, videos were used in a majority of the interviews, which allowed the authors a chance to interpret body language and reactions that otherwise would get lost (Creswell 2017). Furthermore, as highlighted by Creswell (2017), the authors considered the importance of being good listeners, being respectful, and completing the interviews within the agreed time frame. In addition, due to the semi-structured setting, the authors remained flexible to make adjustments to the interview guide as situations emerged (e.g. by adding new questions during an interview) to get more insightful interviews, which is also highlighted as important by Eisenhardt (1989). An overview of the conducted interviews can be found in Appendix A.5. Furthermore, the interview guide can be found in Appendix A.5.1, structured in accordance with the investigation model.

3.5.1.5 Analyze

Data analysis considers categorizing, examining, tabulating, or testing evidence to produce empirical findings (Yin 2014). The authors followed the three concurrent flows of activities proposed by Miles and Huberman (1994), i.e. data reduction, data display, and conclusion drawing/verification. Similar to Norrman and Kembro (2019), both within-case and cross-case analyses were conducted using the structure of the investigation model. The purpose of the within-case analyses was to draw conclusions regarding the SRM process in each case company in the form of a gap analysis compared to the investigation model. Given that multiple data sources were

used for some cases, which risked being contradictory, the authors had to use explanation building (Yin 2014) to understand root causes for the potential discrepancies.

More concretely, the within-case analysis was conducted by grading different elements in the investigation model on a scale from one to five depending on to what extent the company resembled the investigation model (detailed in Table 3.4). Evidently, the grading aspect was subjective in nature as it was based on the authors' impressions. Consequently, other researchers might arrive at different grading outcomes, which might be argued to affect the reliability of the study. Nevertheless, the authors argue that the purpose of the grading was not to determine the "objectively correct grades", but rather enable a structured way of identifying general patterns and draw conclusions in the cross-case analysis.

Table 3.4: Description of grading system for case assessment.

Description	Grade
Not in line with theory	1
Partly in line with theory	2
More or less in line with theory	3
Fully in line with theory	4
More sophisticated than theory	5

Once the within-case analyses were complete, pattern matching (Yin 2014; Miles & Huberman 1994) was used to identify similarities and dissimilarities across the cases in a cross-case analysis. Once again, explanation building (Yin 2014) was used to explain the patterns that emerged. Special emphasis was put on drawing general conclusions regarding SRM at small and medium-sized companies in the agrifood industry and to identify potentially transferable best-practices. The main takeaways from the cross-case analysis were summarized in tabular format to facilitate the connection between the analysis and recommendation.

3.5.1.4.1 Development of the SRM model

To develop the SRM model, the authors primarily considered three aspects: (1) the investigation model, (2) the takeaways from the analysis, and (3) the stakeholder criteria[17]. The investigation model served as the starting point, to which different elements were added, removed, and adjusted based on the takeaways and stakeholder criteria. More concretely, this could e.g. translate to involving certain tools based on their user-friendliness and to what extent the analysis indicated them being used in practice and the involvement of objective data source tools to ensure trustworthy output. The developed model was visualized in process flow charts, highlighting both "soft aspects" (such as process participants and periodicity) and "hard aspects" (such as what tools, techniques, and documentation to use).

[17] (1) User-friendly model, (2) structured process, and (3) trustworthy output.

3.5.1.4.2 SRM model validation

The model validation was conducted in a two-hour long workshop in December 2020 in a remote setup using Microsoft Teams. In addition to the authors, the workshop participants also included the Purchasing Manager, Supply Chain Manager, and Sustainability & Product Development Manager at Company Alpha. At the time of the workshop, the authors had developed a draft for the final deliverable. As mentioned in section 3.2.1.4.1, the workshop had four primary purposes: (1) conceptually explain the model, (2) practically show the practitioners how to use it, (3) get concrete feedback to incorporate before the final deliverable, and (4) evaluate the process based on the stakeholder criteria.

The workshop commenced with a presentation of the SRM model based on the process flow charts. During the presentation, the participants had the opportunity to ask questions, discuss how different process steps could be implemented at the company, and give feedback for further model improvements. Once the presentation of the process was completed, the authors provided a more in-depth explanation of how the model could be practically used, by going through certain aspects of the model and applying some of the tools. Lastly, the practitioners evaluated the stakeholder criteria. Initially, the authors opted for a quantitative assessment where the stakeholder criteria could be assessed on a scale from one to five. However, the practitioners found this exercise difficult as they could not accurately grade the criteria without trying the model in practice first. Therefore, the evaluation was conducted in a qualitative discussion around the criteria instead.

3.5.1.6 Share

According to Yin (2014), the following areas are important to consider before starting the composing process: (1) audiences for case study reports, (2) varieties of case study compositions, and (3) procedures for composing a case study. The audience of this thesis consists of both academic colleagues, practitioners at Company Alpha, and potentially other practitioners who want to implement the model. The audiences have different interpretations of what is of importance, which makes it essential to compose the thesis in a way that communicates to all target audiences successfully. According to Yin (2014), academic colleagues find the academic research and findings as the most important aspects, while practitioners are more interested in portraying real-world situations as well as the implications for action. To achieve this, the authors developed a thesis that fulfilled the academic requirements (e.g. including an extensive methodology chapter and suggesting future research) while also delivering a practically valuable SRM model to the practitioners.

In accordance with Yin (2014), the report was presented using single cases in separate chapters and additional chapters for cross-case analysis, with the secondary single cases being placed in Appendix C and D to limit the number of pages in the main report. Moreover, a linear-analytic composition was used as this is the standard approach for composing research reports and a structure which most researchers are most comfortable with, which is an advantage when trying to reach the academic audience.

In terms of composition procedure, the authors began drafting portions of the report early in the process, as this way of working is included in the overall methodology of writing a master's thesis

at LTH. This is also advised by Yin (2014), as it helps a researcher to focus its thoughts more clearly on the actual analysis and conclusions. This was especially advantageous considering that Yin (2014) argues analysis to be the toughest part of a case study. Moreover, composition procedure also relates to how to treat anonymity of cases and their informants. After discussing the issue during the interviews, all case companies wished to remain anonymous in the thesis.

3.5.1.6 Summary of case study

To conclude and summarize the case study approach, an adaptation of Yin's (2003) case study model is presented in Figure 3.7.

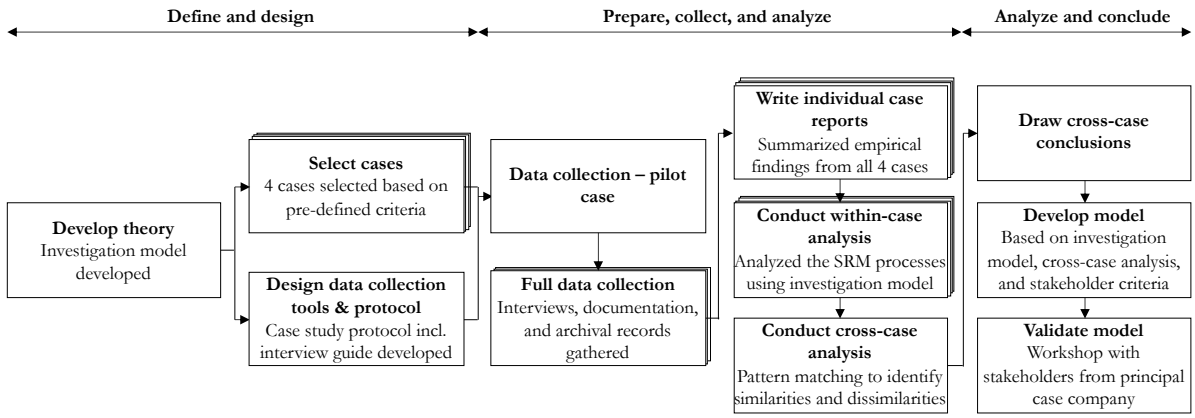

Figure 3.7: An overview of the conducted case study, an application of Yin's (2003) framework.

3.6 Research credibility

The last part of the methodology framework (Figure 3.1) relates to research credibility. As argued by Yin (2014), this is especially important in a case study as there have been some critics in the form of researchers who fail to stay objective.

3.6.1 Validity and reliability

Björklund and Paulsson (2012) define validity as to what extent one measures what was intended to be measured. Further, reliability is related to the authenticity of the results. In other words, a study with a high degree of reliability would expect to provide the same conclusion if repeated. In the context of case studies, Yin (2014) argues that the quality of the design can be examined using logical criteria and mentions four commonly used criteria to examine and establish the quality of an emerging design, which are strongly related to the terms validity and reliability. These are (1) construct validity, (2) internal validity, (3) external validity, and (4) reliability. Table 3.5 below includes an overview of the tactics the authors adopted to address all these areas.

Table 3.5: An overview of how Yin's (2014) logical criteria were addressed in this thesis.

Criteria	Tactics adopted
Construct validity	• Multiple sources of evidence used to support conclusions (Ellram 1996; Yin 2014; Norrman & Kembro 2019). • Key informants reviewed both initial draft reports and the final study (Ellram 1996; Yin 2014). • Feedback from peer researcher (i.e. LTH supervisor) on interview guide (Norrman & Kembro 2019).
Internal validity	• Data displayed in tables to facilitate cross-case analysis and pattern matching (Norrman & Kembro 2019). • Model validated with stakeholders at Company Alpha.
External validity	• Replication logic (literal replication) in the case study design (Yin 2014). • Usage of multiple cases in case study design (Voss et al. 2002).
Reliability	• Usage of case study protocol (Yin 2014), including a standardized interview guide (Norrman & Kembro 2019). • Usage of case study database (Yin 2014; Norrman & Kembro 2019). • Usage of tabular overviews to be transparent on how sources contributed to the conceptual SRM model in the literature review.

3.6.2 Objectivity

To ensure objectivity in this thesis, the authors avoided emotionally charged words which might indicate subjectivity, as this was suggested by Björklund and Paulsson (2012). Furthermore, the authors also considered the importance of being clear and explicit when stating sources and referring to information gathered from interviews in a correct manner (Björklund & Paulsson 2012).

4 Empirical findings

This chapter covers the empirical findings of the case study. It commences with a tabular overview of some characteristics of the case companies to provide some context. Thereafter, the empirical findings of Company Alpha are covered, structured in accordance with the investigation model. To limit the page number of the main report, the empirical findings of the other cases are placed in Appendix C.

To provide an overview and case-specific context, some key characteristics of the investigated case companies are provided in Table 4.1.

Table 4.1: Overview of purchasing related information in the case companies.

Company	Products	Turnover	Sourcing scope	Suppliers	Estimated purchasing spend (% of turnover)
Company Alpha	Juices, musts, ciders, lemonades, wines, and chutneys	685 MSEK	Global, with emphasis on Europe	~65	~450 MSEK (66 %)
Company Beta	Spices, starches, fibers, and customer-specific blends	750 MSEK	Global, with emphasis on Asia	100 - 150	~300 - 400 MSEK (40 % - 53 %)
Company Gamma	Ingredients to food industry, helps customers with product innovations and general advisory	490 MEUR[18]	Global, with emphasis on Europe	~2 500	~250 - 300 MEUR (51 % - 61 %)
Company Delta	Products for the food industry	3 200 MSEK	Global, with emphasis on Europe	150 - 200	Not shared due to secrecy

4.1 Company Alpha

4.1.1 Company information

Company Alpha is a family-owned Swedish company present in the agrifood industry. A general company description has already been provided (recall section 1.3), and this paragraph will mainly detail how the purchasing function operates. The purchasing organization is part of the more holistic Supply Chain function led by the Supply Chain Manager. It consists of three Operational Purchasers dealing with the day-to-day business and ensures that the goods arrive at the company's facilities at the desired time, quantity, and condition. Furthermore, they have a Purchasing Manager who is responsible for the more strategic aspect, such as defining the sourcing strategy and developing the long-term plan. At the time of the thesis, the company had just appointed a new person for this role with the ambition of moving towards a more structured and strategic approach

[18] ~4 944 MSEK.

to sourcing, as it has historically been more operationally focused. As an example, the Supply Chain Manager mentioned that they, at this time, do not formally use the Kraljic matrix to categorize their purchasing portfolio, even though they might consider the dimensions of strategic value and supply risks in other contexts. In general, there is much more focus on quality and delivery reliability than price when the company selects suppliers. Some of the KPIs used at the purchasing function are a contribution to profit margin, service level from supplier, and quality deviations.

4.1.2 Risk identification

At Company Alpha, SRM is strongly linked with the abbreviation QESH, i.e. quality/safety, environmental, social, and heritage. Additionally, one of the biggest risks mentioned by the Sustainability & Product Development Manager is the lack of visibility of transshipment points. In general, they have good visibility on the country of origin and country of production but lack visibility on potential intermediary stocking points, which might incur risks if the storage is conducted improperly.

Company Alpha includes some well-defined standardized processes in their risk identification, which are all centered around first creating longlists of potential risks, which are later reduced and prioritized in the assessment step. To identify food safety and quality risks, they follow the HACCP method, which gets applied to different product groups with similar process characteristics. Moreover, they follow the standardized TACCP (Threats Assessment and Critical Control Points) method, which is similar to HACCP but instead considers risk of threats and sabotage. As part of TACCP, they sometimes evaluate potential future scenarios. As an example, they recently performed risk assessments connected to climate change from the potential impact of increased ocean levels. Lastly, they also use VACCP (Vulnerability Assessment and Critical Control Points), which is focused on the risk of "cheating" of their supply chain partners.

Several tools are involved in the above-mentioned processes. Firstly, there is always an element of brainstorming when they are listing potential risks. The brainstorming can be either informal or structured according to a cause-effect diagram or "five whys"[19]. Moreover, as part of HACCP, they conduct an internal process mapping. Although no formal supply chain map is constructed to visualize the upstream supply chain and identify risks, Company Alpha tries to identify "map-related risks" from a supply chain perspective in a less visual manner using Excel. Lastly, at a management level, they conduct SWOT analyses to identify high-level risks.

To identify purchasing related risks, they have continuous contact with the suppliers, where they try to understand how the suppliers are doing financially and operationally. Another tool used for more continuous risk identification is Rapid Alert System for Food and Feed (RASFF). RASFF is a notification service in the European food industry that monitors risks that might be dangerous for end-consumers. If safety breaches are identified, relevant actors are informed about the breach and the involved suppliers and importers.

[19] An iterative method where the root cause to a specific problem is identified by repeatedly asking "why?" five times.

Another, more formal, way of identifying risky suppliers is conducted through their supplier evaluation, which has been conducted in a similar manner since 2017. The supplier evaluation is a prerequisite before conducting any business with a new supplier, and the company aims to continuously reevaluate all suppliers every third year. As a basis for this evaluation, Company Alpha sends questionnaires with relevant questions to the suppliers, presented in Appendix B. Table 4.2 provides an extract from the process' Excel sheet and highlights that they evaluate their suppliers based on (1) strategic value, (2) purchasing spend, (3) quality and product safety, (4) CSR (including the environmental aspect), and (5) risk of cheating. To objectively identify countries where the CSR and cheating aspect might be an issue, they try to include external sources and indices such as Maplecroft and BSCI. Evidently, the supplier evaluation is much focused on the quality and sustainability-related aspects and no explicit focus on other supply risk sources such as delivery reliability, capacity, and suppliers' general awareness/maturity within SCRM.

Table 4.2: An extract from Company Alpha's supplier evaluation Excel sheet.

Supplier ID	Supplier name	Responsible	Classification	Approval date	Planned reevaluation	Strategic value	Purchasing spend	Quality	CSR	Risk of cheating	Risk assessment	Comments
1234	Supplier A	Purchaser X	A	June-20	June-23	3	1	1	2	1	6	...

4.1.3 Risk assessment

For HACCP, TACCP, and VACCP there are well-defined processes, where risks are typically assessed based on their potential impact and probability of occurrence. The variables are multiplied to derive a risk score. If the risk score reaches a predefined threshold, it is considered for mitigation actions. The ownership of these processes lies within the quality function. A clarifying overview of the variables assessed in HACCP is shown in Table 4.3 and Table 4.4.

Table 4.3: Overview of how Company Alpha assess the severity variable in HACCP.

Severity	**Explanation with clarifying example**
8 - Very high	Risk of death
6 - High	Hospitalization
4 - Medium	Nausea, vomiting, minor allergic reactions
2 - Low	Uncomfortable feeling, change of product taste or appearance

Table 4.4: Overview of how Company Alpha assesses the probability/frequency variable in HACCP.

Probability/frequency	**Explanation with clarifying example**
4 - Daily	Occurs every day
3 - Rarely	1 - 2 occurrences per quarter
2 - Very rarely	Some occurrences every second year
1 - Never	Has never occurred, but might occur in the future

Another type of risk assessment is the supplier evaluation, which is conducted after the survey has been returned from the suppliers. As evident from Table 4.2, Company Alpha evaluates their suppliers using five criteria (strategic value, purchasing spend, quality, CSR, and risk of cheating), which are all assessed from one (low risk) to three (high risk) based on their perceived riskiness. Purchasing spend has predefined ranges, where a total spend of 0 - 0.5 MSEK equals one (low risk), 0.5 - 7 MSEK equals two (medium risk), and above 7 MSEK equals three (high risk). The other categories are qualitatively assessed, partly based on the underlying received data from the questionnaire. Company Alpha also tries to involve external sources to ensure objectivity in the assessment of criteria where it is possible. After all criteria are assessed, they are multiplied to derive a total risk score indicating the supplier's overall risk. A score below 15 is regarded as low risk, 16 - 40 as medium risk, and above 41 as high risk. The Sustainability & Product Development Manager has ownership of this task and conducts the assessment. After the assessment is done, the results are shared with other relevant stakeholders (e.g. the Purchasing Manager) for their validation and input. The assessment process is visualized in Figure 4.1.

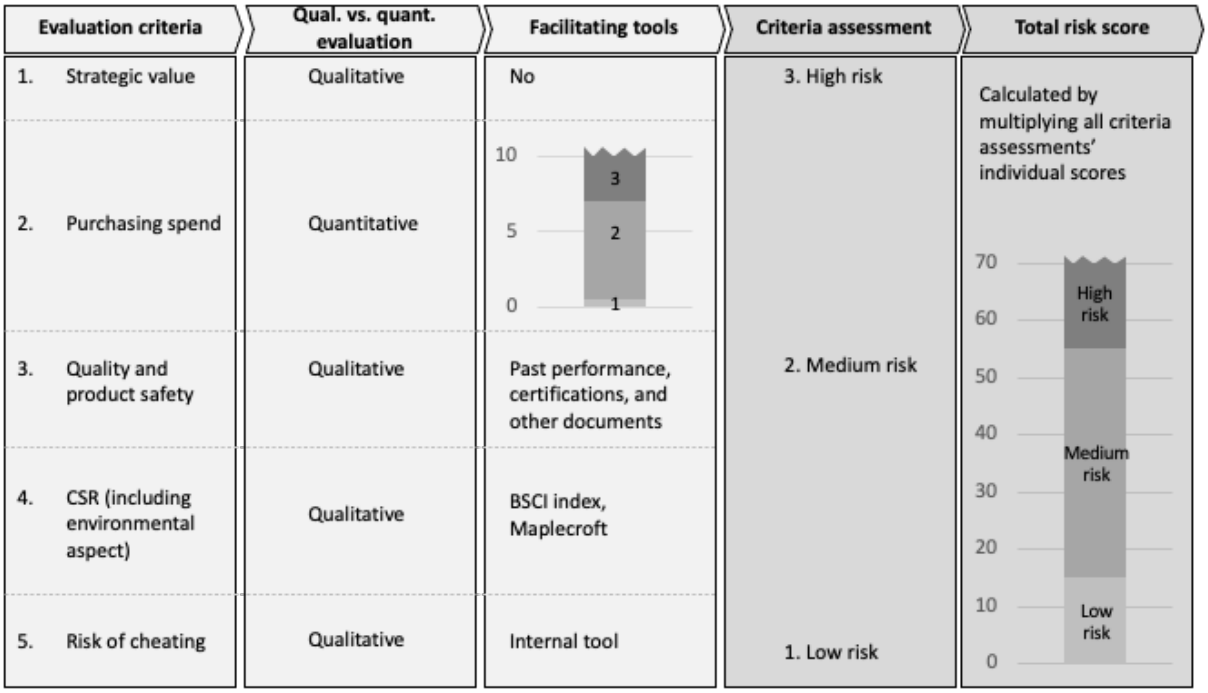

Figure 4.1: Conceptual overview of the assessment in Company Alpha's supplier evaluation.

4.1.4 Risk mitigation

Company Alpha typically does not document pursued mitigation actions more than changing the way of working. To mitigate risks identified from HACCP, TACCP, and VACCP, the result is often a change of routines. These routines can be either change in the internal flows or others, such as a change of supplier. Mitigation activities also include altering the specification/requirements towards the suppliers and adding monitoring activities such as additional analyses and sample testing.

In terms of purchasing related risks, the Supply Chain Manager mentions that the company pursues several different mitigation actions. The actions are highly context-dependent and can e.g. be

physical audits, forcing suppliers with delivery problems to change their logistics provider, or the usage of safety stocks. Another risk mitigation can be to source from smaller, local suppliers instead of larger, global ones, as the smaller suppliers are more likely to be flexible regarding e.g. order quantities. This can allow Company Alpha to order a smaller order quantity that reduces the obsolescence risk. Furthermore, they always aim to have at least two suppliers for strategically important raw materials. The Supply Chain Manager also mentions that some risks can be fully avoided from specifications and agreements with the suppliers. However, if there are risks they are not able to solve with the suppliers, they might be able to do so internally by modifying recipes or changing the overall product specifications. In general, there is no defined process on how mitigation actions are chosen as they are rather based on the experience of the employee.

4.1.5 Risk monitoring

Company Alpha has a process in place where they monitor certain suppliers more closely. As an example, they typically conduct monthly meetings with especially risky suppliers where they can share forecasts and other relevant information. However, there is no element of documentation included. They also follow a structured process to monitor risks as part of HACCP. Typically, it is conducted by defining critical values for different control parameters. By implementing monitoring systems, they are able to continuously ensure that they are operating within the approved limits.

During the interviews, it was apparent that continuous improvement plays an important part in the HACCP, TACCP, and VACCP processes. This is mainly done through internal revisions (and customer and third-party revisions) where they seek ways to make their existing processes more efficient and effective. In addition, the importance of getting "fresh eyes" on "old processes" was also emphasized. As the Quality Coordinator & Team Leader of Labs, who is heavily involved in the HACCP process, is a recent graduate from University, he is able to add another perspective and challenge the existing routines.

4.1.6 Risk organization

To govern the overarching risk management work, the risk topic is being discussed by the management team[20]. The management team follows a dynamic agenda which is always subject to what discussion points the members "submit" before their monthly meetings. As a result, the risk topic is being discussed once deemed necessary. As another governance mechanism, the management team discusses the supplier evaluation twice a year. During this meeting, they e.g. discuss whether there have been any major changes in the environment that would impact the underlying data and affect the evaluation. If that is the case, they might decide that they need to reevaluate some of the suppliers despite the fact the process "should" only be conducted every third year.

As evident from previous sections, much of the concrete SRM work is centered around the quality function, with some involvement from the supply chain function (primarily in the form of purchasing) as well. Within the quality function, they have defined a food safety group that meets

[20] The management team consists of: (1) CEO, (2) CFO, (3) HR Manager, (4) Sales & Market Director, (5) Sales Manager Private Label, (6) Supply Chain Manager, (7) Production Manager, and (8) Sustainability & Product Development Manager.

five to six times a year and is for instance responsible for leading HACCP on an annual basis[21]. Moreover, the quality function has defined an environmental group that discusses more environmentally focused risks. To bridge the gap between the quality function and other functions, there are scheduled formal meetings with the production and supply chain function twice a week.

To align the operational plans with the sales plans, they conduct alignment meetings. However, the sales function does not directly participate in these meetings, as the "sales perspective" is brought by an employee responsible for the forecasts (but formally part of the supply chain function). In the interviews, both the Sales Manager for Own Brand and Sales Manager for Private Label mentioned that there was lacking a formal process where they get notified of potential supply risks, which was only handled on an ad hoc basis apart from an annual review at management level.

Another element of Company Alpha's risk organization is the crisis management team. The members of the team are somewhat dynamic. The core always consists of the management team members, while other relevant stakeholders might be included depending on the areas affected if a crisis should occur. Formally, the CEO is responsible for the team, but if a crisis relates to product safety, the Sustainability & Product Development Manager takes ownership instead. During the interview, the Sustainability & Product Development Manager emphasized the importance of efficient communication in times of crisis, and also highlighted this as an area where they could improve. To be better prepared, they have a predefined communication plan that states who are responsible for what kind of communication both internally and externally. The Sustainability & Product Development Manager also mentioned how they have occasionally performed "role-playing" at management team meetings to simulate certain crisis scenarios. As only a few members are informed about the exercise beforehand, all members take the situation seriously. This allows for meaningful discussions afterward, where they can evaluate how the team responded to the "crisis".

Furthermore, Company Alpha annually offers risk training (as a part of a more general employee training) to all of their employees, which among other topics also touches upon crisis management. However, this more general training does not go into the same level of detail as the crisis exercises at the management team, as the general employees only need to be aware of the immediate steps if a crisis is identified such as who they should reach out to in a specific crisis. The employee training is led by the quality function.

In terms of risk culture, there are variations between different functions at the company. From the conducted interviews, it is apparent that the quality function is the heart of the risk organization, where risk management is perceived with great importance and something the employees are explicitly dedicating much effort into. Other functions are encouraged to have the same mindset, but might not consider risk management as explicitly as part of their everyday job.

[21] However, the HACCP team itself is cross-functional, even though it is led by the quality function representatives.

5 Analysis

This chapter aims to analyze the empirical findings. Firstly, a within-case analysis from Company Alpha is presented, structured in accordance with the investigation model. To limit the page number of the main report, only one within-case analysis is presented in this chapter, and the reader is referred to Appendix D for the secondary cases. Thereafter, the cross-case analysis is presented, where similarities and dissimilarities between cases are discussed, conclusions drawn, and takeaways summarized.

5.1 Within-case analysis

5.1.1 Company Alpha

In this section, the results of the grading of Company Alpha's SRM process are presented followed by the reasoning behind the grading.[22]

5.1.1.1 Risk identification

An overview of how the authors graded Company Alpha's risk identification process compared to the investigation model is shown in Table 5.1. The overview is followed by the reasoning behind each grade.

Table 5.1: Assessment of Company Alpha's risk identification process.

Investigation model: Risk identification	**Grade**
Structured identification process	2
Documented identification process	2
Regularly scanning for risks	2
Holistic approach to risk identification	2
Involvement of tools	3

By using HACCP, TACCP, and VACCP, Company Alpha is well aligned with the investigation model, as they follow a structured and documented identification approach conducted on a regular basis. They also include several of the tools from the investigation model, such as brainstorming and cause-effect diagrams. Naturally, however, there is no holistic risk scope inherent in these processes as they are designed to only focus on specific risk types.

The authors were able to identify a gap in terms of their more general risk identification, as the company has no process in place where they document risks at a "concrete risk level" outside of HACCP, TACCP, and VACCP[23]. This is considered to be covered in the supplier evaluation by the practitioners, but the authors claim that this only allows for a high-level overview of supplier risks and is not sufficiently detailed. As they are not listing concrete risks, the subsequent steps of

[22] Recall the grading system described in section 3.5.1.5, where 1 is *not in line with theory*, 2 is *partly in line with theory*, 3 is *more or less in line with theory*, 4 is *fully in line with theory*, and 5 is *more sophisticated than theory*.

[23] Which contradicts Kern et al. (2012), who showed that assessment is typically conducted at a risk level.

the process are suffering and they are not able to follow the structured approach advocated by the theory. Furthermore, the authors argue that Company Alpha would benefit from conducting supplier evaluation (or some other type of "general" risk identification) more frequently, as the three-year interval is perceived as too infrequent[24].

In terms of risk scope, it was mentioned in the interviews that Company Alpha considers both risks at supplier and raw material level, which resembles the distinction between *supplier* and *network* risks made by the authors in the investigation model. However, the authors argue that Company Alpha also, to some extent, consider *macro* risks by evaluating the general conditions of the countries their suppliers are present in. One concrete example of this is that they use the BSCI index to evaluate the risk associated with specific countries. As BSCI considers aspects such as political stability, regulatory quality, rule of law, and control of corruption, the authors argue that it to some extent relates to both political (MPO), legal (MLE), and social (MSO) risks in the investigation model. In terms of *supplier* risks, Company Alpha addresses several of the elements in the investigation from their supplier questionnaire (Appendix B) that lays the foundation for the supplier evaluation. More specifically quality (SQU), sustainability (SSU), security (SSE), legal (SLE), and operational (SOP) risks are given attention. In addition, aspects such as financial (SFI) and logistical (SLO) risks are also considered, but not as part of the supplier evaluation.

Even though many of the risk categories of the investigation model is somewhat considered, there is a skewness where quality and sustainability get a major focus and other relevant risk areas not being given the same attention[25]. The authors believe this is partly driven by the general quality and food safety focus in the food industry, both from regulation and Company Alpha's various certifications. Another explanation is that there has historically not been a strategic approach to purchasing at the company, which naturally leads to more focus on daily operations than proactively identifying risks. The authors believe that these two factors have caused the quality function to take much more responsibility for the identification process.

Lastly, in terms of tools, almost all of the tools in the investigation model was explicitly mentioned during the interviews. In addition, some new tools emerged, such as notification services, indices, and "five-whys". However, some tools are mainly being applied as part of the HACCP, TACCP, and VACCP processes, and not considered for all risk types.

5.1.1.2 Risk assessment

An overview of how the authors graded Company Alpha's risk assessment process compared to the investigation model is shown in Table 5.2. The overview is followed by the reasoning behind each grade.

[24] The need for a frequency and regularity in the identification process was highlighted by Kern et al. (2012).

[25] Which contradicts Kern et al. (2012), who argue the importance of a holistic risk identification scope.

Table 5.2: Assessment of Company Alpha's risk assessment process.

Investigation model: Risk assessment	Grade
Structured assessment process	2
Documented assessment process	2
Criticality assessment and prioritization of risks	2
Assessment on risk level	2
Consistent methodology for all risks	1
Involvement of tools	3

For the HACCP, TACCP, and VACCP processes, the company has a risk assessment process that is well-aligned with the investigation model through the usage of a risk assessment matrix. This allows them to work with risk assessment in a structured and documented way to prioritize their identified risks. However, in the authors' view there exists no proper assessment for more general risks. This translates to a gap compared to the investigation model, which advocates a consistent methodology for all risks[26]. This is a natural consequence of a lacking risk identification step, where concrete risks are not being listed. Essentially, the company's risk assessment step is replaced by a supplier assessment (as part of the supplier evaluation) as they are solely assessing risks at a more high-level and at supplier level.

5.1.1.2 Risk mitigation

An overview of how the authors graded Company Alpha's risk mitigation process compared to the investigation model is shown in Table 5.3. The overview is followed by the reasoning behind each grade.

Table 5.3: Assessment of Company Alpha's risk mitigation process.

Investigation model: Risk mitigation	Grade
Structured process for choosing mitigation actions	1
Documented mitigation process	1
Considering strategic alignment	1
Considering cost versus benefit	1

Several of the mitigation actions from the investigation model were mentioned during the interviews with employees at Company Alpha, such as safety stock (BUF1), multiple sourcing (NET1), audits (COL5). In addition, some new mitigations emerged, i.e. to demand suppliers to change service providers, change product specifications/design, introduce additional product controls, and to source from suppliers where Company Alpha has a larger bargaining power.

[26] Which was highlighted by Bailey et al. (2019).

Overall, the authors argue that Company Alpha lacks a structured and documented process for choosing mitigation actions. This is a consequence of a lacking structure and documentation from the previous steps, as structured risk mitigation requires a list of assessed risks as input. Instead, risks are mitigated ad hoc using the experience of the involved employees. Consequently, there is no formal element of either strategic alignment or cost versus benefit considerations involved in the process.

5.1.1.2 Risk monitoring

An overview of how the authors graded Company Alpha's risk monitoring process compared to the investigation model is shown in Table 5.4. The overview is followed by the reasoning behind each grade.

Table 5.4: Assessment of Company Alpha's risk monitoring process.

Investigation model: Risk monitoring	**Grade**
Structured monitoring process	3
Documented monitoring process	1
Monitor development of identified risks	3
Monitor already treated risks	3
Monitor and continuously improve the process	2

The risk monitoring was one area where Company Alpha showed similarities with the investigation model. The importance of monitoring past activities and discussing "lessons learned" was apparent, and the company actively worked with monitoring of both identified risks and pursued actions. However, as all risks and actions are not formally documented, the authors suspect that there is room for improvement and make the monitoring process more formal[27].

Furthermore, the authors grade "monitoring and continuously improve the process" as partly in line with theory, mainly due to the emphasis in HACCP/TACCP/VACCP. However, there is no explicit process for continuously improving the supplier evaluation.

5.1.1.2 Risk organization

An overview of how the authors graded Company Alpha's risk organization compared to the investigation model is shown in Table 5.5. The overview is followed by the reasoning behind each grade.

[27] E.g. compared to Ericsson's SRM process, including a well-documented monitor plan.

Table 5.5: Assessment of Company Alpha's risk organization.

Investigation model: Risk organization	**Grade**
Prioritized by management	4
Risk board	3
Cross-functional participation	2
Risk culture	3

The authors perceive that top management prioritizes the risk topic, as the management team is playing an active role in Company Alpha's risk management work, e.g. through their role as a governing risk board where they annually evaluate the risk situation. Moreover, they are acknowledging the importance of risk management as they are spending time simulating various scenarios, trying to be as prepared as possible for potential crisis situations. As top management serves as role models[28], this likely positively affects the overall risk culture in the organization.

Although the management team fulfills the role of a risk board at the company, the authors argue that there is still a minor gap compared to theory in this regard. In the literature review, it was mentioned that companies should have a dedicated board solely discussing the risk topic, whereas the management team at Company Alpha only considers it as an item part of their wider agenda. Moreover, it does not fully cover all of the aspects the "theoretical risk board" should do, such as defining ownership of specific risks to ensure execution.[29]

In terms of cross-functional participation, it is apparent that Company Alpha involves several functions in its risk management work. However, the authors argue that there is still room for improvement in this regard. The work is mainly conducted by the purchasing and quality function, with the latter taking a major part of the responsibility. As a concrete example, the Sustainability & Product Development Manager conducts and takes ownership of the assessment in the supplier evaluation without any involvement of other functions, apart from getting their validation after it is conducted. The authors argue that this further emphasizes the strong focus on quality and sustainability risks, negatively affecting the desired holistic risk focus. Additionally, there is a lack of formalized meetings with some relevant functions, such as sales.

Lastly, the risk culture is regarded as relatively strong at the company. The reason it is not graded as 4 by the authors is that the risk topic is still mainly driven by the quality function, and there is still room to improve the overall risk awareness among other functions.

5.2 Cross-case analysis

In this section, the results of the grading of all case companies are summarized, general patterns identified, and conclusions drawn.[30]

[28] Recall section 2.6.2.

[29] E.g. compared to the risk board discussed by Bailey et al. (2019).

[30] Recall the grading system described in section 3.5.1.5, where 1 is *not in line with theory*, 2 is *partly in line with theory*, 3 is *more or less in line with theory*, 4 is *fully in line with theory*, and 5 is *more sophisticated than theory*.

5.2.1 Risk identification

A summary of how the authors assessed the companies' risk identification process is shown in Table 5.6. The table is followed by a discussion of identified patterns and general conclusions.

Table 5.6: Assessment of the case companies' risk identification process.

Investigation model: Risk identification	**Company Alpha**	**Company Beta**	**Company Gamma**	**Company Delta**
Structured identification process	2	3	2	2
Documented identification process	2	2	2	2
Regularly scanning for risks	2	3	2	2
Holistic approach to risk identification	2	2	3	3
Involvement of tools	3	3	3	3

All case companies to some extent consider all three overarching risk source categories (i.e. macro, network, and supplier risks) in their risk identification. However, not all of the aspects within each overarching category were explicitly mentioned during the interviews. As the interviewees were not shown and specifically asked about the categories, it is possible that some of the risk categories were simply forgotten by the interviewees. Nevertheless, the authors argue that some key insights can be drawn from the interviews regardless, as it indicates what risk categories the interviewees consider to be especially important. The main takeaway is that the companies put much emphasis on quality (SQU) and to some extent sustainability (SSU) risks, with the other risk categories not being given the same attention. This was a pattern identified at all case companies and indicates a gap compared to theory which takes a much more holistic perspective towards SRM. This was not only reflected in the risk scope, but also in the overall process maturity which was at a much more mature stage for quality related risks.

The reason for this skewed focus is believed to be explained by the context of the (agri)food industry, with its heavy regulations and widely used quality and safety certifications demanded by the downstream customers. Another potential explanation might be that all case companies are relatively small/medium-sized. It is possible that larger companies would show more maturity in their risk identification, with a more holistic and structured approach.

All companies involved tools as part of their identification process. When cross-checking with the tools from the investigation model (Table 5.7), some patterns emerge. One thing all companies had in common was that they used supplier scorecards, audits, and HACCP. Furthermore, the analysis shows that some of the more conceptual/theoretical tools are rarely used in practice, such as the cause-effect diagram, FTA, and ETA. One explanation to this might be that they are perceived as "too theoretical", and that practitioners are not aware of all the tools developed and discussed by researchers. Another explanation might be that they unknowingly adopt the main idea in the tools without reflecting on it. This hypothesis emerged after interviewing the Supply Chain Manager at Company Alpha, who did not recognize the names "cause-effect diagram" and "FTA". However, after explaining how the tools were used, the interviewee argued that the same

mindset of breaking down problems into their root causes was used, although perhaps more informally and non-structured. The same argumentation probably also applies to brainstorming. While only the interviewees at Company Alpha could relate to the formal way of conducting brainstorming as described in theory, the other companies likely also involve it in their identification process in a more informal manner.

Table 5.7: An overview of what identification tools/techniques are used in the case companies.

Identification tool/technique	Company Alpha	Company Beta	Company Gamma	Company Delta
Supply chain mapping		X		
Kraljic matrix		X		
Cause-effect diagram	X			
Fault tree analysis			X	
Event tree analysis				
SWOT analysis	X	X	X	
Brainstorming	X			
Supplier scorecard	X	X	X	X
Supplier audits	X	X	X	X
HACCP	X	X	X	X

In addition to the tools from the investigation model, several new tools emerged during the interviews, such as participating in trade associations, following indices, and using notification services. The common denominator among these tools is that they can all be seen as "external business environment monitoring" conducted by a third party, which enables the companies to save time and resources, and requires little commitment. This finding is in line with the conclusion drawn by Fan and Stevenson (2018), who argue that practitioners in general prefer more simple and easy-to-use methods. However, the authors of this thesis argue there are some problems if companies rely too heavily on such tools. Firstly, the indices and trade associations only allow for a generic and high-level overview of potential risks and require further work to fully understand the implications for the focal company. Secondly, the notification services are reactive in nature as the company is only notified once the risk occurs and does not allow for proactive mitigation actions. Thus, in the authors' opinion, it should not be the main tool used in a proactive SRM model, but rather function as a complementary reactive tool.

Concludingly, the authors argue that lacking conceptual/theoretical identification tools might be causing the overall missing structure in the companies' identification processes. As they have no conceptual model to base their identification on, there exists no element of listing concrete risks in their processes. Thus, it will be an essential element to include when developing the model for Company Alpha.

5.2.2 Risk assessment

A summary of how the thesis' authors assessed the companies' risk assessment process is shown in Table 5.8. The table is followed by a discussion of identified patterns and general conclusions.

Table 5.8: Assessment of the case companies' risk assessment process.

Investigation model: Risk assessment	Company Alpha	Company Beta	Company Gamma	Company Delta
Structured assessment process	2	2	2	2
Documented assessment process	2	2	2	2
Criticality assessment and prioritization of risks	2	2	2	2
Assessment on risk level	2	2	2	2
Consistent methodology for all risks	1	1	1	1
Involvement of tools	3	3	2	3

The companies were graded equally in almost all regards of the risk assessment, indicating similar process maturity. In general, the risk assessment at the case companies was insufficient in many regards, as it showcased a lack of structure and documentation. A general observation was a lack of distinction between the identification stage and assessment stage. This especially emerged once asked how the companies assessed non-quality related risks, as this was often conducted without any clear process. As already mentioned, the companies had a much more structured assessment for quality risks as this was required by regulation. As discussed in the literature review, Kern et al. (2012) argue the generalizability of assessment methods, as the same kind of methods are appropriate to use for both general supply chain risks and supply risks. The generalizability should further imply that there are no inherent reasons why the assessment methods used for quality risks could not be applied to all risk types. Consequently, the authors of this thesis argue that the companies in general would benefit from adopting the same assessment methodology for all risks to address the identified gap.

Another insight was that some of the companies referred to their supplier evaluation when asked how they typically assess risks. However, from the authors' viewpoint, this form of assessment is not comparable to assessing at a concrete risk level. While an assessment at a concrete risk level provides deep insights for specific risks, the supplier evaluations used by the companies only provide general guidance on the overall high-level riskiness of a supplier. Thus, the authors argue that a supplier evaluation should not be seen as a replacement for risk assessment and that the companies would benefit from adding a structured process for listing/assessing concrete risks to their SRM process.

In the authors' view, there is also another potential dimension of risk assessment that no company explicitly assessed, namely assessment at a product level. By mapping the supply chain for each product (similar to Ericsson) as a starting point, the authors argue that it might provide some value to evaluate the riskiness at a product level. This assessment could take consideration to all three overarching risk sources (macro, network, and supplier risks) and e.g. evaluate the product risks

based on how many available suppliers it exists for the underlying raw materials, the geographical concentration of the suppliers (and to what extent the location is affected by "macro risks"), and if any of the strategically important suppliers has much "supplier risks".

As observed in Table 5.9, only the risk assessment matrix was used in practice among the case companies. However, there was no consensus on its exact application. This is in line with the literature review, where several different approaches were discussed by researchers (e.g. by Coyle et al. (2015) and Manuj and Mentzer (2008)). In the empirical observations, the assessment dimensions varied from qualitative categories (e.g. in Company Beta's *unlikely*, *likely*, and *very likely* assessment) to quantitative numbers (e.g. in Company Alpha's assessment). As a consequence, there were also slight differences in how the companies decided what risks to proceed with. In the "numerical assessments", threshold values were typically defined to determine which risks were seen as critical enough to grant a mitigation action, whereas the "classification assessments" had defined what categories in the matrix required further actions.

The authors suspect a general tendency that the limits might be a bit too strictly defined in the assessments, resulting in a large proportion of the assessed risks simply being accepted with no actions even considered. This was primarily seen at Company Beta, where actions are only required in 33 % of the potential outcomes (recall Figure C.2), which means that e.g. risks with very likely probability that are likely to get detected is not given any attention at all.

Regarding the other assessment tools, none of the interviewees recognized neither the names nor the procedures of the tools. The authors argue that the reason is the same as for the identification tools, simply that the practitioners might not be aware of all the tools discussed by researchers. The conclusion from Fan and Stevenson (2018) regarding practitioners preferring simple identification thus likely applies to assessment tools as well.

Table 5.9: An overview of what assessment tools/techniques are used in the case companies.

Assessment tool/technique	**Company Alpha**	**Company Beta**	**Company Gamma**	**Company Delta**
Risk assessment matrix	X	X	X	X
Delphi technique				
Failure modes and effects analysis				
Analytical hierarchy process				
Ericsson's risk management tools	N/A	N/A	N/A	N/A

5.2.3 Risk mitigation

A summary of how the authors assessed the companies' risk mitigation process is shown in Table 5.10. The table is followed by a discussion of identified patterns and general conclusions.

Table 5.10: Assessment of the case companies' risk mitigation process.

Investigation model: Risk mitigation	Company Alpha	Company Beta	Company Gamma	Company Delta
Structured process for choosing mitigation actions	1	2	2	1
Documented mitigation process	1	1	2	1
Considering strategic alignment	1	2	1	1
Considering cost versus benefit	1	4	1	1

Similar to the risk sources, the authors did not show the mitigations actions from the investigation model to the interviewees during the interview, and it is consequently not possible to assume that non-mentioned mitigations actions are not used by the companies. Nevertheless, the authors argue the analysis still provides useful insights to what mitigation actions are considered to be of the greatest importance. Among the most frequently mentioned mitigation actions are multiple sourcing (NET1) and buffer inventory (BUF1), which was mentioned by all case companies. Given that these were the two actions most frequently occurring in the reviewed articles as well[31], they undoubtedly seem to be the most popular mitigation actions from both a theoretical and practical perspective.

A general gap was identified in terms of how companies determine appropriate mitigation actions given an identified/assessed risk. Company Beta proved to be "best-in-class" in this aspect, as they had some defined tools they utilized for this task. However, while the other companies did not refer to explicit tools or processes other than the intuition and experience of their employees, they likely consider similar aspects as Company Beta indirectly, although in a less formalized manner.

Neither of the investigated companies had a formal documentation linking pursued mitigation actions with concrete risks. Although, at one case company (Company Gamma) it was mentioned that the output of pursued actions are always documented in other formats, such as purchasing strategy documentations and contracts. Nonetheless, the authors argue this makes the consequent step of risk monitoring virtually impossible for treated risks, as there is no obvious way of extracting the "mitigation elements" and the underlying risks in those documents. Thus, this is a major gap that applies to all the observed companies.

5.2.4 Risk monitoring

A summary of how the authors assessed the companies' risk monitoring process is shown in Table 5.11. The table is followed by a discussion of identified patterns and general conclusions.

[31] Recall Table 2.5-2.12 in the literature review.

Table 5.11: Assessment of the case companies' risk monitoring process.

Investigation model: Risk monitoring	Company Alpha	Company Beta	Company Gamma	Company Delta
Structured monitoring process	3	1	1	1
Documented monitoring process	1	1	1	1
Monitor development of identified risks	3	2	2	2
Monitor already treated risks	3	1	1	1
Monitor and continuously improve the process	2	1	1	1

The analysis of the risk monitoring step showed some varied results between the cases, with Company Alpha showing the overall highest process maturity. Among the aspects part of the investigation model, mainly monitoring of identified risks appeared to receive attention, although often without any formal process. Interestingly, the Category Procurement Manager at Company Delta even mentioned that this was not of any practical value, as it was more relevant to spend time on proactive risk identification, assessment, and mitigation. This insight is well aligned with the conclusion drawn by Fan and Stevenson (2018) who highlight that the risk monitoring aspect typically is overlooked by researchers. Judging by this small-scale case study there appears to be limited attention from the practical perspective as well.

5.2.5 Risk organization

A summary of how the authors assessed the companies' risk organization is shown in Table 5.12. The table is followed by a discussion of identified patterns and general conclusions.

Table 5.12: Assessment of the case companies' risk organization.

Investigation model: Risk organization	Company Alpha	Company Beta	Company Gamma	Company Delta
Prioritized by management	4	3	3	-
Risk board	3	2	2	-
Cross-functional participation	2	3	3	-
Risk culture	3	2	4	-

The factor detailing how prioritized SRM is by management was probably the most difficult one to assess as it contains a high degree of subjectivity. However, all companies were perceived to have relatively prioritized risk management work, likely driven by regulatory requirements. The prioritization from management appeared particularly strong at Company Alpha, exemplified by e.g. their crisis team exercise and risk training offered to employees. Even though it is difficult to assess, the authors emphasize the importance of the prioritization aspect as it sets the foundation to how much resources a company is willing to dedicate towards SRM, and, as mentioned by Levy et al. (2010), top management act as role models towards an organization and their behaviour affects the entire risk culture.

Neither of the companies had a dedicated risk board that exclusively discussed the risk topic, which contradicts the investigation model. However, the authors of this thesis argue that this might be explained by the small/medium-size of the investigated companies. Given the limited resources available, it might not make economic sense to dedicate such resources, as long as the topic is given explicit focus as a standing point on the agenda of the management team meetings.

All case companies had a SRM process to a varying extent characterized by cross-functional participation. In some of the companies, the authors argue there might be a bit too "quality function heavy", with the purchasing function mainly acting as support. This was especially the case at Company Alpha, where the entire assessment process was conducted by the Sustainability & Product Development Manager with no "external" perspective outside of the quality function apart from validation. The authors suspect that this might further emphasize the skew risk scope focus as non-quality/sustainability aspects are likely not weighted with equal importance.

The risk culture was also somewhat difficult to assess, similar to the management prioritization, as this is a subjective factor some of the interviewees had difficulties relating to. Overall, the risk cultures appeared to be relatively well aligned with theory as the importance of risk management was acknowledged in the companies although some minor concerns and improvement areas were identified. Firstly, the authors believe that the lack of cross-functionality in some of the companies negatively impacted the risk culture, as Levy et al. (2010) mentions the involvement and information-sharing across the organization as an important element when ensuring a strong culture. Secondly, some indications could be drawn relating to a somewhat lacking risk awareness and perception of risk management. In several of the companies, it was mentioned that many employees conduct "risk management work" without explicitly thinking of it as risk management, particularly outside of the quality function. For instance, a purchaser might negotiate contracts in a certain manner or pursue dual sourcing for some products based on experience and not reflecting on it as being risk mitigation actions. The authors argue that this might be a consequence of a lack of structure in the overall process, where employees do not think of risk management as the theoretical stepwise approach.

5.2.6 Summary of takeaways

To conclude the cross-case analysis, the main takeaways are summarized in a tabular format in Table 5.13. These will serve as an important inspiration to the model development in the subsequent chapter.

Table 5.13: Summary of takeaways from analysis.

#	Part of investigation model	Takeaway from analysis
1	Risk identification	A skew risk scope was identified, as the companies primarily focused on quality and sustainability risks
2	Risk identification	All companies lacked a structured way of listing/documenting more general supply chain risks at a concrete risk level
3	Risk identification	The companies were in general good at involving tools in their risk identification but lacked a conceptual tool/model to structure the process
4	Risk identification	Several new tools emerged during the interviews, leveraging on third party actors, but exclusively relying on them might result in insufficient and reactive risk identification
5	Risk assessment	The companies lacked a structured and consistent assessment methodology for all risk types
6	Risk assessment	General supply chain risks were mainly assessed at a supplier level rather than a concrete risk level
7	Risk assessment	The risk assessment matrix was the most frequently used assessment tool among the companies, well in line with theoretical findings
8	Risk mitigation	A structured process for determining and documenting mitigation actions was lacking at all companies
9	Risk mitigation	The strategic alignment and cost versus benefit aspect were only somewhat formally considered at Company Beta
10	Risk monitoring	The monitoring and continuous improvement aspects were overlooked by almost all companies, which is well aligned with the theoretical findings
11	Risk organization	Top management prioritization was difficult to assess, but the interviews indicating the risk topic being somewhat prioritized at all companies
12	Risk organization	Neither of the companies had a dedicated risk board, which is likely explained by the small/medium company sizes that might not justify such dedicated resources
13	Risk organization	The major gap in cross-functionality was identified at Company Alpha, driven by the Sustainability & Product Development Manager having the sole ownership of major parts of the risk management work
14	Risk organization	A common observation from the companies was that risk management is mainly explicitly considered by the quality function, whereas other functions (e.g. purchasing) conducts "risk management activities" without reflecting on it being risk management

6 Developed SRM model

This chapter presents the authors' recommendation in the form of a developed SRM model. Firstly, some general remarks are discussed, followed by the actual model, which is divided into elements of (1) risk identification, (2) risk assessment, (3) risk mitigation, (4) risk monitoring, and (5) risk organization. Lastly, a tabular overview details how the takeaways from the analysis were considered in the model development.

6.1 General remarks

With the investigation model as a starting point and considerations taken to the takeaways from the analysis and the stakeholder criteria, the authors have developed an SRM model for Company Alpha which will be presented and argued for in this chapter. The authors propose a primary process that is conducted on an annual basis, from hereon referred to as the *Annual SRM process*, with each step being conducted in workshop settings in relatively concentrated time-space. In addition to this primary process, some elements of the SRM model are suggested to be conducted in a more frequent/continuous manner to enable actions from changes to the environment throughout the year. This is conceptually illustrated in Figure 6.1.

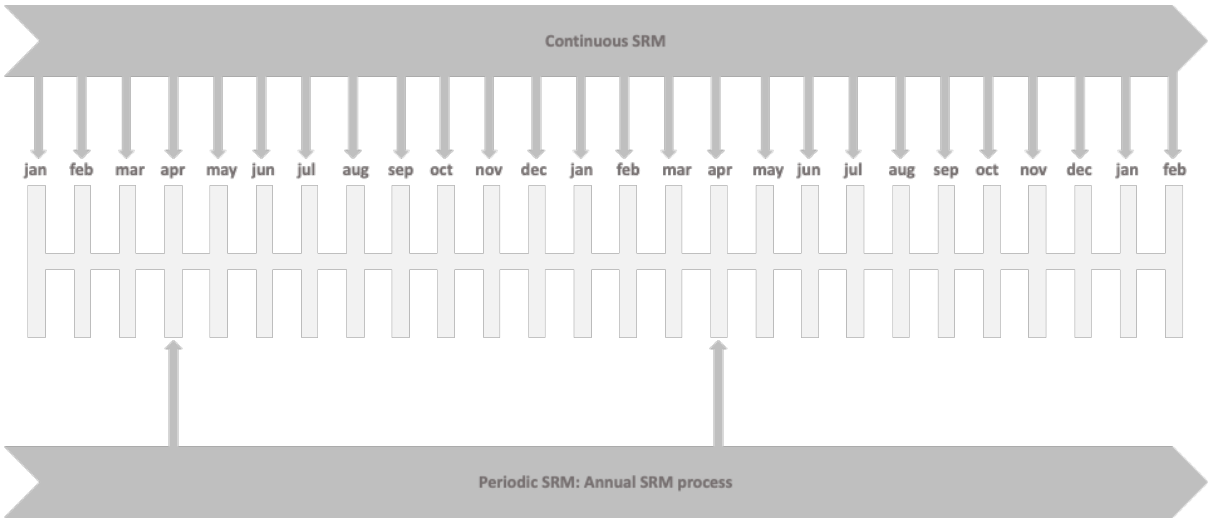

Figure 6.1: Conceptual overview of the periodicity of the process.

The authors propose that Company Alpha document the process using Excel spreadsheets. However, a more sophisticated documentation procedure and system might be interesting to consider in the future. The two main Excel sheets that are suggested will from hereon be referred to as *D1: Risk document*[32] and *D2: Supplier contact*. The authors further recommend that all documents are being stored in a central location that is accessible for all relevant stakeholders.

A conceptual overview of the model is shown in Figure 6.2, which unarguably shows much resemblance to the systems approach and the system the authors have had in mind throughout the research process (recall Figure 3.4). Next, all of the components of the model will be elaborated in more detail.

[32] Mainly inspired by Ericsson's *Template for risk assessment and treatment* (recall Figure 2.13).

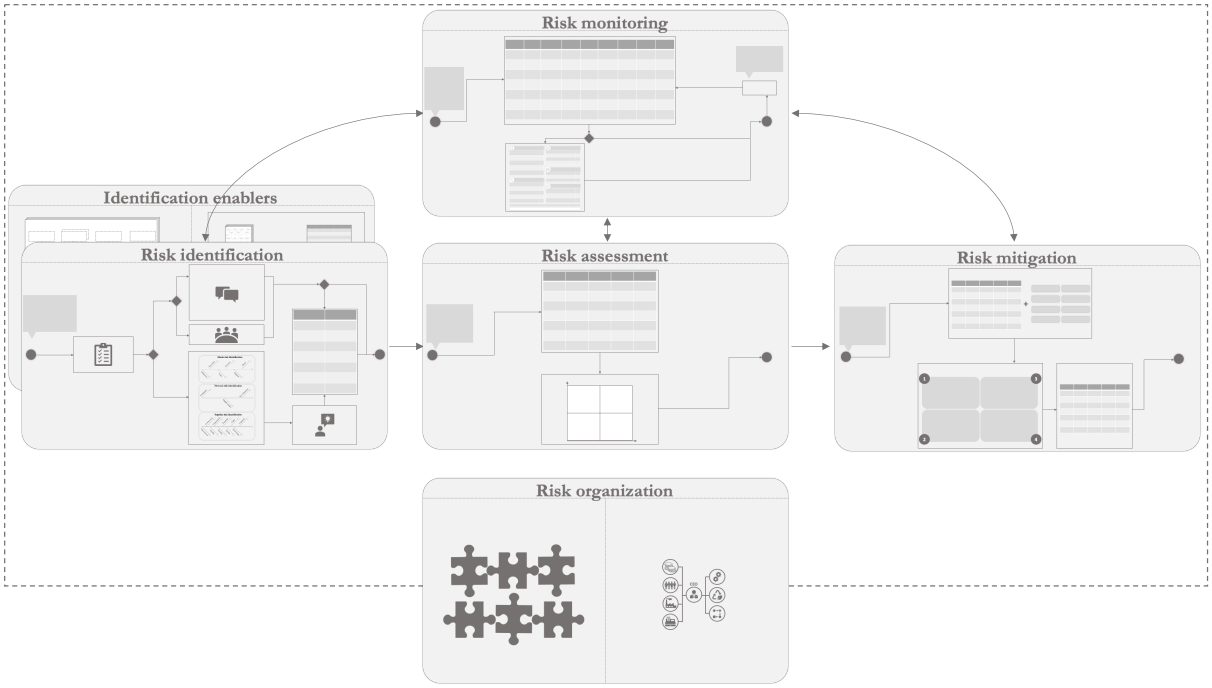

Figure 6.2: Conceptual overview of proposed SRM model.

6.2 Risk identification

As an effective identification process lays the foundation for successful risk management, the authors emphasize the importance of spending much resources at this step. In the proposed risk identification process, the authors intended to address the observed gap of lacking structure and regularity and extend the risk scope to become more holistic to not overlook non-quality/sustainability risks. First of all, the authors propose that certain *identification enablers* are in place, before commencing the actual process. Thereafter, the authors propose a risk identification process that contains two sub-processes: (1) *annual risk identification* (part of the Annual SRM process) and (2) *continuous risk identification*.

6.2.1 Identification enablers

The proposed identification enablers are not specific to SRM, as they relate to purchasing in general. The authors argue that Company Alpha is lacking some general structure in terms of strategic purchasing, which is a gap that has also been identified by the practitioners themselves. Thus, the recommendation of addressing the enablers is well aligned with their overarching objective of a more strategic approach towards purchasing.

Firstly, the authors argue that Company Alpha should visually map their upstream supply chain as no such map currently exists. The map should mainly be used as guidance to easier identify risky aspects in their supply chain, such as single sources for critical components. The proposed mapping approach is inspired by the one used at Ericsson, with some minor alterations.

It is recommended that the company follows the already existing product categorization used in HACCP and constructs a unique map for each of the product groups. While this recommendation is slightly more aggregated than Ericsson's (which is conducted on product level), the authors

believe there might be some synergy effects from using the already existing categorization. This way, they can match their upstream map with the corresponding internal one developed in HACCP to get a holistic view of each product group flow.

Initially, the authors recommend that the company only maps the first tier of suppliers, in contrast to Ericsson where three tiers are considered. This recommendation is mainly driven by the resource constraint, as Company Alpha is a relatively small company. However, if the company aspires towards a more mature approach towards SRM (and SCM in general) in the future, adding multiple tiers to the maps might be an appropriate starting point. If that is the case, the company might also find some of Ericsson's mapping practices mentioned in section 2.2.2.1 of interest.[33]

Secondly, the authors recommend that Company Alpha segment their purchasing portfolio using the Kraljic matrix. Although the dimensions in the matrix are already considered in a less formal manner today, a more documented segmentation may have positive effects on both their SRM work and purchasing in general.[34]

The authors recommend that the Purchasing Manager has the ownership of ensuring that the identification enablers are in place and to include the Operational Purchasers in the process. A conceptual overview of the identification enablers is shown in Figure 6.3.

[33] Such as the computation of BRTs and the assignment of scores depending on how many approved sources there exist for each raw material, which could be considered in other parts of the SRM model.

[34] For a more in-depth discussion on how the segmentation can be conducted, the reader is referred to section 2.2.2.2 or van Weele (2014).

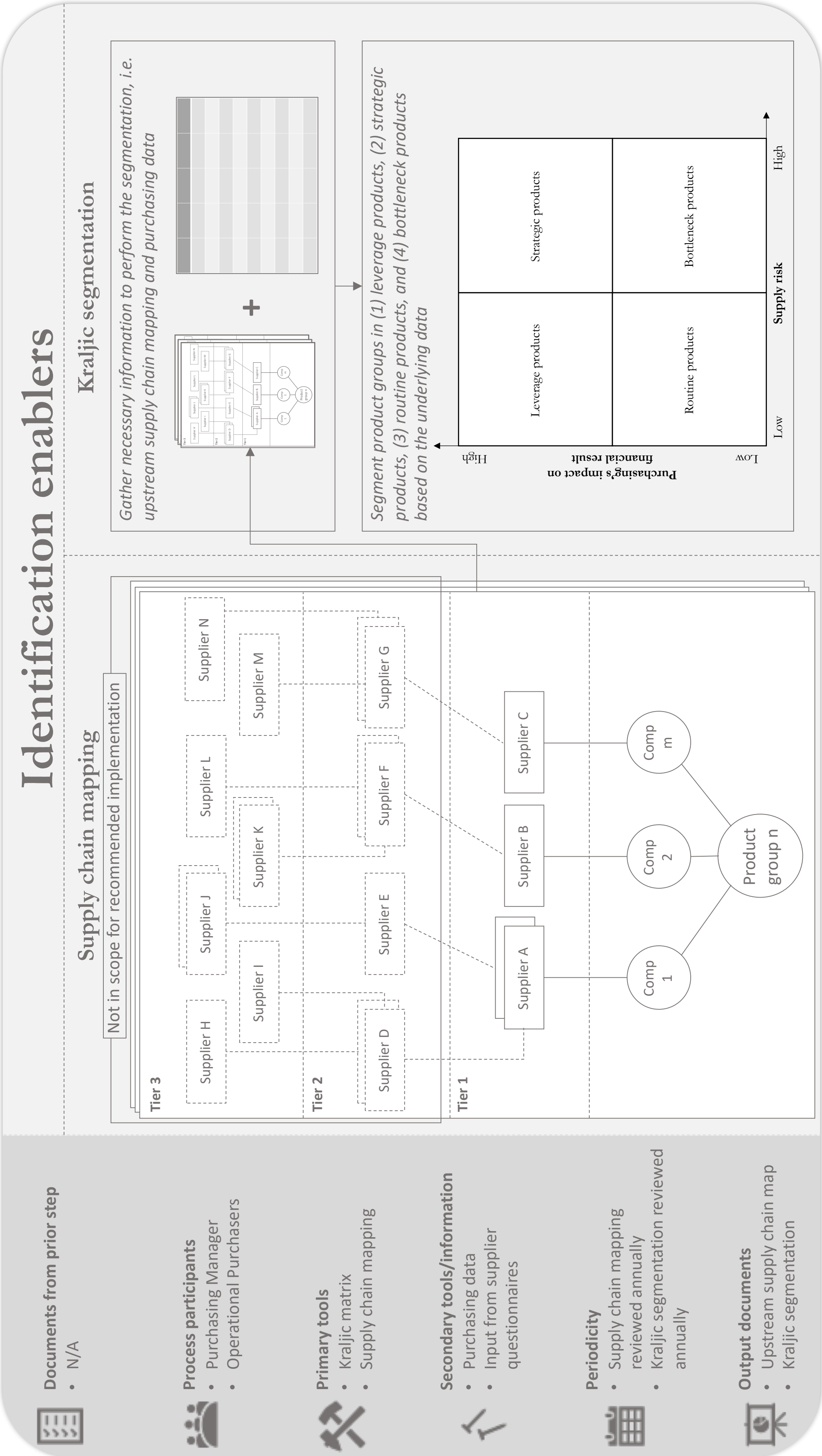

Figure 6.3: Conceptual overview of the identification enablers.

6.2.2 Annual risk identification

The annual risk identification is conducted as part of the Annual SRM process. The authors recommend that several tools are used, and some specific data is being gathered prior to the process. Firstly, it is recommended that the identification enablers from section 6.2.1 are in place, i.e. Kraljic segmentation and upstream supply chain map. Secondly, the supplier evaluation and associated data received from the suppliers should be accessible. Thirdly, it is recommended that supplier performance data is considered, e.g. relating to delivery performance. Lastly, information sources such as BSCI, Maplecroft, and CPI indices should also be readily available. The involvement of these analyses and information sources should allow for a rigorous identification process and overall more trustworthy result, which was regarded as important by the stakeholders[35].

In accordance with the conceptual risk source framework developed in the literature review (Figure 2.15), the authors propose a process for annual risk identification that is split into (1) macro risks, (2) network risks, and (3) supplier risks. Within each category, the authors emphasize the importance of including a conceptual model to structure the identification. As Company Alpha already has experience from working with cause-effect diagrams in their HACCP process, it is considered to be an appropriate option. More concretely, it is advised to use cause-effect diagrams that incorporate the risk categories from Figure 2.1 as a primary categorization[36], visualized in Figure 6.4. Moreover, the authors suggest that the brainstorming technique is used and that the various documents and information sources mentioned in the previous section are incorporated as much as possible.

- The authors propose that the *macro risk diagram* is considered for the following geographical areas: North America, South America, Africa, Europe, and Asia. Evidently, the suggested areas are relatively high-level, which means that the process participants will need to "zoom in" within each region to consider risks that affect the specific locations where their suppliers operate.[37]
- The authors suggest that the *network risk diagram* is used for each raw material group. In contrast to the flexibility in the macro risk diagram, the authors strongly advise the process participants to remain at this granularity to not lose essential details.
- The authors recommend that the *supplier risk diagram* is applied to all suppliers in Company Alpha's supply network.

[35] Recall the stakeholder criteria, e.g. mentioned in section 3.2.1.4.1.

[36] Together with new risk source categories that emerged from the empirical findings, distinguished with an asterix (*): Company Alpha (-); Company Beta (-); Company Gamma (-); Company Delta (Complexity).

[37] As a concrete example, it is not advised to list too general risks such as "risk of earthquakes in Asia". Instead, they should focus on the areas within Asia where they conduct business and identify more local/regional risks.

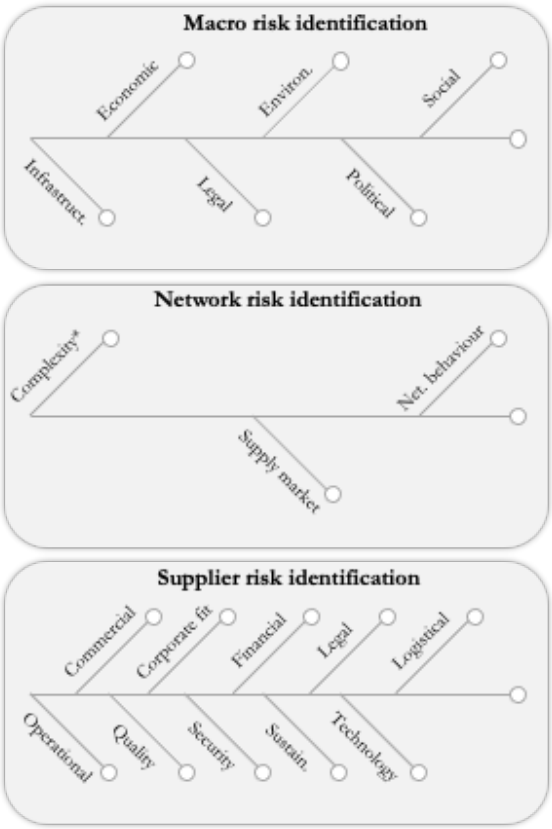

Figure 6.4: Cause-effect diagrams used in the annual risk identification.

The authors recommend that the annual risk identification is conducted in a workshop format, with some individual pre-work conducted beforehand.

1. **Pre-work:** Before the workshop, the process participants should divide the risk areas (i.e. different geographical locations, raw material groups, and suppliers) between each other, and individually make an initial attempt of identifying relevant risks.
2. **Risk identification workshop:** The purpose of the workshop is to go through potential risks in a group. The identified risks from the pre-work serve as the baseline, to which risks are added or removed based on the group discussion and collective brainstorming. After the relevant risks have been confirmed, they should be added to *D1: Risk document*, as exemplified in Figure 6.5.

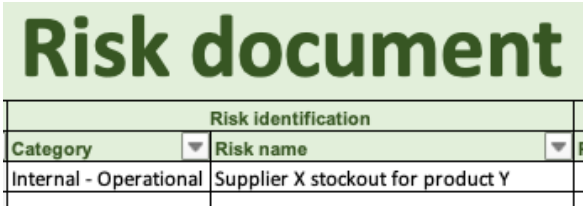

Figure 6.5: D1: Risk document after the risk identification, which serves as the output of this process step.

Ideally, the authors advocate that the annual risk identification should, as the name suggests, be conducted on an annual basis. However, if the workload in the workshop is considered too high, it might be appropriate to instead conduct it twice per year and split the workload between the sessions. As an additional benefit, this would allow the periodic aspect of the SRM model to

become more continuous. Another possibility that might be worth investigating is to differentiate between the risk categories by leveraging the information from the identification enablers (i.e. upstream supply chain maps and Kraljic segmentation). This way, the riskiest geographical locations, raw material groups, and suppliers can be identified and prioritized, while the non-prioritized areas can be considered at a slightly reduced frequency (e.g. bi-annually).

The process participants are suggested to consist of the Purchasing Manager, Supply Chain Manager, and Sustainability & Product Development Manager, from hereon referred to as the *core team*. Moreover, for risk categories that are on a more detailed level (supplier risks and potentially also network risks), it is advised to include operational employees that work closer to the suppliers (e.g. Operational Purchasers) in the process. Lastly, the authors suggest that the Purchasing Manager should have ownership of the annual risk identification.

6.2.3 Continuous risk identification

Continuous risk identification relates to identifying risks in a more frequent manner as part of daily operations. This is a practice that already exists at the company, although the authors propose some changes to how the process should be documented as this is currently lacking. The authors propose a continuous risk identification that contains two sub-processes: (1) supplier-centered identification and (2) company-centered identification.

The supplier-centered identification focuses on risks found externally in the supply chain, and the authors recommend that these are identified using both an informal and formal method. The informal method is similar to the continuous dialogue the company already maintains with its suppliers, with the purpose of gaining valuable insights and information that could help to identify potential risk sources. In addition to how they currently perform this dialogue, the authors recommend that relevant observations are documented in *D2: Supplier contact*, exemplified in Figure 6.6.

In terms of the formal method, the authors recommend recurring monthly meetings with suppliers deemed especially risky, which is already conducted at the company. Similar to how Company Alpha currently operates, the authors recommend that they use formal meetings as a forum where they can share forecasts and discuss general capacity and supply issues. The authors recommend that the practitioners document important notes from the meetings in the same Excel sheet (Figure 6.6) as from the informal supplier contact. Concludingly, if any concrete risk is unveiled from the supplier contact (either informal or formal), they should also be added to *D1: Risk document* and be considered for further assessment. The Purchasing Manager is recommended to maintain the ownership of the formal supplier contact, while responsibility of the informal contact remains with the Operational Purchaser responsible for the specific supplier.

Supplier contact

#	Supplier name	Formal meetings	Previous contact	Responsible Purchaser	Next scheduled contact	Takeaways from previous contact
1	Supplier A	Yes	2021-03-05	Purchaser X	2021-04-05	Problems with equipment and will produce at a reduced capacity for 3 months
2	Supplier B	No	2021-01-15	Purchaser Y	2021-05-01	Recently changed supplier for raw material X to improve delivery reliability and quality

Figure 6.6: D2: Supplier contact with a clarifying example.

The company-centered identification focuses on risks found internally in the company. The authors recommend that they continue with the recurring cross-functional meetings already in place. In addition, it is also recommended that formal meetings between the sales and purchasing functions are initiated to enhance the cross-functionality and risk awareness throughout the company. Similarly as in the supplier-centered identification, the practitioners should note any potential risk that emerges from internal discussions in *D1: Risk document* to enable further assessment.

A conceptual overview of the full risk identification step is shown in Figure 6.7.

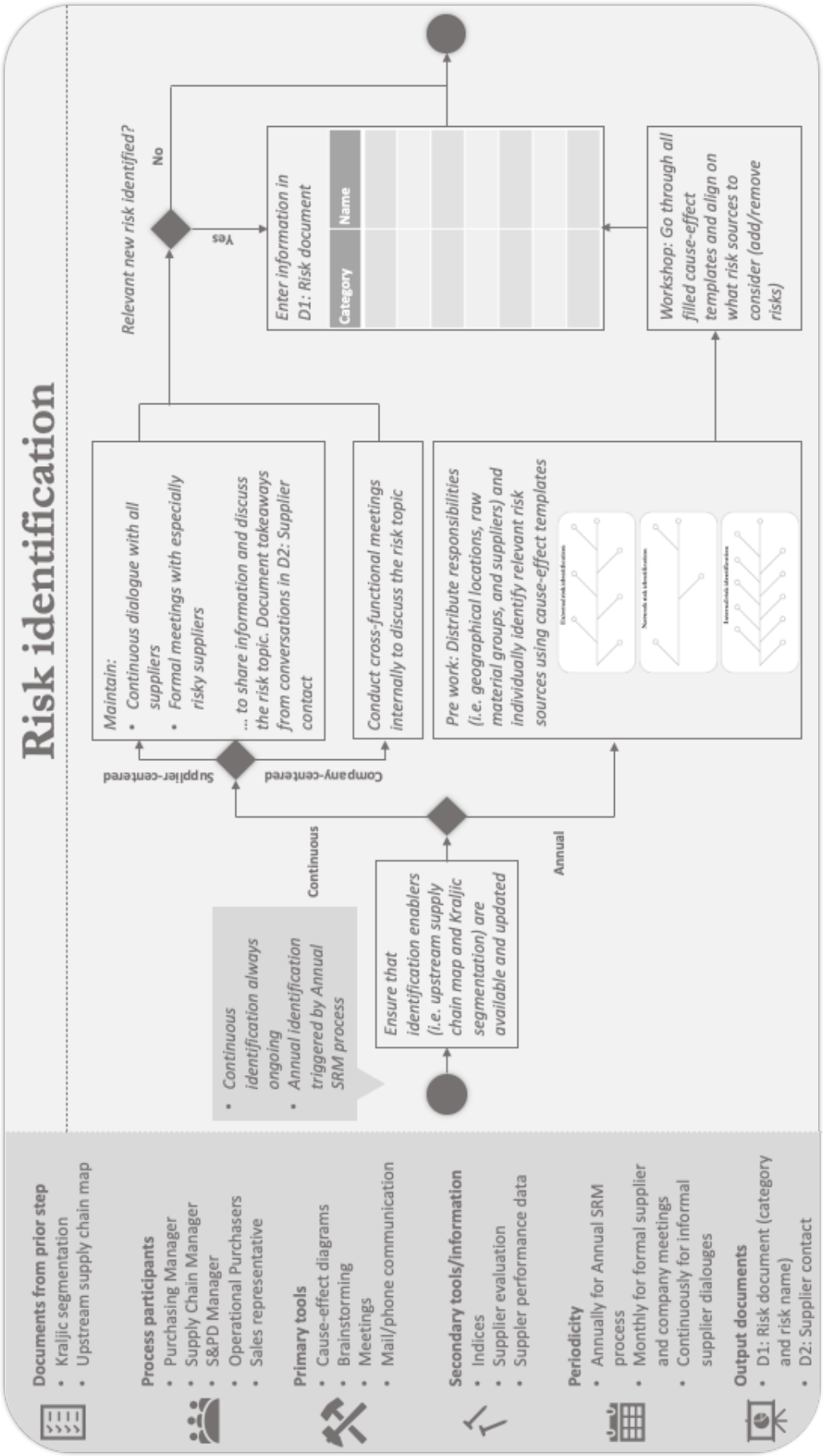

Figure 6.7: Overview of the proposed risk identification process.

6.3 Risk assessment

A major gap in the current risk assessment is the lack of methodological consistency for different risk types and that not all risk assessment is conducted at risk level, which the authors intend to address in the proposed model. Furthermore, as one important stakeholder criterion was the user-friendliness of the model and that practitioners in general tend to prefer easy-to-use tools ahead of analytically heavy ones, the authors opted for a simple (primary) assessment tool. The natural choice was the risk assessment matrix, given that both the theoretical and empirical findings indicate that it is the most frequently used one in practice. Another benefit of the risk assessment matrix is that practitioners at Company Alpha already are familiar with it. In terms of secondary tools and information sources, it is recommended that the process participants include the same ones as in the annual identification process[38]. In addition, it might also be relevant to include data relating to bill of material and historical sales data to fully capture the size of each risk.

D1: Risk document serves as input for the risk assessment, in which all identified risks have been documented. At the assessment step, all risks should be discussed explicitly by the process participants and assessed in terms of its *probability of occurrence* and the *potential negative business impact* (considering revenues, costs, and brand image) on a scale from one to five, which is clarified in Table 6.1 and 6.2. To keep the output as trustworthy as possible, the authors emphasize the importance of considering the secondary tools and information sources where possible as this will allow for a more objective assessment. A potential improvement of this assessment that Company Alpha might consider in the future is to make the impact assessment more operationalized and tangible. As a concrete example, it might be possible to consider the business impact in terms of BRT or BIV as Ericsson utilizes in their SRM process.

Table 6.1: Clarification of the probability variable.

Probability value	**Explanation**
1	No previous occurrences / Less than yearly occurrences
2	Occurs every year
3	Occurs every quarter
4	Occurs every month
5	Occurs every day

[38] I.e.: (1) Kraljic segmentation, (2) upstream supply chain maps, (3) indices, (4) supplier evaluation, and (5) supplier performance data.

Table 6.2: Clarification of the impact variable.

Impact value	Explanation
1	Very limited impact to revenues, costs, and brand image
2	Limited impact to revenues, costs, and brand image
3	Moderate impact to revenues, costs, and brand image
4	High impact to revenues, costs, and brand image
5	Very high impact to revenues, costs, and brand image

The probability and impact variables cover the criticality aspect of risk assessment, but the investigation model also contains a prioritization aspect. The authors therefore recommend that a prioritization order is established as guidance on where to prioritize the efforts. To rank the risks, the authors propose that a risk score is computed as probability of occurrence times the potential impact, as exemplified in Figure 6.8.

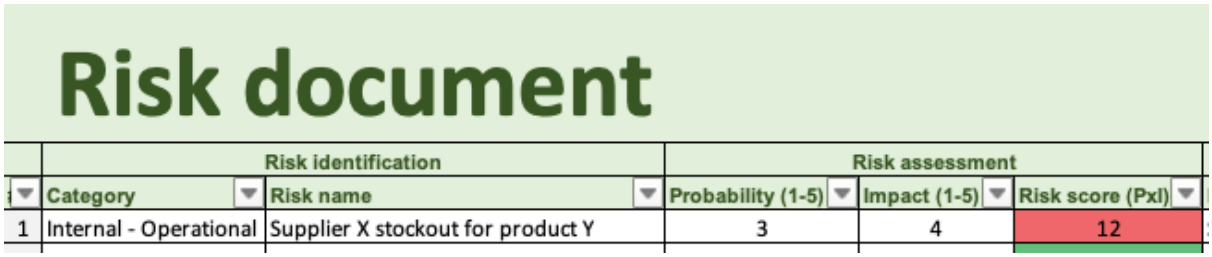

Figure 6.8: D1: Risk document after the risk assessment, which partly serves as the output of this process step.

The results of the risk assessment can be visualized in a risk matrix by plotting the probability and impact combinations (visualized in Figure 6.9). This chart provides a high-level overview of the risk situation, which makes it appropriate to use as the basis for discussions when governing the process (further detailed in 6.6.1). Moreover, as detailed in the figure, it enables a natural categorization of risks distinguished by the quadrants.

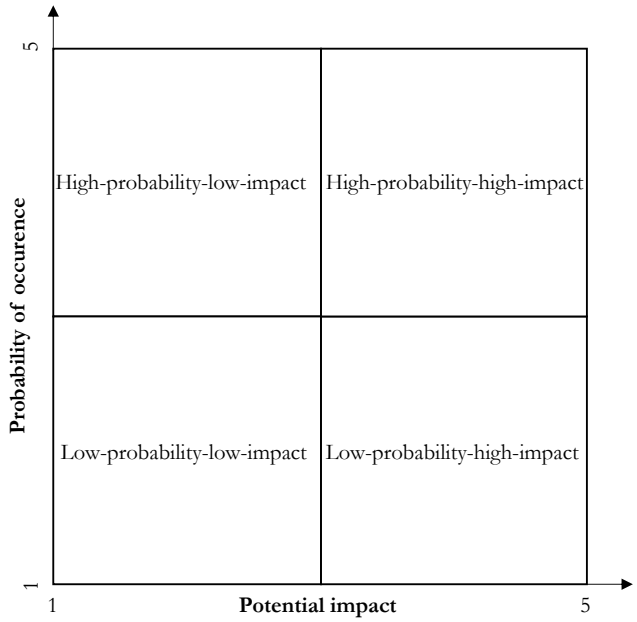

Figure 6.9: A conceptual example of the risk matrix, visualizing the current risk situation, which partly serves as the output of this process step.

The risk assessment participants are recommended to consist of the cross-functional core team[39], where the Purchasing Manager has the ownership of the process. This is a major difference compared to the current supplier evaluation, in which the Sustainability & Product Development Manager conducts the evaluation with limited cross-functional involvement. The authors believe the change in ownership and emphasis on cross-functional participation will enable a more holistic approach towards risk assessment. In terms of periodicity, the risk assessment should follow the risk identification part of the Annual SRM process. In addition, some ad hoc assessment is needed for risks derived from continuous identification.

A conceptual overview of the full risk identification step is shown in Figure 6.10.

[39] Purchasing Manager, Supply Chain Manager, and Sustainability & Product Development Manager.

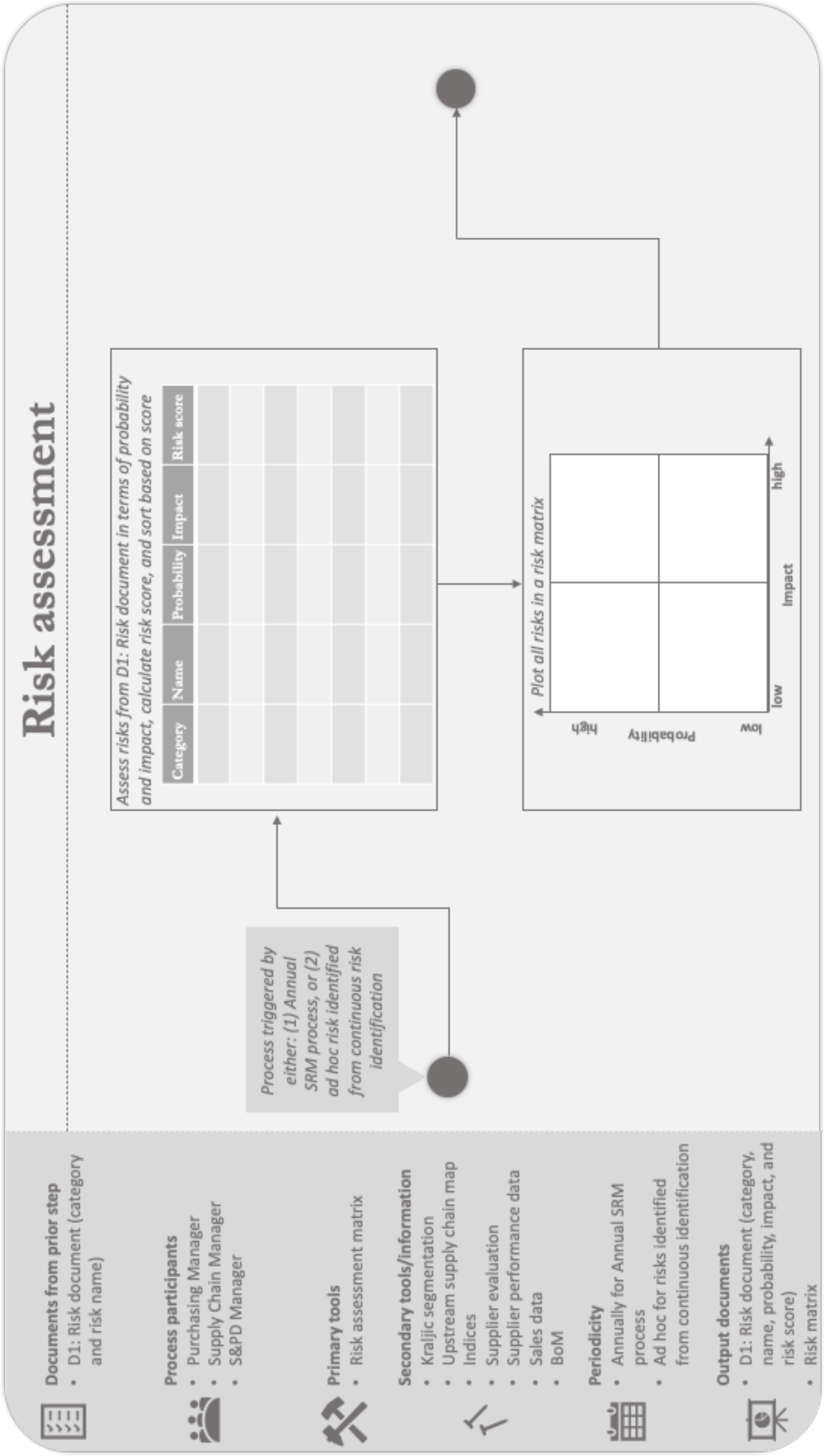

Figure 6.10: Overview of the proposed risk assessment process.

6.4 Risk mitigation

The main issue with the existing risk mitigation process at Company Alpha is the lack of clear structure when choosing feasible mitigation actions. Moreover, no formal element exists where strategic alignment, costs, or benefits is considered. This will be addressed in this process proposal, where the authors have taken inspiration from primarily Company Beta and the investigation model.

D1: Risk document is the main input to the risk mitigation step, in which risks have been identified, assessed, and prioritized. For each risk, the authors recommend that the process participants briefly consider all the high-level risk mitigation categories present in the conceptual model in Figure 6.11[40]. If the high-level category (e.g. buffering) is deemed relevant for a particular risk, they should proceed to the next level and identify potential concrete mitigation actions (e.g. excess inventory) that potentially could be applied.[41]

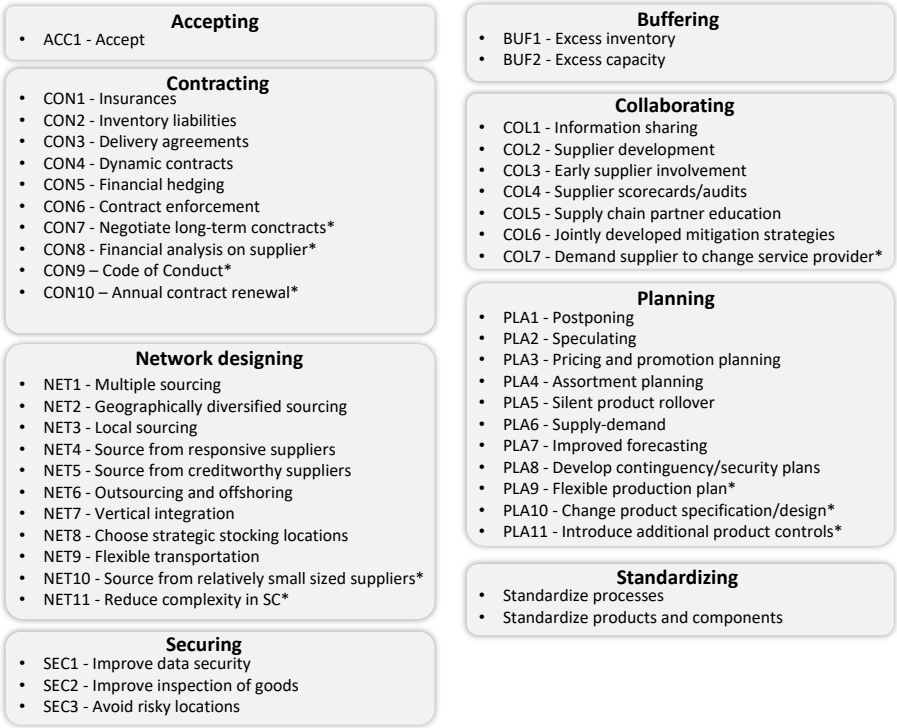

Figure 6.11: Overview of mitigation actions from theoretical and empirical findings.

The next step is to formally evaluate potential mitigation actions based on the following criteria: (1) strategic alignment with company strategy, (2) strategic alignment with product strategy, (3) benefits, and (4) costs and/or issues. This step is conceptually illustrated in Figure 6.12.[42] Ideally,

[40] The mitigation actions exclusively derived from the empirical findings are distinguished with an asterix (*): Company Alpha (NET10, COL7, PLA10, PLA11); Company Beta (PLA10); Company Gamma (PLA9, CON7, CON8, CON9), Company Delta (CON10, PLA9, NET11).

[41] For a more in-depth discussion regarding the mitigation categories and actions, the reader is referred to section 2.4.1 in the literature review.

[42] For a more detailed description about what to consider when choosing mitigation actions, the reader is referred to section 2.4.2.

it is desired that costs and benefits are quantified to the extent possible to allow for an objective and fair comparison between different mitigation actions.

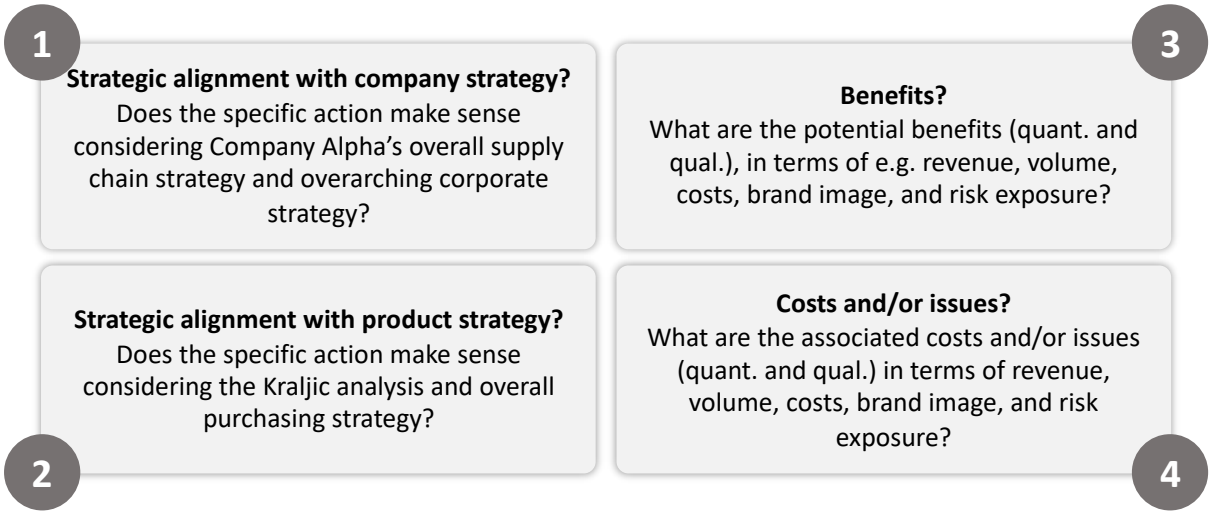

Figure 6.12: Factors to consider when choosing mitigation action.

Once all potential mitigation actions have been evaluated, the process participants should determine an appropriate action plan. This does not necessarily mean that only one single mitigation action should be chosen, as multiple mitigation actions for a single risk can sometimes be feasible[43]. For instance, it might be relevant to determine different mitigation actions for the short and long-term time horizons. Once the mitigation action(s) have been determined, they should be added to the *D1: Risk document* to register the decision, illustrated in Figure 6.13.

Risk document

	Risk identification		Risk assessment			Risk mitigation
	Category	Risk name	Probability (1-5)	Impact (1-5)	Risk score (PxI)	Pursued mitigation
1	Internal - Operational	Supplier X stockout for product Y	3	4	12	Share demand forecast with supplier

Figure 6.13: D1: Risk document after the risk mitigation, which serves as the output of this process step.

As previously mentioned, it is advised that all risks are given attention in this step, but the authors acknowledge that time and resources might be limited. Therefore, the practitioners are recommended to follow the prioritization order and prioritize risks with high risk scores. A potential future adjustment of the model is to clearly define a threshold value once the practitioners are more comfortable with the process and have a better understanding of what risk scores that are typically not worth discussing.

In terms of process participants, the authors recommend Company Alpha to involve the cross-functional core team[44] in the risk mitigation. It is recommended that the Supply Chain Manager has the ownership to ensure that the chosen mitigation actions are considered from a holistic supply chain perspective. Regarding periodicity, the risk mitigation should follow the risk

[43] As e.g. mentioned by Tang (2006).

[44] Purchasing Manager, Supply Chain Manager, and Sustainability & Product Development Manager.

assessment part of the Annual SRM process. However, the process can also be triggered by ad hoc risks identified in continuous identification.

A conceptual overview of the full risk identification step is shown in Figure 6.14.

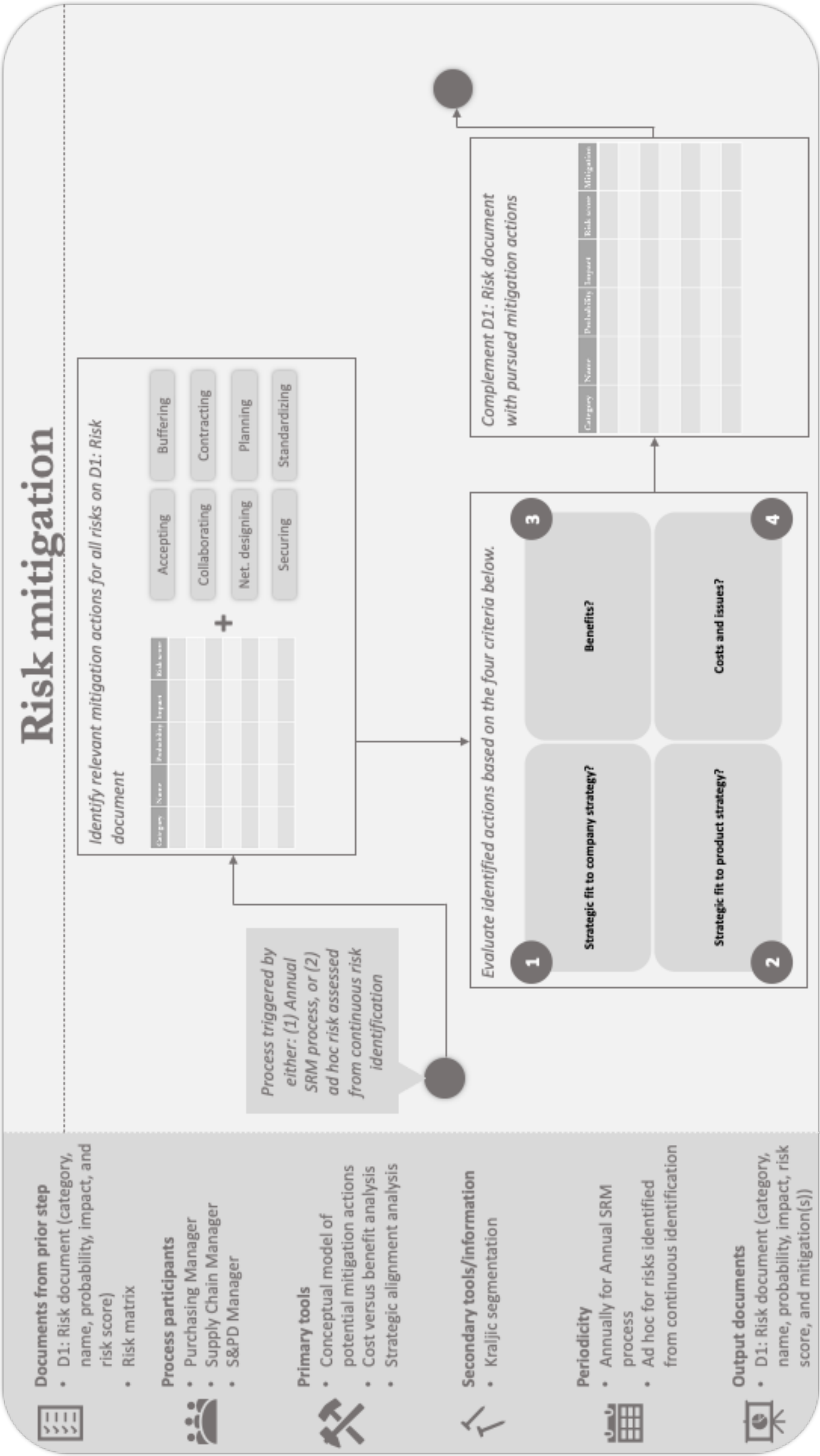

Figure 6.14: Overview of the proposed risk mitigation process.

6.5 Risk monitoring

The importance of risk monitoring and process evaluation was emphasized during the interviews with the practitioners at Company Alpha. Thus, the authors hope that the element of risk monitoring will be perceived as important as prior steps and not be neglected, which sometimes appear to be the case judging from both theoretical and empirical findings. The authors have constructed a risk monitoring process that contains three elements: (1) define monitoring plan, (2) follow-up on monitoring plan, and (3) process evaluation and continuous improvement.

6.5.1 Define monitoring plan

Before defining a monitor plan, *D1: Risk document* from the risk mitigation step serves as a necessary input, that details identified, assessed, and prioritized risks with their pursued mitigation actions. Documentation is essential to allow for effective and efficient monitoring, and to enable this, the authors suggest that *D1: Risk document* is complemented with information regarding risk owner[45] and monitor date (i.e. when risks should be monitored), visualized in Figure 6.15.

The monitor date should be guided by the severity of the risk and to what degree the severity is likely to change. A risk with a high risk score with much uncertainty might grant weekly monitoring, whereas other risks do not require any monitoring at all. The risk owners should preferably be the employee who works close to the origin of the risk. The document should be filled subsequent to the mitigation step and is thus included in the Annual SRM process. Similarly to previous steps, the core team is involved and the ownership of the overall risk monitoring process remains with the Supply Chain Manager.

Risk document

	Risk identification		Risk assessment			Risk mitigation	Risk monitoring		
	Category	Risk name	Probability (1-5)	Impact (1-5)	Risk score (PxI)	Pursued mitigation	Risk owner	Monitor date	General commen
1	Internal - Operational	Supplier X stockout for product Y	3	4	12	Share demand forecast with supplier	SC Manager	2021-04-01	

Figure 6.15: D1: Risk document after the risk monitoring step, which partly serves as the output of this process step.

6.5.2 Follow-up on monitoring plan

Naturally, the follow-up element of risk monitoring is conducted by the risk owner at the date detailed in *D1: Risk document*. The risk owner is advised to monitor the (1) risk source and (2) chosen mitigation action(s). In terms of risk source, the risk owner should investigate whether there have been any changes in the environment, resulting in a changed risk probability or impact. If this is the case, the risk assessment should be reiterated to become more up-more-date. In terms of the mitigation action(s), the risk owner is advised to evaluate its performance, and if the performance is not in line with the expectations it might be necessary to reevaluate the risk mitigation and whether any other actions are more appropriate.

[45] The risk owner has the overall responsibility for a specific risk. However, in some cases when multiple mitigation actions are being pursued, it might be relevant to also define a "mitigation action owner" to ensure execution. In these cases, the specific mitigation action owners should be clarified in the "General comment" cell.

6.5.3 Process evaluation and continuous process improvement

The last element of risk monitoring relates to evaluating the SRM process itself to enable an element of continuous improvement. The authors propose that a short evaluation form (illustrated in Figure 6.16) is conducted once the Annual SRM process has been completed. The evaluation questions are mainly based on the stakeholder criteria (i.e. trustworthiness, user-friendliness, and process structure) and to ensure process compliance. It is recommended that the form is taken by all process participants to capture all viewpoints[46]. By calculating average scores from completed forms, it will be possible to derive an overall process KPI that can be used to track how the perceived performance of the SRM process develops over time. Moreover, it will also be possible to derive a specific compliance KPI by computing the average value of the compliance-related questions. The KPIs are recommended to be used as a basis for the management teams' discussion in the annual risk meeting (detailed in section 6.6.1) where decisions can be made to improve the overall SRM process. The Supply Chain Manager has the ownership of sending, compiling, presenting, and documenting the evaluation data. A conceptual overview of the full risk identification step is shown in Figure 6.17.

Risk identification	
1. The formal process is followed (compliance)	1-5
2. The risk categories in the cause-effect templates are sufficient and enable us to identify all relevant risks	1-5
3. The risk identification is conducted at sufficient granularity level	1-5
4. The tools and information sources are user-friendly and easy to use	1-5
5. The process is structured and easy to follow	1-5

Risk assessment	
6. The formal process is followed (compliance)	1-5
7. All risks are considered for risk assessment	1-5
8. The output is easy to understand and take action on	1-5
9. The tools and information sources are user-friendly and easy to use	1-5
10. The process is structured and easy to follow	1-5

Risk mitigation	
11. The formal process is followed (compliance)	1-5
12. All risks are considered for risk mitigation	1-5
13. The tools and information sources are user-friendly and easy to use	1-5
14. The process is structured and easy to follow	1-5

Risk monitoring	
15. The formal process is followed (compliance)	1-5
16. All risks are considered for risk monitoring	1-5
17. The risk owners are taking their responsibility to follow the monitoring plan	1-5

Risk organization	
18. All relevant employees are participating in the process	1-5
19. The risk management process is prioritized and percieved with importance	1-5
20. The risk topic in general is priorized and percieved with importance at the company	1-5

Any other comment regarding the process?	Open text input
Overall process KPI: Average of all scores	
Compliance KPI: Average of Q1, Q6, Q11 & Q15	

1 = Not at all | 3 = I agree to some extent | 5 = I fully agree

Figure 6.16: Process evaluation form, which partly serves as the output of this process step.

[46] Naturally, the process participants that are only involvement in certain aspects of the process (i.e. Operational Purchasers) should only answer questions that relate to the specific aspect.

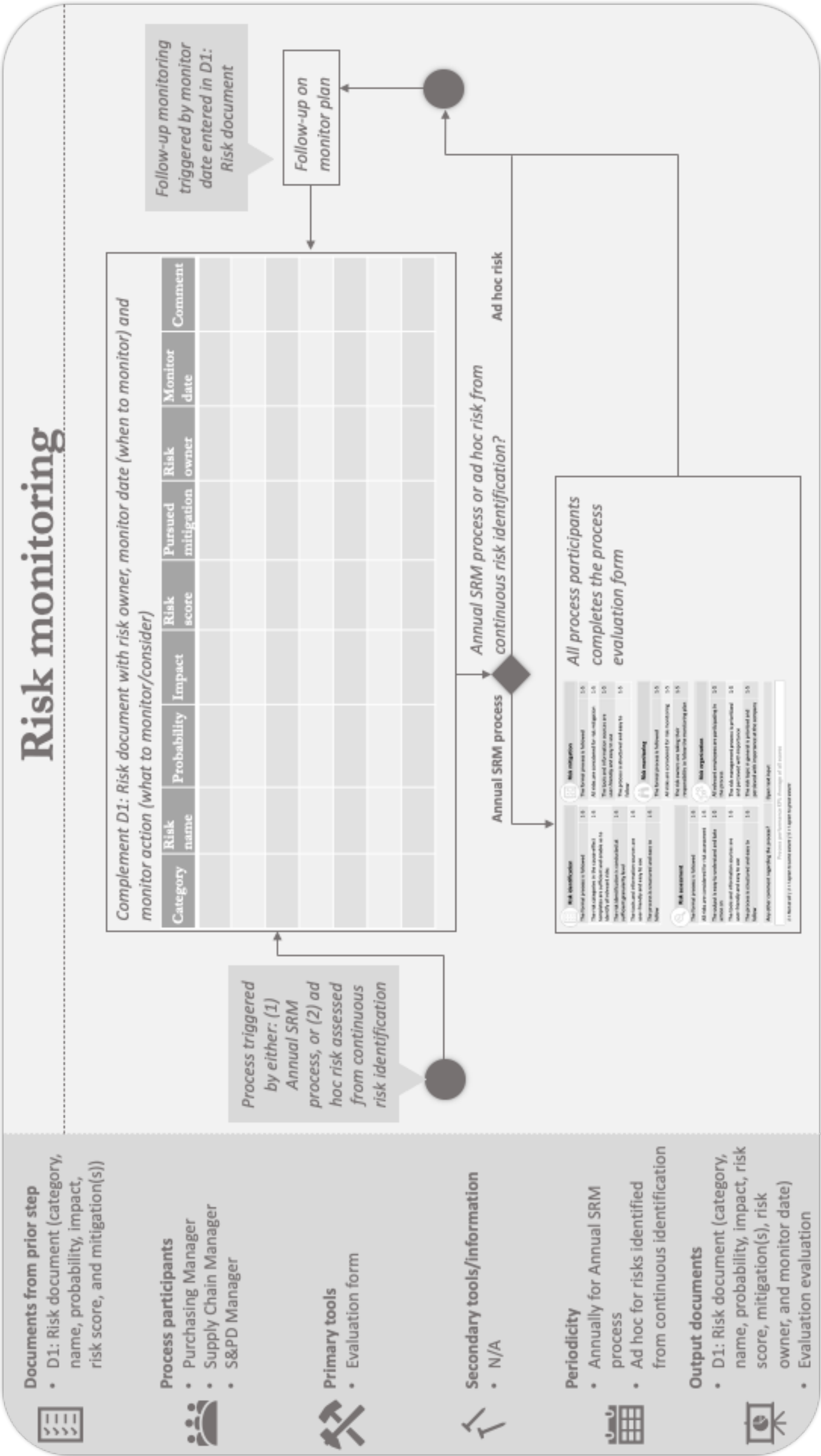

Figure 6.17: Overview of the proposed risk monitoring process.

6.6 Risk organization

In this section, the authors have summarized some aspects that Company Alpha should consider to ensure a strong organizational foundation for their SRM process. It primarily clarifies the role of the governing body and what levers the company should address to strengthen their risk culture. A conceptual overview of the full risk identification step is shown in Figure 6.18.

6.6.1 Process governance

The analysis indicated that neither of the investigated companies used a formal risk board to govern the SRM work, which is likely explained by their relatively small company sizes. Therefore, the authors deemed it infeasible to propose such a dedicated board. Instead, it is advocated that the governance role is taken by the management team, similarly to how the company operates today. However, the authors raise some concerns towards the current practice of using a non-standardized agenda, as this might result in the risk topic being neglected if no member specifically suggests its involvement prior to the meeting. Therefore, the authors advise the core team to make a habit of suggesting the risk topic being part of the agenda on at least a quarterly basis.

The authors view the management team meetings as a forum for information sharing where representatives from various roles and functions can discuss new potential risk sources that might be of relevance. Furthermore, the authors recommend that the core team share the current supply risk situation by showing the other meeting participants an up-to-date visual risk matrix (detailed in section 6.3).

In addition to these (at least) quarterly meetings, the authors propose that a more extensive discussion is being conducted in the meeting following the Annual SRM process. Here, the main takeaways from the conducted process can be shared by the core team. It also provides a natural opportunity to escalate potential problem areas that might need input or involvement from other functional areas in the company. In this meeting, the meeting participants should also review the process KPIs from the evaluation form, as presented by the Supply Chain Manager, and discuss whether any modifications to the SRM process are needed.

6.6.2 Risk culture

The conducted analysis shows that the risk culture already is somewhat present at the company, with the main issue being the risk awareness and perception of risk management around the company. To ensure a strong risk culture in the future, the authors have identified six levers that should be given attention throughout the process: (1) cross-functional participation, (2) formalized risk training, (3) top management prioritization, (4) proactive mindset, (5) continuous improvement, and (6) documentation.

Firstly, the importance of *cross-functional participation* must be acknowledged. While previously much responsibility has been at the quality function through the Sustainability & Product Development Manager, it is important to formally involve other functions in a more active role in the process. The authors believe that this will help spread risk awareness and develop the risk culture in other parts of the company. The authors have considered this in the model development by establishing

a cross-functional core team. Moreover, formal risk meetings between functions that previously only discussed risks ad hoc (between purchasing and sales) are recommended as part of the continuous risk identification process.

Secondly, it is important to spread risk awareness to all hierarchy levels in the company through *formalized risk training*. This is a lever that is already being pursued and the authors strongly advise that Company Alpha continue to dedicate efforts. Focus in the training should be to share escalations rules for different risk types for when an employee identifies a potential risk. It is essential that all employees realize the importance of escalating and not keep this information for themselves.

Thirdly, an element of *top management prioritization* is necessary, as they act as role models for the other employees in the organization. It is essential that the top management acknowledge the importance of risk management and dedicate resources to it as this can shape the overall perception of the topic of all employees. This aspect has mainly been considered by the authors by clarifying the involvement of the management team as a governance body in the SRM process, where they e.g. monitor the SRM process and its compliance. Another element of top management prioritization is to continue with the regular crisis management exercises. Although, the authors argue this is more related to reactive risk management it still contributes to the overall risk awareness in the management team.

Fourthly, a general shift in attitude from a reactive to *proactive mindset* is advocated, to emphasize the risk awareness rather than acting ad hoc. It is addressed in the model by not basing the risk identification on "reactive tools" as risks are encouraged to be proactively discussed and also by encouraging the management to continue with their crisis management exercises.

Fifthly, an element of *continuous improvement* and constructive challenging of actions is needed at all levels in the organization to ensure a strong risk culture. The empirical findings indicated that this was a lever that was already somewhat acknowledged in the company, however, the importance could be further emphasized in a more cross-functional, company-wide perspective. To formally ensure that this lever is being considered, the authors included the evaluation form and corresponding follow-up, where areas for improvements are addressed by the management team.

Lastly, Company Alpha is recommended to improve their *documentation* of the process, which has been explicitly addressed in the developed model in the form of D1: Risk document and D2: Supplier contact. The authors argue that a proper documentation is essential in order for the company to work more proactively, learn from past mistakes, and allow for an overall improved risk awareness.

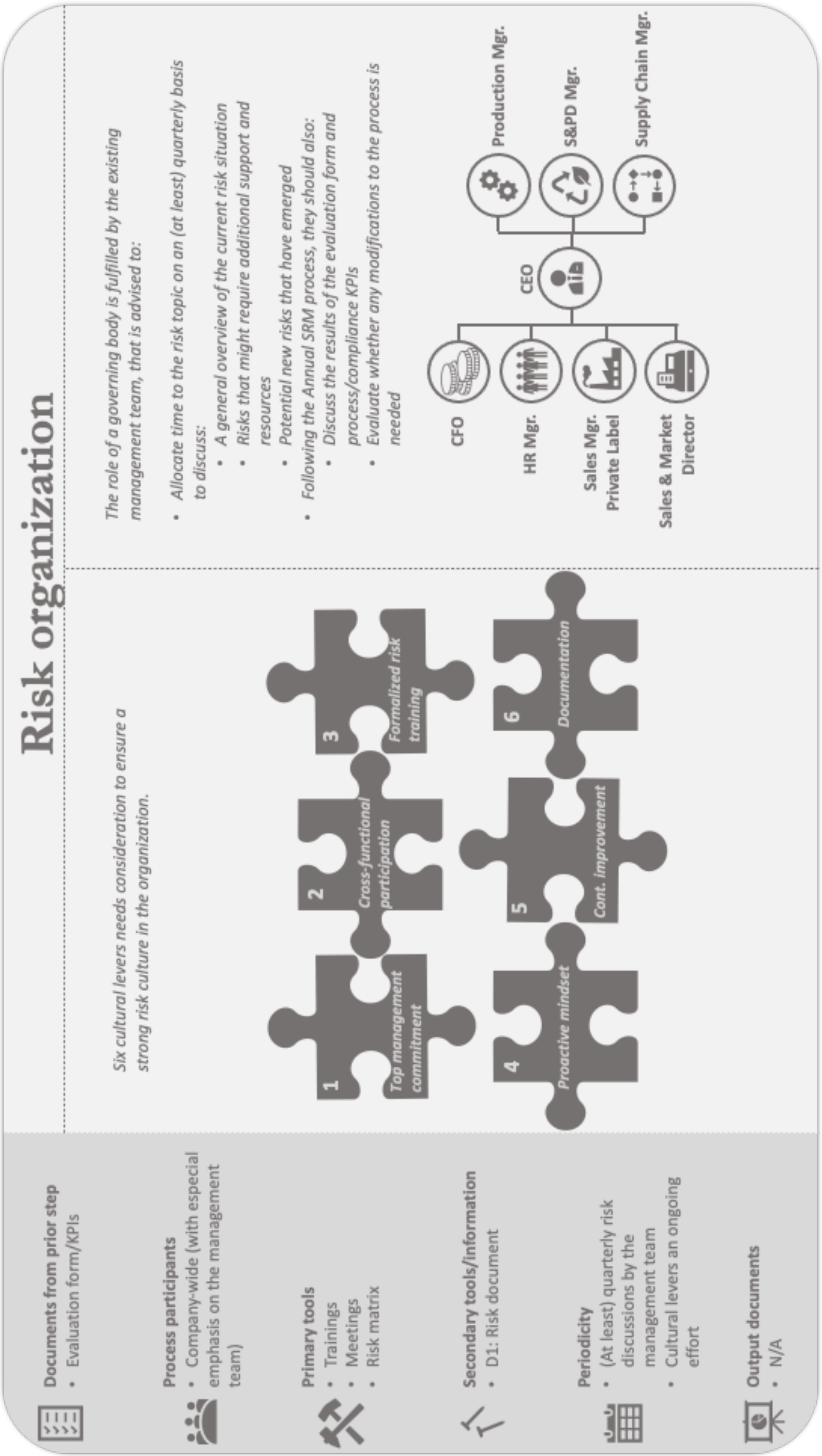

Figure 6.18: Overview of the proposed risk organization.

6.7 Clarification of connection to analysis

To clarify how the recommended SRM model has been developed by incorporating the analysis, Table 6.3 and Table 6.4 visualize how the takeaways from the analysis have been considered in the development phase.

Table 6.3: Overview of how the takeaways from the analysis were considered in the model development (1/2).

#	Part of investigation model	Takeaway from analysis	Consideration in model development
1	Risk identification	A skew risk scope was identified, as the companies primarily focused on quality and sustainability risks	Cause-effect diagrams with a more holistic risk scope were included to ensure that no aspect is overlooked
2	Risk identification	All companies lacked a structured way of listing/documenting more general supply chain risks at a concrete risk level	The process includes a formal element of listing/documenting concrete risks
3	Risk identification	The companies were in general good at involving tools in their risk identification but lacked a conceptual tool/model to structure the process	The cause-effect diagrams serve as the conceptual tool that structure the risk identification
4	Risk identification	Several new tools emerged during the interviews, leveraging on third party actors, but exclusively relying on them might result in insufficient and reactive risk identification	The third-party tools were mainly included in the model as supportive tools and information sources, not as primary tools
5	Risk assessment	The companies lacked a structured and consistent assessment methodology for all risk types	The process contains a consistent assessment methodology for all risk types[47]
6	Risk assessment	General supply chain risks were mainly assessed at a supplier level rather than a concrete risk level	The process includes an assessment at a concrete risk level
7	Risk assessment	The risk assessment matrix was the most frequently used assessment tool among the companies, well in line with theoretical findings	The risk assessment matrix was used as an assessment tool due to its empirical and theoretical popularity

[47] With an exception of the assessment part of HACCP, which needs to be conducted as a separate process due to regulatory reasons.

Table 6.4: Overview of how takeaways from the analysis were considered in the model development (2/2).

#	Part of investigation model	Takeaway from analysis	Consideration in model development
8	Risk mitigation	A structured process for determining and documenting mitigation actions was lacking at all companies	The process includes a more structured approach to determine and document mitigation actions
9	Risk mitigation	The strategic alignment and cost versus benefit aspect were only somewhat formally considered at Company Beta	The strategic alignment and cost versus benefit aspects are formally evaluated in the risk mitigation step
10	Risk monitoring	The monitoring and continuous improvement aspects were overlooked by almost all companies, which is well aligned with the theoretical findings	To ensure that monitoring is not being overlooked, the process contains a formal element of monitoring and continuous improvement
11	Risk organization	Top management prioritization was difficult to assess, but the interviews indicating the risk topic being somewhat prioritized at all companies	The top management prioritization was emphasized as one lever to ensure a strong risk culture
12	Risk organization	Neither of the companies had a dedicated risk board, which is likely explained by the small/medium company sizes which might not justify such dedicated resources	In the proposed risk organization, the management team fulfills the role of the risk board, as the company size might not justify a dedicated board
13	Risk organization	The major gap in cross-functionality was identified at Company Alpha, driven by the Sustainability & Product Development Manager having the sole ownership of major parts of the risk management work	The gap was addressed by giving purchasing and supply chain a more active role in the process and moving the ownership away from the Sustainability & Product Development Manager for certain tasks
14	Risk organization	A common observation from the companies was that risk management is mainly explicitly considered by the quality function, whereas other functions (e.g. purchasing) conducts "risk management activities" without reflecting on it being risk management	The awareness of risk management is addressed by the proposed cultural levers

6.8 Stakeholder criteria evaluation

As mentioned in the methodology chapter, the Purchasing Manager, Supply Chain Manager, and Sustainability & Product Development Manager were asked to evaluate the developed SRM model in terms of its (1) user-friendliness, (2) structure, and (3) trustworthiness. The user-friendliness was an aspect the stakeholders found especially difficult to evaluate solely based on the model workshop. They mentioned that it seemed easy to apply and use from the authors' demonstration, but that they would need to fully test it themselves to formally evaluate the aspect. Next, the structure aspect was deemed fulfilled, as the flow charts clearly highlighted the process steps, inputs, and outputs. Lastly, the stakeholders raised some concerns towards the trustworthiness in the assessment step, particularly in terms of assessing the risk of qualitative nature. To address this potential issue, the authors emphasized the need to incorporate data sources and tools whenever

possible, to limit the subjective nature of risk assessment as far as possible. As a potential future modification, it has also been suggested to make the assessment categories more operationalized.

7 Conclusion

This chapter aims to summarize and conclude the thesis. Firstly, a summary of the findings is provided, which details how all of the research questions (RQs) were answered and incorporated into the supply risk management (SRM) model. Thereafter, practical implications, generalizability, and contribution of the study is covered. Lastly, some limitations and potential areas for future research are discussed.

7.1 Summary of findings

To conclude and summarize the findings, this section highlights how all research questions (RQs), which represents the units of analysis, were answered and incorporated into the supply risk management (SRM) model. The developed model consists of a primary process performed on an annual basis (i.e. Annual SRM process) and some complementary elements conducted in a more frequent manner, and is conceptually illustrated in Figure 7.1.

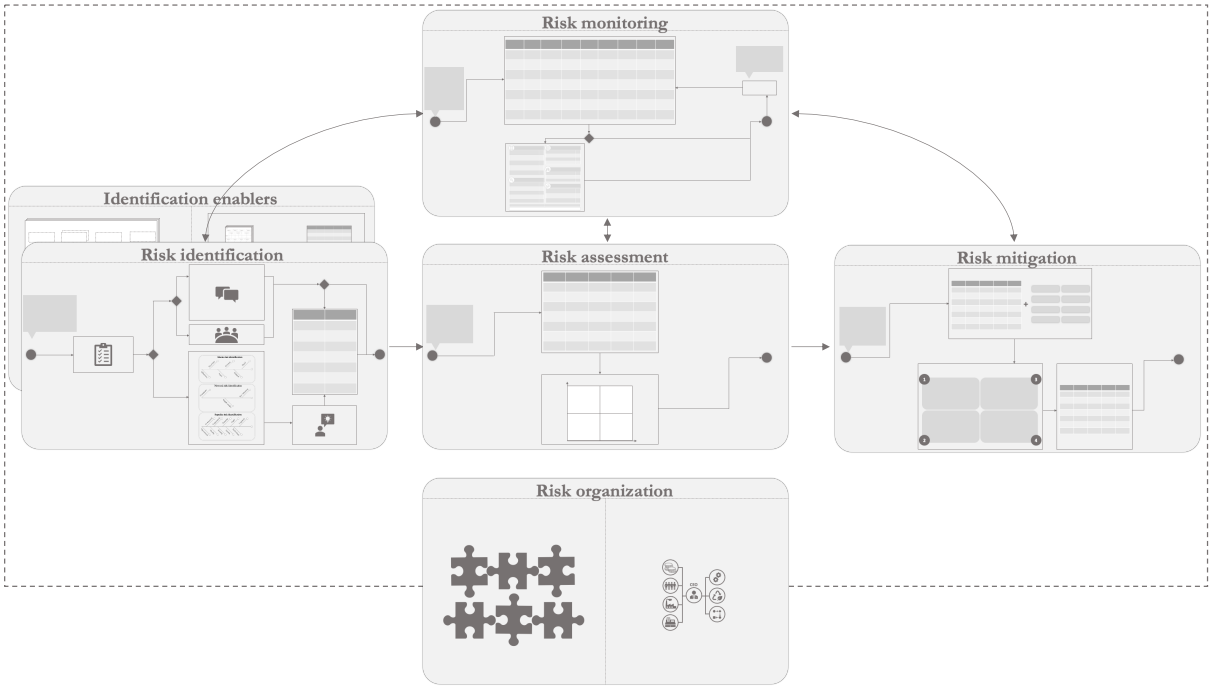

Figure 7.1: A conceptual overview of the recommended SRM model.

RQ1: How should supply risks be identified at Company Alpha?

This RQ was addressed in the risk identification step, illustrated in Figure 6.3 and Figure 6.7. First of all, the authors argued the importance of having two identification enablers in place, i.e. an upstream supply chain map and a Kraljic segmentation. Moreover, the authors developed a comprehensive framework with *supply risk sources* to enable a holistic risk perspective and assist practitioners in their identification efforts. A risk identification process that included two subprocesses was proposed: (1) annual risk identification and (2) continuous risk identification. The annual risk identification should be conducted as part of the Annual SRM process and incorporates cause-effect templates and brainstorming to allow for a structured and holistic identification. The continuous risk identification complements the annual identification by utilizing the suppliers and internal meetings and allows for identification continuously throughout the year.

RQ2: How should identified supply risks be assessed and prioritized at Company Alpha?

This RQ was addressed in the risk assessment step, illustrated in Figure 6.10. The authors recommended a risk assessment process where risks are evaluated in terms of their probability of occurrence and potential impact on a scale from one and five. The authors further recommended visualizing the output of the risk assessment in a risk matrix, where all risks are plotted in regard to the two variables. To allow for prioritization, it was advised to calculate a risk score (by multiplying the variables), and prioritize risks with high scores.

RQ3: How should identified supply risks be mitigated at Company Alpha?

This RQ was addressed in the risk mitigation step, illustrated in Figure 6.14. The authors presented a framework with numerous *concrete mitigation actions*. It was proposed that mitigation actions from this framework were chosen for the assessed risks. To facilitate this step, the process participants were advised to consider the following four aspects: (1) strategic alignment with company strategy, (2) strategic alignment with product strategy, (3) benefits, and (4) costs and/or issues.

RQ4: How should Company Alpha work with risk monitoring to assure a dynamic SRM model?

This RQ was addressed in the risk monitoring step, illustrated in Figure 6.17. The suggested risk monitoring process contained three elements: (1) define monitoring plan, (2) follow-up on monitoring plan, and (3) process evaluation and continuous improvement. When defining a monitoring plan, a risk owner is assigned, and a monitor date decided. At the follow-up, the risk owner evaluates how the risk source has developed and the performance of the mitigation action(s). A new monitor date is also determined. Lastly, to evaluate the process and allow for an element of continuous improvement, the authors developed an evaluation form that should be answered by all process participants following the Annual SRM process.

RQ5: How should process governance and risk culture be considered in the risk organization at Company Alpha?

This RQ was addressed in the risk organization, illustrated in Figure 6.18. The authors recommended that the management team should have the responsibility for process governance, and advised that the risk topic is to be discussed on at least a quarterly basis. Furthermore, to ensure a strong risk culture, the authors identified six levers that need to be considered and given attention, namely: (1) cross-functional participation, (2) formalized risk training, (3) top management prioritization, (4) proactive mindset, (5) continuous improvement, and (6) documentation.

7.2 Academic contribution

The main contribution of this thesis was the development of an SRM model for Company Alpha, which, in accordance with Lukka (2003), serves as a natural contribution itself. In addition, it addressed the perceived need of industry specific SRM research highlighted by Hoffman et al. (2013), as it focused on companies present in the agrifood industry. Moreover, the authors argue that the extensive literature review of risk sources and mitigation actions served as another contribution, as it presents two new frameworks that summarizes and categorizes existing research.

7.3 Practical implications and generalizability

The analysis indicated that all case companies had a relatively similar approach to SRM. While the process for handling food safety/quality risks was at a mature stage, they were all to some extent lacking structure, documentation, conceptual tools, consistency, and regularity for their more general SRM. Despite the sample size being relatively small, this finding might indicate that there is a lack of SRM maturity for small and medium-sized companies in the Swedish agrifood industry in general. A practical implication of this finding is that more companies with similar characteristics might benefit from investigating potential improvements in their SRM work.

In this thesis, the authors developed an SRM model that was developed specifically for Company Alpha. However, it is still relatively generic in nature in terms of the process steps and involved tools. Therefore, with potential modifications to the organizational aspects, the authors argue that it might be applicable for other similar companies as well.

7.4 Limitations

The authors have identified some limitations with the study, which likely impacted the reliability, validity, and overall trustworthiness. Firstly, the time constraint of 20 weeks impacted some of the authors' methodological choices, primarily in the data collection phase of the study. With more time available, the authors would have opted for conducting more interviews with the secondary case companies to get a broader (cross-functional) understanding of their SRM work. In hindsight, by interviewing only employees from the purchasing functions, some aspects might have been overlooked by the authors. This was especially apparent when trying to draw conclusions regarding the risk organization, which was challenging from single interviews. Moreover, multiple interviews from the same case companies would have enabled the authors to work more actively with triangulation.

Secondly, the decision to select comparable companies with relatively similar sizes as secondary cases inherently led to some limitations. While this allowed the authors to draw general conclusions of how small and medium-sized companies in the Swedish agrifood industry works with SRM, it did only provide limited inspiration in terms of transferable best-practices. If a larger (and potentially more mature) company would have been included in the study instead, it might have been easier to get inspired by best-practices in the model development. However, the authors argue that this perspective was somewhat part of the literature review, as several aspects of Ericsson's SRM process were discussed, albeit not from an agrifood perspective.

Thirdly, the grading system in the analysis was subjective in nature and other researchers might derive different grades even if they were to perform the exact same exercises. This evidently affects the reliability of the study negatively. However, as already pointed out in the methodology chapter, the purpose of the grading was not to determine "objectively correct grades", but rather allow for a somewhat structured approach of identified patterns between the cases. Even though other researchers might grade the aspects differently, they would likely identify similar patterns.

Lastly, while the model was to a minor extent validated by practitioners in a workshop setting, a more extensive test of the model in practice would undoubtedly enable a better understanding of its practical value and would have allowed for further modifications by the authors. However, given the time limitation it was not considered feasible to include such an extensive test in this thesis.

7.5 Suggested future research

The authors have identified several areas where future research could be conducted, both internally at Company Alpha and relating to more general research. At Company Alpha, it would be interesting to make a case revisit in a few years' time to better understand the implementation aspect, the performance of the model, and whether any modifications were needed to make the developed model practically useful. Moreover, while this model focuses on proactive SRM, it is important to not neglect the reactive aspect of the concept. Therefore, the authors argue that the company should investigate the possibilities of extending the model to enable a structured way of working with reactive SRM as well. Furthermore, they could consider operationalizing the risk assessment further, by incorporating elements of BRT and BIV, and extend the model to also include operational and demand risks. Lastly, the proposed model emphasizes user-friendliness and is adapted to fit Company Alpha, who in the authors' view might lack some IT maturity. As a consequence, a simple process heavily relying on spreadsheets for documentation was proposed. However, it might be interesting to investigate how the model can be further developed to leverage data analytics and potentially be integrated into existing IT systems.

In terms of more general research, it would be interesting to focus on the SCM perspective of SRM in the agrifood industry. More specifically, a potential direction might be to study how companies in a supply chain collaboratively can achieve better performance by e.g. incorporating the perspective of incentive alignment[48]. Furthermore, it would be interesting to investigate if the developed model can be applied to other companies in the agrifood industry and what modifications it would require. From a broader perspective, another potential area for future research would be to specifically investigate industry differences in an SRM/SCRM setting, and what particular aspects of the process it impacts. Relating to the findings and gaps in this thesis, it would be interesting to investigate the barriers that hinders small and medium-sized companies from working more structured and process-oriented with SRM/SCRM and the discrepancy of tools suggested by theory but neglected by practitioners. Lastly, it would be interesting with a more thorough investigation of what enablers exist for successfully implementing an SRM process, in addition to the ones pointed out in this thesis.

[48] As discussed by e.g. Simatupang and Sridharan (2005) from a more general SCM viewpoint.

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Purchaser at Company Delta. (2020). Interviewed by Melin, A. & Ehlers, J. 2020-11-10.

Purchasing Manager at Company Beta. (2020). Interviewed by Melin, A. & Ehlers, J. 2020-10-28.

Quality Coordinator & Team Leader of Laboratories at Company Alpha. (2020). Interviewed by Melin, A. & Ehlers, J. 2020-11-18.

Sales Manager Own Brand at Company Alpha. (2020). Interviewed by Melin, A. & Ehlers, J. 2020-11-11.

Sales Manager Private Label at Company Alpha. (2020). Interviewed by Melin, A. & Ehlers, J. 2020-11-18.

Supply Chain Manager at Company Alpha. (2020). Interviewed by Melin, A. & Ehlers, J. 2020-11-16.

Sustainability & Product Development Manager at Company Alpha. (2020). Interviewed by Melin, A. & Ehlers, J. 2020-06-17.

Appendix

A Case study protocol

A.1 Background

This multiple case study had its theoretical foundation on already published articles in the field of SCRM. Examples of articles included in the literature review were Ericsson's Proactive Supply Chain Risk Management by Norrman and Jansson (2004) and Global Supply Chain Risk Management by Manuj and Mentzer (2008).

The following RQs were stated and answered in the study:

1. How should supply risks be identified at Company Alpha?
2. How should identified supply risks be assessed and prioritized at Company Alpha?
3. How should identified supply risks be mitigated at Company Alpha?
4. How should Company Alpha work with risk monitoring to assure a dynamic SRM model?
5. How should process governance and risk culture be considered in the risk organization at Company Alpha?

A.2 Design

The UoA was *supply risk management process*, with each element of the conceptual SRM model serving as a subunit[49], as the case study aimed to develop a new SRM model for Company Alpha. A multiple case embedded study including four cases was conducted, with all RQs explicitly linked to the principal case company. The secondary cases had an implicit link to the RQs, as their empirical findings inspired the model development.

A.3 Case selection

Company Alpha was considered as the principal case as the RQs were developed in collaboration with the company. The secondary cases were identified in a screening process, in which comparable companies were found based on the criteria presented in Table A.1.

[49] I.e. (1) risk identification, (2) risk assessment, (3) risk mitigation, (4) risk monitoring, and (5) risk organization.

Table A.1: Criteria for case selection.

Criteria	Rationale
Present in the agrifood industry	Due to the uniqueness in AFSCs, with context-specific risk sources, the authors argued it would make sense to only include companies in the agrifood industry.
Actively working with SRM	If the case company did not pursue any type of SRM work, it would not provide an as useful inspiration to the model development.
GFSI approved certification	As a major concern for Company Alpha was the requirements posed by their FSSC 22000 certification, it was deemed appropriate to include companies with similar food safety and quality regulations to make the cases more comparable.
Operating in Sweden	If the case companies were not subject to the same local regulations and requirements they would not be as comparable to Company Alpha.
Sourcing globally	As a company with local or regional sourcing is not exposed to the same types of risks, the author argued this to be a necessary criterion.
A maximum turnover of 5 000 MSEK	To be able to identify patterns specific for small and medium-sized companies, the authors opted for an upper limit for the turnover.

A.4 Case study procedures and roles

Both authors contributed to all phases in the conduction of this case study. To govern how the work progresses and identify potential risks, a GANTT chart was used.

A.5 Data collection

A tabular overview of the collected data (Table A.2) and conducted interviews (Table A.3) are provided below.

Table A.2: A summary of the received data.

Description	Case	Type of data
Organizational chart	Company Alpha	Qualitative
Supplier evaluation process description and template	Company Alpha	Qualitative
Documentation of risk identification and assessment	Company Beta	Qualitative
Overview of risk categories considered in the process	Company Delta	Qualitative
Interviews	All case companies	Qualitative

Table A.3: An overview of the conducted interviews.

Case	Role	Date	Duration
Company Alpha	Production Leader	2020-11-05	60 minutes
Company Alpha	Sales Manager Own Brand	2020-11-11	60 minutes
Company Alpha	Supply Chain Manager	2020-11-16	60 minutes
Company Alpha	Sustainability & Product Development Manager	2020-11-17	60 minutes
Company Alpha	Sales Manager Private Label	2020-11-18	60 minutes
Company Alpha	Quality Coordinator & Team Leader of Labs	2020-11-18	60 minutes
Company Beta	Purchasing Manager	2020-10-28	60 minutes
Company Gamma	Category Procurement Manager	2020-11-10	60 minutes
Company Delta	Purchaser	2020-11-10	60 minutes

A.5.1 Interview guide

A.5.1.1 Introduction

i. Present ourselves and the purpose of the thesis
ii. Explain how the empirical data from the interview will be used in our thesis
iii. Explain that we will send the parts covering their company to make sure that we understood everything correctly and later send the full master's thesis once it is complete

A.5.1.2 General questions

1. Can you tell us about yourself and your role at the company?
2. Can you tell us how you work with sourcing/purchasing at your company?
    a. How is the sourcing/purchasing function organized?
    b. How many purchasers are you?
    c. How big is your purchasing spend? (absolute or % of revenue)
    d. How many suppliers do the company have?
        i. Geographical location?
    e. What determines the nature of the relationships you pursue with your suppliers? (transaction-oriented versus partnership-oriented)
    f. Do you have any specific make-buy strategy? (outsourcing versus vertical integration)
3. What KPIs are used at the company?
    a. In general in the company?
    b. At the purchasing function?

A.5.1.3 SRM process

<u>Risk identification</u>

4. Do you have any documented processes for risk identification?
5. Who is involved in the identification process?
6. How often do you identify risks?

7. What kind of risks do you consider in your risk management process?
    a. Do you have any risk categorization?
8. Do you put additional emphasis on identifying any specific risk type or are all considered with equal importance?
9. What tools and techniques do you use to identify risks?
    a. Can you describe these tools?
        i. Advantages?
        ii. Disadvantages?
10. Are all tools/techniques used to identify all types of risks, or do you make any differentiation?
11. *Show our tools identified in literature review to check which are used by the company*

Risk assessment

12. Do you have any documented processes for risk assessment/prioritization?
13. Who is involved in the process?
14. How often do you assess/prioritize identified risks?
15. What tools and techniques do you use to assess/prioritize risks?
    a. Can you describe these tools?
        i. Advantages?
        ii. Disadvantages?
16. Are all tools/techniques used to assess/prioritize all types of risks, or do you make any differentiation?
17. *Show our tools identified in literature review to check which are used by the company*

Risk mitigation

18. What type of mitigation strategies do you consider for your identified/assessed risks? (e.g. increasing safety stocks, using multiple suppliers, contracts, etc)
    a. Do you have any predefined list of potential strategies or are these rather identified using brainstorming?
19. How do you determine an appropriate mitigation strategy for a given risk?
    a. Who is involved?
    b. Could multiple mitigation strategies be used for one given risk?
20. What type of mitigation strategies do you mainly use?

Risk monitoring

21. How do you monitor your identified risks?
    a. What type of risks do you monitor?
    b. How often?
    c. Who is involved?
22. How do you monitor your already treated risks?
    a. What type of treated risks are monitored?
    b. How often?
    c. Who is involved?
23. Do you have any evaluation to monitor your overall risk management process?
24. Any element of continuous improvement?

Risk organization

25. How is risk management perceived by top management?
26. What does your risk organization look like?
27. Do you have any risk board/committee or similar?
    a. Who are involved?
    b. What are the responsibilities?
    c. How often do they meet?
28. Who is involved in the overall process?
    a. Any difference between users and decision-makers?
29. How would you describe the risk culture at the company?
    a. What is the general perception of risk management?
    b. Do you have any directives from management on "risk tolerance"?

A.5.1.3 Other

30. Do you have anything else to add regarding your organization and/or risk management that might be of value to us?

A.6 Analysis

The analysis was based on the investigation model developed in the literature review. Both within-case and cross-case analyses were conducted, which were structured in a tabular format to enable an organized way of identifying patterns within and across cases. The within-case analyses focused on understanding the SRM process in the individual cases and identifying gaps compared with the theory. The cross-case analysis used pattern matching to identify similarities and dissimilarities between the cases. Moreover, explanation building was used to understand root causes of potential discrepancies.

To develop the final SRM model, the authors considered both the investigation model from the literature review, the findings from the within-case and cross-case analyses, and the criteria regarded as important by the stakeholders at Company Alpha. The investigation model was used as the baseline, to which elements were added and removed based on the analysis and stakeholder criteria. Furthermore, a validation workshop was conducted to ensure that the developed model would be implementable at the company.

A.7 Plan validity and reliability

Tactics applied to ensure the validity of the case study are summarized in Table A.4.

Table A.4: An overview of how trustworthiness was ensured.

Criteria	Tactics
Construct validity	● Multiple sources of evidence used to support conclusions ● Key informants reviewed both initial draft reports and the final study ● Feedback from peer researcher (i.e. LTH supervisor) on interview guide
Internal validity	● Data displayed in tables to facilitate cross-case analysis and pattern matching ● Model validated with stakeholders at Company Alpha
External validity	● Replication logic (literal replication) in the case study design ● Usage of multiple cases in case study design
Reliability	● Usage of case study protocol, including a standardized interview guide ● Usage of case study database ● Usage of tabular overviews to be transparent on how sources contributed to the conceptual SRM model developed in the literature review

A.8 Study limitations

The following delimitations have been made in this case study:

1. The developed SRM model only considered the supply of raw materials such as fruits, berries, and additives.
2. Supplies specific to the wine brand were not considered.
3. The time frame was limited to 20 weeks.
4. The scope was limited to develop the conceptual model, hence, implementation of the model will not be conducted.
5. The model only considered the proactive aspect of risk management, neglecting the reactive aspect.

A.9 Reporting

The target audience of this case study consisted of:

- Practitioners at Company Alpha
- Academic colleagues
- Other practitioners wishing to implement a modified version of the model at their company

B Company Alpha's supplier questionnaire

Document name:		
SUPPLIER EVALUATION: MANUFACTURERS & TRADERS		
Document number: **2.4.2**	Version number: **4**	Revision date: **2019-10-14**

Company name: *If several names can be used on products/ certificate, please explain relations.*	
Company registration number:	
Date:	
Sales contact person:	
Contact details incl e-mail:	
QESH contact person:	
Contact details incl e-mail:	
Products/product types supplied to Company Alpha (list)	
Describe your role in the supply chain, i.e. if you are a trader/broker/agent or a manufacturer of the products. If both, please give details.	
This document is to be filled out by the supplier to Company Alpha. If you trade the goods in any way, it is your responsibility as a supplier to assure all sub-suppliers and products therein.	

1. MANAGEMENT SYSTEM

1.1. Are you certified according to a GFSI-approved system?

** For information around GFSI, please see http://www.mygfsi.com/about-gfsi/gfsi-recognised-schemes.html*

YES (If yes, please attach certificate)	NO
Comments (if no, describe your quality/product safety work):	

1.2. Which are your main focus areas in respect of food safety?

(Describe your work and give examples of your KPIs):

1.3. Are you certified to any other management systems (environmental, sustainability, quality etc)?

YES (If yes, please attach certificate)	NO
Comments (if no, describe your work regarding this matters):	

1.4. Which are your main focus areas in respect of environment/sustainability?

(Describe your work and give examples of your KPIs):

1.5. How do you approve your suppliers? Please describe your work from a QESH perspective
(quality/product safety, environment/sustainability, safety, health)

(Describe your work):

1.6. How do you secure and prevent fraud & sabotage in supply chain?

(Describe your work):

1.7. On which parts do you conduct internal audits?

Product safety	Quality	Safety & health	Environment	CSR	Others: pls state
Comment on frequency:					
Our demand is minimum annual internal audits, which are documented/available for Company Alpha AB on request.					

2. PRODUCT SAFETY

2.1. According to current EU legislation, a HACCP-plan must be implemented. Is this in place for all products produced to Company Alpha?

YES	NO
Please state main risks and control measures for all products produced for Company Alpha and enclose a process flow chart indicating ccp's and foreign matter prevention (sensitivities/mesh sizes)	
How often is the HACCP plan reviewed?	
Comment:	

2. 2 Traceability & recalls: Do you have full traceability of your products? Is the system tested regularly?

YES	NO
Comment on level:	
Company Alpha demands that you always contact us immediately if one of your products delivered to us are involved in a recall.	
In case needed, we demand you to provide all necessary data within 4 hours.	

2.3 Legality: How do you assure that products delivered comply with the relevant actual EU Regulations for food-grade products?

Please explain:

2.4. Hygiene & pest control: Do you work after common hygiene praxis and EU legislation (regular cleaning, personnel hygiene, pest control etc)?

YES	NO
Comment:	

2.5 Product assurance

a.	Company Alpha demands to receive dated product specifications for all products. Please confirm and attach latest version	YES	NO
b	Updated and modified specifications or other documents related to product **declaration** and **functionality** will be send automatically to Company Alpha	YES	NO
d	Which analyses/frequency do you perform regarding product safety?	YES/ Quaterly	YES/ Annually / NO
	- Allergen assurance		
	- Pesticides		
	- Heavy metals		
	- Pathogens		
	- HRM, heat resistant microorganisms		
f	Do you do shelf life tests of the products?	YES	NO
Comment:			

2.6 Storage, warehousing and transport

a.	How are the conditions of the stored goods, in regard of hygiene and contamination risks?	Describe:
b.	Do you store your finished goods in an own or commercial warehouse?	Describe:
c.	How do you assure hygienic and safe transport?	Describe:

d Are specific storage conditions recommended?	Describe:
Other comments:	

2.7 Claims

a. Do you have a documented system for administration and investigation of customer complaints in place?	YES	NO
b. Can you assure that possible complaints are answered sufficient and within the mentioned timing of 5 working days?	YES	NO
Comment:		

2.8 Packaging

a. Please confirm that your products are supplied in package approved for food contact and that you, if required, will be able to revert with a migration test showing it's suitability.	YES	NO
b Please mark which information is labelled on your packaging (N/A for bulk deliveries) - Best before date - Article name - Batch number - Production date - Article no *Other, please describe:*		
The goods and delivery note must contain information about batch number and best-before date and the delivery note must also contain our purchase order number		

3. SOCIAL & ENVIRONMENTAL RESPONSIBILITY

3.1 Have you read and accepted Company Alpha's "Code of conduct"? If yes please enclose.

YES	NO
Comment:	

3.2 Have you communicated the demands in our Code of Conduct (or equal) to your employees, contractors and sub-suppliers?

Employees?	YES	NO
Contractors?	YES	NO
Sub-suppliers?	YES	NO
Comment on how:		

3.3. Management system

a. Does your company have an implemented and communicated CSR policy? If yes please enclose.	YES	NO
b. Does your company hold any CSR certificate, for example. SA8000, BSCI?	YES	NO
c. Are you a member of Sedex?	YES	NO
d. Have you had any external audits regarding social responsibility? If yes, add a copy.	YES	NO
Comment:		

3.4 Legal compliance

Does your company comply with all national laws and regulations as well as other applicable standards? (e.g. collective bargaining agreements or other codes of conduct)

YES	NO
Comment:	

3.5 Forced Labour (ILO 29/105)

a. Does your company participate in, or benefit from any form of forced labour, including bonded labour, forced prison labour, slavery, servitude, or human trafficking?	YES	NO
b. Do your employees have the freedom of movement during the course of their employment?	YES	NO
c. Do your employees have a contract of employment?	YES	NO
Comment:		

3.6 Child labour/young workers (ILO 138, 182)

a. Are all your employees above 15 years of age?	YES	NO
b. Do you follow the guidelines for young workers stated by ILO convection 138?	YES	NO
Comment:		

3.7 Non-discrimination (ILO 100/111)

Does your company engage in or support discrimination on the basis of race, colour, sex, language, religion, political or other opinion, caste, national or social origin, property, birth, union affiliation, sexual orientation, age, disability or other distinguishing characteristics?

YES	NO
Comment:	

3.8 Freedom of association (ILO 87/98)

a. Do your employees have the right to bargain collectively?	YES	NO
b. Do your employees have the right to associate to trade unions or if not allowed in the area, supported by alternative measures to gather independently?	YES	NO
c. Do you assure non-discrimination of workers' representatives?	YES	NO
Comment:		

3.9 Workplace health and safety

a. Is your company certified according to OHSAS 18001 or other work safety initiative?	YES	NO
b. Does your company ensure that workers are offered a safe and healthy working environment, including, but not limited to protection from fire and accidents?	YES	NO
c. Do you provide protective clothing and necessary training?	YES	NO
d. Are there routines in place for reporting of workplace accidents/incidents?	YES	NO
e. Are your personnel informed about risks in the workplace including first aid routines?	YES	NO
f. Do you have a systematic fire preventive work, including regular internal/ external inspections, training, clearly marked emergency exits and evacuation practises?	YES	NO
g. Do you have an implemented drug policy to assure absence of drugs at the workplace?	YES	NO
Comment:		

3.10 Conditions of employment and work (ILO 95/131/132)

a. Does your company protect workers from acts of physical, verbal, sexual, or psychological harassment, abuse, or threats in the workplace, whether committed by managers or fellow workers?	YES	NO
b. Does your company act in compliance with domestic laws concerning working hours and wages?	YES	NO
c. Does your company ensure a reasonable work-week (max 48h/legal limits)?	YES	NO
Comment:		

3.11 Anti-Corruption

a. Does your company have an anti-corruption policy? If yes please enclose	YES	NO
b. Does your company identify and eliminate corruption internally and within the Supplier's external supply chain?	YES	NO
Comment:		

3.12 Environmental Protection

a. Does your company have an environmental policy? If yes please enclose	YES	NO
b. Does your company take proactive precautions to minimize the negative environmental/working environmental impact of your operations?	YES	NO
c Do you present an annual sustainability report? If yes, please attach!	YES	NO
Comment:		

Significant Environmental Aspects are to be defined, documented and implemented. Please state your major aspects and how you work pro-actively in this area:

3.13 Have your company in any way been involved in unethical business – concerning workers rights, social responsibility, environment and/or fraud?

YES	NO
Comments (if yes, please describe):	

3.14 Food defense/TACCP

4.1 Do you have a food defense plan including secured assess to facilities, registration of employees and visitors?	YES	NO
Please describe:		

4. PRODUCT GENERAL REQUIREMENTS

- For all products supplied to Company Alpha, allergen datasheet stating possible cross contamination and possible maximum residue limits of allergens due to cross contamination must be provided.
- The product must not be obtained/manufactured, directly or indirectly, with the aid of genetic modification techniques – according to current EC legislation.
- Irradiation is not permitted.
- The usage of palm oil and/or palm oil derivates as well as non-vegan components must be fully transparent declared/communicated to Company Alpha, as we try to minimize the usage in our products
- Levels of contaminants and pesticides may not exceed the maximum levels mentioned in current EC legislation and applicable national legislation.
- The product and package material in direct contact with food and production must comply in all aspects with relevant EC legislation and applicable national legislation. If trade agreements exist, these are to be followed as well.
- At least 75% remaining shelf life of products (or, if more relevant, products from latest crop) delivered to Company Alpha or its customers must be guaranteed.
- All changes that influence product declaration and//or functionality must be immediately informed to Company Alpha

We confirm that we endorse and will comply with these requirements:

YES	NO

We confirm that information in this document is correct for delivered products to Company Alpha. All changes in the information and/or other product related documents have to be announced and approved in writing in advance by Company Alpha.

Name and function	**Signature**
Date and place	**Company (stamp)**

C Empirical findings

C.1 Company Beta

C.1.1 Company information

Company Beta offers specialized expertise in seasonings, with a broad portfolio of high-quality spices, starches, fibers, and customer-specific blends. Quality, safety, traceability, and sustainability plays an essential part in the company's overall strategy. This is also reflected in the overarching KPIs used, which emphasize the quality and delivery reliability of the sold products. The KPIs used in the purchasing function also focuses on quality and delivery reliability, but from the suppliers, and is thus well aligned with the overarching metrics. The purchasing organization consists of seven employees, of which three focus on the strategic aspect of purchasing (e.g. defining purchasing strategies) and three have more operational roles (e.g. operational buying, follow up delivery deviations). Lastly, they have one role of more administrative nature, allowing the others to focus on more value adding purchasing related tasks.

The Kraljic matrix plays an essential part in Company Beta's purchasing strategies and when defining long term plans, as it helps categorize the purchasing portfolio. The company has defined strategies for the different quadrants, e.g. maintaining more close and tight relationship with suppliers for strategic components and utilizing multiple sourcing to negotiate better deals for standard products. The Kraljic matrix also helps prioritize where they should focus their efforts in terms of e.g. supplier audits and projects, and also contributes to their risk management work.

C.1.2 Risk identification

Company Beta mainly considers quality related risks in their SRM work. One aspect of quality risks relates to food safety, which they are explicitly required to manage using HACCP. In addition, they also consider other risks, such as product counterfeiting, CSR, delivery reliability, and financial stability of their suppliers. The risk of price escalations from the supply market due to poor harvesting seasons (inherent in the agrifood industry) is also given attention.

In terms of tools and techniques, Company Beta utilizes several different information sources to gather intelligence regarding potential risks. Firstly, they use *external services and websites*, such as RASFF, CSR Risk Check tool, Eurofins, and Europol. Secondly, they follow different *indices*, such as BSCI and Corruption Perception Index (CPI). This helps Company Beta to identify potential "risky countries", thus indirectly identifying suppliers that might require additional attention to ensure compliance. Thirdly, Company Beta is part of several *trade associations* (e.g. The Swedish Food Federation[50] and The Aroma and Spice Federation[51]), where they can participate in discussions with similar peer companies with similar risks, e.g. regarding the implications of upcoming regulation changes.

[50] Swedish: *Livsmedelsföretagen*.

[51] Swedish: *Arom & Kryddföreningen*.

Fourthly, *suppliers* are another major source of input to the risk identification process. As part of their process, they gather data on three different occasions: (1) before using a new raw material or supplier, (2) proactive identification, and (3) reactive identification.

As the name suggests, (1) is conducted when Company Beta decides to source either a new type of raw material or use a new supplier. Extensive preparatory work is conducted as the new supplier or material is mapped in detail in a supply chain map to identify potential risks. More concretely, this is done by sending out a supply chain questionnaire to all suppliers, which requires them to share information for each item. The information gathered gives Company Beta a clear picture of the supply chain for each raw material and article. The Quality Assurance (QA) officers have the responsibility to gather and continuously update this data, and discuss potential actions for improvement together with the purchasing team.

As part of the (2) proactive identification, Company Beta uses scorecards to keep track of the performance of their suppliers. The scorecard is divided into different sections, which are weighted differently depending on the perceived importance. To exemplify, logistical and quality aspects have a higher relative weight than the factor detailing how quickly a supplier is able to send samples. Company Beta has used the same scorecard for ~8 years, and while some of the questions might be outdated, the consistency allows them to keep track of individual supplier development and compare suppliers with each other. As a general rule, they aim to send scorecards to all of their suppliers on an annual basis. However, in practice they include an element of subjective judgement when determining what suppliers to evaluate, as some suppliers are not perceived as important and only checked every second or third year.

As another element of proactive identification, the company conducts supplier audits considering two areas. One area relates to the product and production aspects, as they e.g. investigate how the supplier's internal processes are functioning and performing. The second area relates to how the supplier is performing from a CSR perspective. While they conduct the product and production audits on their own, they sometimes involve third party actors to conduct the CSR audit to get an objective view to complement their own assessment. To prioritize the audits, they make yearly plans, e.g. considering geographical locations (e.g. whether the supplier is based in a "risky country"), purchasing spend, sensitivity of raw material (e.g. whether it contains allergens), and the CSR aspect. The proactive identification process is primarily owned by the purchasers and QA representatives.

Furthermore, Company Beta conducts (3) reactive identification in the form of quality controls as the goods arrive at their facilities. In this control, they partly focus on HACCP related risks. Another important aspect of the quality control is to ensure the authenticity of the raw material. Even though this aspect might not be as severe as the HACCP related risks (as it does not physically harm the end-consumers), it is still essential to maintain their brand image. The quality controls are owned by the quality control (QC) function.

Lastly, the company leverages *internal information* and already conducted analyses, such as Kraljic and SWOT, to identify risks and guide their attention. An overview of all tools/information sources is shown in Figure C.1.

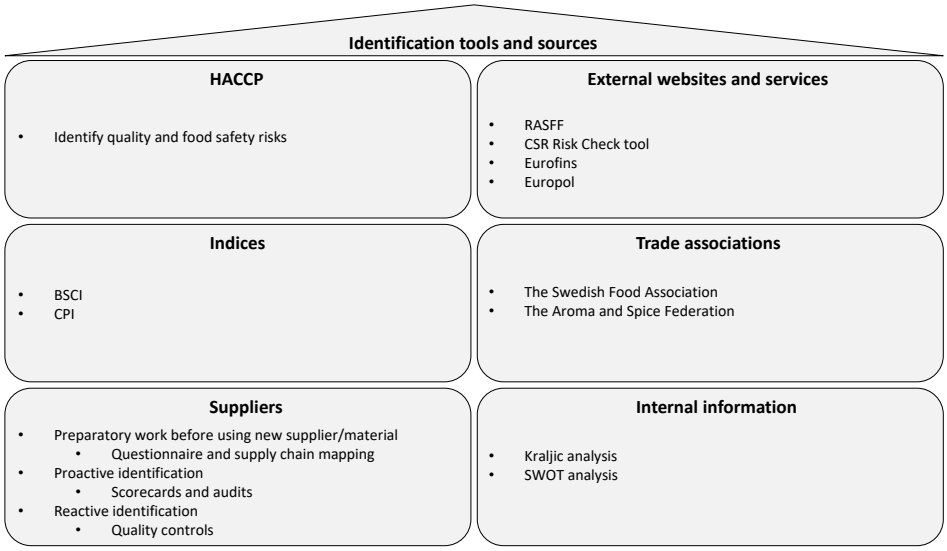

Figure C.1: Overview of identification tools and information sources used at Company Beta.

C.1.3 Risk assessment

For general risks, there is no clear distinction between identification and assessment, as much of the assessment is conducted simultaneously with the identification (e.g. through the scorecards). However, there is a clearly defined assessment process included in HACCP to assess quality and food safety related risks. An extract from Company Beta's HACCP analysis (conducted in an Excel spreadsheet) is shown in Table C.1. It illustrates how the company e.g. details the source of the risk, acceptable levels, and the effect on humans. Moreover, in terms of assessing the risks, the company considers the aspects *probability* and *severity*, which are assessed from one to five. A total risk score is computed by adding the two variables, and if this value is above a predefined threshold value the risk requires a mitigation action.

Table C.1: An extract from an Excel sheet included in Company Beta's HACCP process.

Allergen	Raw material	Packaging	Production	Acceptable level	Effect on human	Severity (1-5)	Probability (1-5)	Risk score	Significant risk?	
Gluten	X		X	<20mg/kg	The most common symptoms among children are diarrea and inegatively mpacting their growth. [...]	5	5	10	YES	

Moreover, there is a process in place to assess risks related to product counterfeiting. For this task, Company Beta uses a risk assessment matrix, visualized in Figure C.2. The risks are assessed in two dimensions based on the probability of occurrence and probability of detection. The dimensions are qualitatively assessed as *unlikely*, *likely*, *very likely*, where mitigation actions are needed for the risks in the highlighted area, consequently neglecting the remaining quadrants.

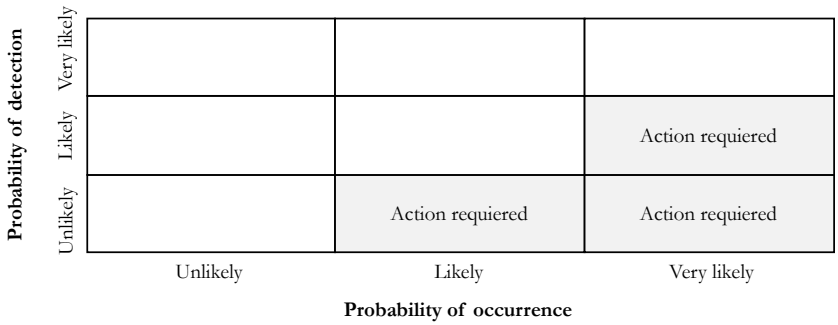

Figure C.2: Risk assessment matrix, adapted from Company Beta's risk management process documentation.

To assess the probability of occurrence, Company Beta considers: (1) history, (2) financial, (3) accessibility, (4) geographic origin, and (5) ease of forgery. *History* relates to whether a specific supplier previously has a record of forging any of their products. *Financial* considers to what extent there is any financial upside to be gained from forgery. *Accessibility* relates to what extent the raw material is available in the supply chain, e.g. whether there is any supply deficit compared to the demand. *Geographic origin* takes into account whether the supplier's country is perceived as risky. Lastly, *ease of forgery* considers whether the supplier can forge the material without much trouble.

In a similar manner, probability of detection is considered based on: (1) geographic origin, (2) nature of raw material, (3) control by supplier, (4) control of raw material, and (5) supplier audits. In this context, *geographic origin* relates to whether the supply chain consists of few or multiple tiers, as counterfeit risks are more difficult to detect if there are multiple tiers. The *nature of raw material* takes into account the physical form of the material, and to what extent this facilitates forgery. *Control by supplier* relates to whether or not there is a quality control process at the supplier. *Control of raw material* concerns to what extent it is possible to perform tests of the raw material (and the difficulty, cost, and time required). The last factor relates to whether any supplier *audits* have been conducted.

C.1.4 Risk mitigation

Company Beta uses several mitigation actions as part of their risk management process. However, there is no predefined list of potential actions, as actions rather emerges based on the experience and expertise of the employees. Moreover, the company does not formally document the relationship between identified risks and pursued mitigation activities. Some examples of pursued actions are change of supplier (e.g. to reduce lead times and uncertainties through local sourcing, or to avoid an existing bad-performing supplier), change of ordering point, adjustments of safety stock levels, and long-term contracts for important products.

To determine mitigation actions, Company Beta considers the inherent tradeoffs. As an example, while sourcing from China might enable lower cost, it also has negative sustainability effects. Thus, the company must consider the tradeoff between lower costs against the benefit of having a more sustainable business, which potentially can justify premium prices in the market. In addition to considering tradeoffs, the company also uses the Kraljic matrix to guide their mitigation decision, as the categorization might indicate appropriate actions. To exemplify, while it might make sense to adjust the product design to make the procurement specifications less unique for bottleneck

products (and effectively decreasing the supply risk), this solution might be inappropriate for a leverage product where there already exists numerous available suppliers.

C.1.5 Risk monitoring

In general, there exist no formal process to monitor the development of identified risks, which is mainly conducted informally on an ad hoc basis. Moreover, there exist no element of evaluation of the performance of already mitigated risks. However, it is argued to be handled automatically, as they will quickly find out whether e.g. a new supplier is able to deliver according to specification or the new safety stock level has the desired effect. Lastly, there exists no monitoring of the SRM process itself (e.g. relating to process compliance) or any element of continuous improvement.

C.1.6 Risk organization

In terms of governance, there exist no formal risk board or risk function with the sole purpose of discussing risks. However, the management team, with cross-functional participation, discuss risk as part of their more general agenda. The management team holds high-level discussions regarding the market situation to understand potential threats and opportunities.

The cross-functionality is not only apparent in the management team but also the employees conducting the actual risk management work, with representatives from e.g. purchasing, QA, QC, and the logistics functions. Naturally, the risk organization also contains a dedicated HACCP group with representatives from QA and QC, as required by legislation. To facilitate information sharing between all relevant stakeholders, Company Beta uses a Supplier Relationship Management system, where all phone calls, meetings, negotiations, and supplier evaluations are stored.

In terms of risk culture, the interviewed Purchasing Manager argues that risk management is reflected in all employees' work. Even though not all might think about it, risk management is influencing many of the existing processes, documentations, and specifications. The Purchasing Manager further argues that top management are committed to risk management and take the subject seriously. More concretely, this is exemplified by a zero accidents or incidents vision and employing a dedicated Quality Officer that is constantly monitoring the security of the factory.

C.2 Company Gamma

C.2.1 Company information

Company Gamma produces ingredients for the food industry and helps their customers with product innovation and general advisory. The company has sites spread across Europe and used to consist of several independent companies, but now operate under a unified company name. In this thesis, the scope of Company Gamma considers the entire cooperation rather than any specific local entity.

The procurement organization consists of both a centralized category management organization as well as regional and local organizations. The central organization is based around three raw material categories. Each category includes a purchaser, a product developer, and a QA representative. Company Gamma categorizes their suppliers as *strategic* (~10), *preferred* (~100-130),

and *others* (~2350), based on the 80/20 rule. 80 % of the purchasing spend should be allocated to 20 % of the strategic and preferred suppliers. The differentiation between strategic and preferred suppliers is based on what suppliers the company pursues especially close relationships with. The regional organizations are responsible for procuring from strategic/preferred suppliers, while the local organizations have flexibility in handling the remaining procurement needs from suppliers they consider feasible. In the procurement organization, they primarily track three types of KPIs: (1) to what extent they meet the budgeted spend, (2) how close they meet the 80/20 allocation among their supplier categories, and (3) the direct spend proportion[52].

C.2.2 Risk identification

The identification process at Company Gamma is primarily owned by the quality function, but purchasing and product development are also involved. There is a clear distinction between the identification process for quality and non-quality related risks. For quality related risks they have a quality management system that they follow, which makes this process very structured and well-documented. More concretely, they follow the processes defined in HACCP and FSSC 22000. In this process, Company Gamma considers varying types of quality risks, such as microbiological, chemical, food fraud, adulteration, and regulatory aspects. The non-quality risks considered include for instance supply chain related risks, such as too high dependency of single suppliers for critical components and delivery issues. Moreover, they consider sustainability risks related to specific suppliers and locations, such as corruption and the incentives of farmers. The identification process is in general not as systematic and documented for non-quality risks.

As an important risk identification tool, Company Gamma leverages their IT system. Through their system, they can e.g. generate overviews of how many different sources they have for all their raw materials, which can help identify products that are only procured from single suppliers. The system also allows them to perform risk analysis on specific countries and regions to give an overview of how their purchasing spend is concentrated in certain areas. The purchaser conducts this analysis "from time to time" as there are no clearly defined guidelines on the periodicity. In practice, this results in the analysis being reevaluated once a year or every second year. Furthermore, the company uses fault tree analysis as a method to identify root causes to potential risks.

Another major input to their risk management process are the suppliers. Company Gamma sends supplier questionnaires to their suppliers every third year to get an understanding of potential risks. In addition to the questionnaire, the company performs occasional physical audits at the supplier sites. To prioritize what suppliers to focus on, they consider the size of the purchasing spend and to what degree the suppliers' country can be considered as risky. Lastly, Company Gamma conducts annual supplier performance assessments to analyze how the suppliers are performing, considering e.g. on-time-delivery reliability, number of claims, how proactive they are towards the company's R&D function, and how quick they are at providing necessary documentation.

[52] I.e. proportion of spend from the initial supplier. This is considered relevant as the company strives to reduce the number of intermediaries in their supply chain.

For the continuous identification of risks, Company Gamma uses different notification services, such as RASFF, which provides daily monitoring and alerts them with potential risks. They are also part of different networks such as the European Spice Association (ESA), which provides them with another alert service.

C.2.3 Risk assessment

There is much difference between how quality and non-quality risks are assessed. For quality risks, the process follows the defined guidelines in HACCP and FSSC 22000, and risks are assessed and prioritized using a risk assessment matrix that considers probability of occurrence and potential impact. No similar assessment is conducted for non-quality risks, which are assessed more informally based on experience and intuition simultaneously as they are identified. Thus, there is no documentation on this assessment and only the quality function is involved in the structured risk assessment process.

C.2.4 Risk mitigation

Quality risks are primarily mitigated using quality controls. A differentiation is made based on how risky a specific material is perceived/assessed. Salt for instance, which is perceived to have very limited risk, is not controlled at all. Meanwhile, other raw materials are tested using different analysis methods. These steps are well documented in accordance with their quality management system. In terms of non-quality risks, Company Gamma uses several mitigation actions, such as dual sourcing, contracts, incoterms, safety stocks (both at own facilities and suppliers'), and avoiding geographical concentration of suppliers. Moreover, they leverage the benefits of having multiple production sites in the corporation, which means they can mitigate certain risks from having the flexibility of producing the same products at multiple locations. To mitigate risks related to the financial health of suppliers, they never pay in advance. Furthermore, if a supplier is perceived as financially risky, the finance function in some occasions performs financial analysis before conducting any business. Lastly, they have a Code of Conduct, which they require suppliers to sign before conducting any business. If the Code of Conduct is not signed, or the supplier questionnaire indicates potential severe risks, Company Gamma simply chooses to not initiate any business with the supplier. While there is no documented process of how the risk mitigation step, and how/why certain mitigation actions are chosen, the output is always indirectly documented in various strategy/sourcing documentation.

C.2.5 Risk monitoring

Monitoring of how identified risks develop is conducted at the company, although not following any formal process. Contrarily, monitoring of already treated risks is not being conducted. However, this is argued to be handled indirectly, as the mitigation action performs well if the specific risk does not occur anymore, and they would notice otherwise. Instead of spending resources on monitoring the past activities, the interviewed Category Procurement Manager argues that it is more relevant and value adding to focus on the identification and assessment of new risks which might occur in the future. This is especially argued to be the case as many of their identified risks are very unique and likely will never exactly repeat themselves. Lastly, there is no evaluation or monitoring of how the risk management process itself is working.

C.2.6 Risk organization

In terms of governance, no formal risk board/committee or similar exists at Company Gamma. However, the risk topic is being discussed as part of a wider agenda in several management teams in the organization. Naturally, the risk topic is also discussed in the HACCP group. Regarding the more "operational risk work", it is mainly conducted by employees from the purchasing and QA functions, with the purchasing representatives focusing on general risks whereas QA are focused on the quality aspect.

In general, the risk culture is perceived to be risk averse. This is likely due to the corporate culture with much emphasis on quality, where the risk tolerance is very low. Another aspect driving the risk averse culture is believed to be the establishment of a unified company with a shared name across all entities in 2012. With the widespread usage of alert systems such as RASFF, any severe accident from any of their local entities would now not only harm the reputation of that entity, but also damage the entire company brand reputation. However, there is no explicit direction from management on how much risk that is acceptable.

C.3 Company Delta

C.3.1 Company information

The purchasing function at Company Delta consists of four employees, including three purchasers and a Head of Procurement, and the function is responsible for the sourcing of packaging, raw materials, and commodities. The purchasing function primarily measures their success by looking at: (1) benchmarking of their purchasing prices against the market prices, (2) delivery security from suppliers, and (3) product complaints from production.

Company Delta emphasizes the importance of having good relationships with their suppliers and has developed many long-term partnership relationships. However, there exist no documented strategic plan on where to pursue these relationships. In the supplier selection process, Company Delta is heavily focused on specification assurance and low prices, and the interviewed Purchaser mentions that the price is often ultimately prioritized over the relationship aspect in negotiations. To segment their supplier base, Company Delta has two supplier categories: *strategic* and *standard*. Strategic suppliers are suppliers with a high total purchasing spend and the purchasers dedicate extra effort for these suppliers to assure supply and low prices. The standard suppliers contain the remaining suppliers, and the company regularly tries to reduce this supplier category by identifying suppliers with few articles and low purchasing spend. The Purchaser mentions that the company does not formally segment their supplier base using the Kraljic matrix, but that the main ideas of the matrix is indirectly considered when they pursue various supplier strategies.

C.3.2 Risk identification

Company Delta strongly relates SRM to quality risks, and they follow the documented HACCP method which QA is responsible for. The purchasing function has the responsibility for the more holistic risks. Some of the risks mentioned by the interviewed Purchaser were:

- Suppliers with only one production line which fails, delaying delivery until the production line is repaired. Lead times for spare parts can be multiple weeks which hinders fast recovery.
- Geographically far suppliers.
- Purchasing through agents instead of the original supplier, negatively affecting visibility and lead times.
- Long lead times.
- Incomplete product deliveries, e.g. a shipment of damaged goods that delays production.
- Too many suppliers (with few articles) which adds unnecessary complexity.

To identify quality risks, the company follows the required steps of HACCP. In addition, the product specifications are described as an important tool, as this facilitates unveiling flaws with the purchased goods. To identify more holistic, purchasing related risks, the purchasing function routinely extracts statistics and data from all suppliers, with general information such as total purchasing spend, number of purchased articles, and geographical location. This data extraction can be used as a tool to identify potential risks in their supplier base.

Another practice to identify and discuss potential risks is through internal information sharing between operational purchasers in different parts of the organization. The company has sporadic purchasing meetings with the purchasers working in the different factories where a round table discussion takes place. During these meetings, each participant shares potential issues or risks, with the purpose to solve the problem together and learn from each other.

Furthermore, Company Delta puts much emphasis on their supplier evaluation process, which is mainly focused around quality, safety, and sustainability. Supplier evaluations are done for all new suppliers and every third year for existing suppliers. They may also be conducted if an apparent risk or uncertainty appears related to a supplier, or when a supplier does not perform as agreed. The evaluation starts by letting the supplier fill in information regarding (1) social responsibility, (2) quality, (3) environment, (4) traceability and product recall, (5) GMO, (6) product control, (7) food safety, (8) animal welfare, and (9) labelling and seals. Moreover, a credit control is conducted to ensure the financial stability of the supplier. As part of the supplier evaluation process, the suppliers are also required to sign a Code of Conduct. Another described identification tool is supplier audits, which are normally done remotely due to time constraints. The company is currently developing an improved version that can be done in closer collaboration between the purchasing and QA function.

For continuous food fraud identification, the company uses RASFF to get fast alerts regarding the detection of potential risks. This tool gives the company a way to monitor the market and know whether any food fraud or similar has affected one of their suppliers. If that is the case, the company contacts the affected supplier for more information.

C.3.3 Risk assessment

Generally, there is no single assessment methodology which is applied, as the risk assessment is rather incorporated as part of several processes in the company's day-to-day operations. One of

these processes is HACCP, where pure quality risks follow a structured and well-documented assessment step, as required by regulation. Moreover, Company Delta conducts a supplier review meeting once a year, where different areas are assessed and graded by allocating points. Depending on the total points, they perform different activities to ensure that the suppliers improve their performance. In the review, the follow areas are being assessed:

- Current business status (Purchaser)
- Delivery performance (Demand & Planning)
- Quality and food safety issues (Quality and Purchaser)

Furthermore, Company Delta follows a formal assessment procedure as part of their supplier evaluation. Once a supplier has submitted the requested information, the purchasing function evaluates the information, identifies and qualitatively assess potential issues and risk sources. If the evaluation requires extensive focus on quality, a quality technician is involved as well. In the evaluation process, not all criteria are treated equally, as the ones perceived to be more important are given more weight.

The output of the evaluation is a color-coded spreadsheet, where the supplier receives one of the following grades: (1) green, (2) blue, or (3) yellow. *Green* is the best grade, where the supplier has passed all requirements and will thus not be evaluated again until three years. *Blue* represents a partial pass, where issues or risks have been assessed, and improvements are required. A blue grade leads to a follow-up evaluation in one year. *Yellow* is given to suppliers that indicate potential issues or risks but where there are no viable alternatives. A yellow grade leads to a follow-up evaluation in six months where identified issues can be reassessed.

C.3.4 Risk mitigation

Risk mitigation for quality related risks has a well-defined process included in the HACCP process. The QA function proactively mitigates risks by creating well-defined requirements and routines for their production flows and products. The purchasing department on the other hand, does not work in a formal and defined process. Risk mitigation is done on a case-by-case basis, and risks are mitigated based on previous experience and intuition. The mitigation is done by the purchasing function in close cooperation with the Demand & Planning function. Company Delta do not have a compiled list of defined mitigation actions, but some mentioned examples are:

- Company Delta looks for suppliers where the company only purchases a few articles and has a low total purchasing spend. To avoid dependency on small suppliers and to reduce their supplier portfolio to gain better visibility, they actively seek to transfer these articles to other bigger suppliers in their portfolio.
- For strategic and important products, the company uses dual sourcing to mitigate potential risks. For some products, the practice of a back-up supplier is also used, where the company can have an agreement with an additional supplier to use if needed.
- In scenarios where an important delivery is missing and supply is urgent, the company reaches out by phone or mail to all their existing and potential suppliers to find an alternative supplier.

- In scenarios where a delivery has not arrived as expected, the Demand & Planning function may temporarily switch the daily production plan to other products to avoid downtime in the factory.
- The company uses safety stocks to mitigate risks. In these scenarios the company considers whether the increased safety stock should be added at the supplier's warehouse or their own.
- To reduce supply uncertainty, the company sends demand forecasts to some of their suppliers (provided from Demand & Planning). These are sent to suppliers that either request it or suppliers where Company Delta has identified a potential risk.
- To assure a certain supply volume, the company uses contracts with volume-guarantees. These contracts and their flexibility vary between suppliers depending on the circumstances.
- To assure supply, the company also uses contracting to control the minimum and maximum volumes from selected suppliers.
- To mitigate potential risks with outdated supplier contracts, the company reviews the contracts on an annual basis.

C.3.5 Risk monitoring

To some extent, the company works with risk monitoring of identified risks. This is done by the individual purchasers using follow-up evaluations from risky suppliers in the supplier evaluation process. However, no documentation is conducted. Moreover, the company lacks a formal process to monitor already treated risks and evaluate the process itself.

C.3.6 Risk organization

Given the cross-functional nature of risk management, the interviewed Purchaser could not comment on how the risk organization in general functions at the company (in terms of governance and risk culture). However, some comments were made in terms of how the purchasing function has operated during the covid-19 pandemic. Weekly meetings have been held, where the purchasing function has discussed new risks, their potential impact, and what mitigation actions they can pursue. Takeaways from the meetings have then been escalated by the Purchasing Manager. However, this is considered to be a temporary setting and the purchasing function is likely to return to discussing risks ad hoc through mail or phone once the pandemic has passed.

Moreover, in terms of the risk culture at the purchasing function, the interviewee mentioned that all employees are actively working with risk management as part of their everyday tasks. Even though they might not think about it as risk management, they consider the risk aspect indirectly.

D Within-case analysis

D.1 Company Beta

D.1.1 Risk identification

An overview of how the authors graded Company Beta's risk identification process compared to the investigation model is shown in Table D.1. The overview is followed by the reasoning behind each grade.

Table D.1: Assessment of Company Beta's risk identification process.

Investigation model: Risk identification	**Grade**
Structured identification process	3
Documented identification process	2
Regularly scanning for risks	3
Holistic approach to risk identification	2
Involvement of tools	3

The authors perceive Company Beta's risk identification process as relatively structured, as they have several well-defined tools and information sources that provide input to the process. However, no overview/flow chart of the identification process exists of the identification process. Moreover, the authors believe there might be room for improvement in terms of documentation as they are not explicitly listing their identified risks. This is primarily done as part of the HACCP and product counterfeit process and not common practice for all risk types.

In terms of the regularity of the risk scanning, the authors argue that Company Alpha performs more or less in line with theory as they have clearly defined the frequency when most of their tools should be applied. However, the authors raise some concerns that it might not be frequent enough, which was highlighted as important by Kern et al. (2012). Especially considering that supplier scorecards and audits for suppliers considered non-risky might get excepted from the annual processes.

In terms of risk scope, it is evident that Company Beta considers *supplier* risks, as they put much emphasis on quality related risks (SQU), e.g. in terms of the general product safety. Furthermore, they focus on risk aspects such as financial (SFI), logistical (SLO), and sustainability (SSU). They also consider *network* risks, as they are able to identify products with limited supply from their Kraljic analysis, which can be seen as a supply market risk (NSM). Moreover, price escalation from suppliers can be seen as either a supply market risk (NSM) if it is caused by general price fluctuations, or a supplier-specific commercial risk (SCO). In addition, the authors argue that the root cause of this risk can rather be described as a *macro* environmental risk (MEN), if it is caused by poor weather conditions. Lastly, from following various country compliance and corruption indices and subscription services, Company Beta can be argued to consider risks related to social (MSO), legal (MLE), and political (MPO) aspects.

Concludingly, it is noted that Company Beta considers risks from all three overarching risk source categories. However, it is evident that not all of the underlying categories are treated equally, as quality risks were given special focus and consideration. This was both "informally" observed during the interviews, as the interviewee strongly related risk management to quality risks, but also more formally as the company weights some aspects more heavily in their supplier surveys. The general focus on quality is likely explained by the company's overall focus on quality and the regulatory requirements on food safety.

In terms of identification tools, Company Beta put much emphasis on the Kraljic matrix, also part of the investigation model. Among the other tools present in the investigation model, they also utilize SWOT analysis, supplier scorecards, audits and supply chain mapping of raw materials. However, they are not using cause-effect diagrams, FTA, ETA, or brainstorming. Moreover, contrarily to the investigation model, the company uses several other tools, such as different external services, websites, indices, and participation in trade associations to detect new risks.

D.1.2 Risk assessment

An overview of how the authors graded Company Beta's risk assessment process compared to the investigation model is shown in Table D.2. The overview is followed by the reasoning behind each grade.

Table D.2: Assessment of Company Beta's risk assessment process.

Investigation model: Risk assessment	**Grade**
Structured assessment process	2
Documented assessment process	2
Criticality assessment and prioritization of risks	2
Assessment on risk level	2
Consistent methodology for all risks	1
Involvement of tools	3

It was evident from the interview that Company Beta does not make the same clear distinction between risk identification and assessment as advocated by theory. While some assessment is naturally conducted as part of the supplier survey process, HACCP, and counterfeit/forgery risks, there were no structured and documented assessment processes in place for all risk types. Furthermore, it was evident that the company did not use a consistent methodology for all risk types, thus contradicting Bailey et al. (2019).

Compared to the investigation model, only different variations of the risk assessment matrix is utilized at Company Beta, as the other tools were not recognized. The assessment used in HACCP shares many similarities with the theoretical risk assessment matrix, where the dimensions of impact and probability is numerically assessed before a risk score is computed. However, no visualization of the risks in matrix format is conducted. Moreover, the assessment process for

counterfeit/forgery risks shares some similarities with the theoretical one, but also contains some key differences. While the theoretical matrix contains the variables probability of occurrence and impact, Company Beta's matrix focuses on probability of occurrence and probability of detection. It thus instead shares some similarities with the assessment performed in FMEA, which also incorporates an element of how easy it is to detect a risk. However, in contrast to FMEA, Company Beta's process neglects the impact variable. The authors argue that this variable is critical to consider in the assessment stage, a viewpoint which appears to be shared with researchers judging by the literature review. Another issue the authors identified with the process was the strict threshold limits, as only three out of nine quadrants are considered for mitigation actions. Consequently, many of the identified risks will simply be accepted without even considering potential actions.

D.1.3 Risk mitigation

An overview of how the authors graded Company Beta's risk mitigation process compared to the investigation model is shown in Table D.3. The overview is followed by the reasoning behind each grade.

Table D.3: Assessment of Company Beta's risk mitigation process.

Investigation model: Risk mitigation	**Grade**
Structured process for choosing mitigation actions	2
Documented mitigation process	1
Considering strategic alignment	2
Considering cost versus benefit	4

Some of the mitigation actions in the investigation model are actively used at Company Beta. To exemplify, they utilize network design actions from making appropriate supplier selection, such as local sourcing (NET3). Furthermore, postponing (PLA1) can be seen as an example of changing order points, and the company also adopts buffering in the form of safety stocks (BUF1). Although not discussed as mitigation strategies by the interviewee, Company Beta also adopts supplier scorecards and audits (COL5). In addition, some new mitigation actions emerged, namely using long-term contracts for important products and changing the product design.

In terms of picking the correct mitigation action for a given risk, the company uses tools which are well in-line with the theoretical investigation model. Firstly, the cost-benefit analysis is explicitly mentioned in both the model and Company Beta's process, in line with Tang (2006). Moreover, while the investigation model emphasizes the strategic fit of mitigation actions with the company's overall strategy, this is partly done at the company at a more detailed level (i.e. product group level) using the Kraljic matrix. Nevertheless, while the company uses relevant tools, there is still somewhat lacking a formal process on how they should be used and documented.

D.1.4 Risk monitoring

An overview of how the authors graded Company Beta's risk monitoring process compared to the investigation model is shown in Table D.4. The overview is followed by the reasoning behind each grade.

Table D.4: Assessment of Company Beta's risk monitoring process.

Investigation model: Risk monitoring	**Grade**
Structured monitoring process	1
Documented monitoring process	1
Monitor development of identified risks	2
Monitor already treated risks	1
Monitor and continuously improve the process	1

A major gap compared to the investigation model was identified at the risk monitoring stage, which was barely conducted or documented at all. The authors agree with the theoretical perspective, and that Company Beta would benefit from a more formal evaluation to enable an element of continuous improvement in their process, which is currently lacking.

D.1.5 Risk organization

An overview of how the authors graded Company Beta's risk organization compared to the investigation model is shown in Table D.5. The overview is followed by the reasoning behind each grade.

Table D.5: Assessment of Company Beta's risk organization.

Investigation model: Risk organization	**Grade**
Top management support	3
Risk board	2
Cross-functional participation	3
Risk culture	2

Top management support is argued to be present at Company Beta, as the management actively discuss the risk topic as part of their agenda and have a clearly defined objective of limiting the internal accidents. In terms of the existence of a risk board, this is only true to some extent. While the management team functions as a risk board, it does not fully align with the purpose of the board discussed in the literature review, as e.g. described by Bailey et al. (2019). More specifically, it is not a dedicated group solely focusing on the risk topic. Instead, the management team mainly has an overarching role, where they discuss the risk topic but does not interfere with the actual process.

The need for cross-functional participation mentioned in the literature review can be clearly seen at Company Beta, as representatives from various functions take an active part of the process. However, to justify the highest grade in this regard, the authors argue that an active involvement of even more relevant functions would be needed, such as sales representatives to capture the customer perspective.

Lastly, in terms of risk culture, it is partly present at the company. The authors e.g. view the zero accident vision from top management as a type of directive on the risk tolerance at the company. However, this takes a rather internal perspective and there does not seem to exist similar directives for supply chain risks. Moreover, risk management is something many employees does not reflect on despite being part of the process, which might indicate a lack of awareness of the risk topic.

D.2 Company Gamma

D.2.1 Risk identification

An overview of how the authors graded Company Gamma's risk identification process compared to the investigation model is shown in Table D.6. The overview is followed by the reasoning behind each grade.

Table D.6: Assessment of Company Gamma's risk identification process.

Investigation model: Risk identification	**Grade**
Structured identification process	2
Documented identification process	2
Regularly scanning for risks	2
Holistic approach to risk identification	3
Involvement of tools	3

For quality risks, the company pursues an identification process which is both structured and conducted at regular intervals. However, there is an apparent lack of structure for more general risk identification. Moreover, some of the tools used in the identification process (such as the supplier overviews from the IT system) is only conducted ad hoc relatively sparsely. Thus, both the structure, documentation, and regularity of Company Gamma's identification process is graded as only partly in line with theory.

In terms or risk scope, all three overarching risk sources are to some extent considered. However, there is some skewness, as much emphasis is put on *supplier* risks such as quality risks (SQU). The underlying reason for the special emphasis is likely driven by both regulatory and certification requirements. Other supplier risks considered are sustainability (SSU) and logistical (SLO) risks. In terms of *network* risks, the company considers supply market risks (NSM), mainly from their relatively sophisticated approach of identifying and geographic concentration of sourcing and dependency on single suppliers. Lastly, Company Gamma also focuses on *macro* risks, from identifying "risky locations" in terms of social (MSO) risks, such as the risk of corruption and

incentives of the workforce. Some environmental (MEN) risks are also identified from their notification services.

Company Gamma actively incorporates tools as part of their identification process. Several of the identification tools present in the investigation model are actively used at Company Gamma, i.e. SWOT analysis, FTA, supplier scorecards, and supplier audits. In addition to the tools mentioned in the investigation model, Company Gamma also utilizes their IT system, notification services, trade associations, and supplier assessment to identify relevant risks.

D.2.2 Risk assessment

An overview of how the authors graded Company Gamma's risk assessment process compared to the investigation model is shown in Table D.7. The overview is followed by the reasoning behind each grade.

Table D.7: Assessment of Company Gamma's risk assessment process.

Investigation model: Risk assessment	**Grade**
Structured assessment process	2
Documented assessment process	2
Criticality assessment and prioritization of risks	2
Assessment on risk level	2
Consistent methodology for all risks	1
Involvement of tools	2

A gap compared to the investigation model was observed in the assessment stage. While Company Gamma has a structured and documented process to assess quality risks, they base the assessment and prioritization of other risk types on intuition and experience with no process in place. For quality risks, however, they are conducting the risk assessment similar to the investigation model by utilizing the risk assessment matrix as their primary tool. This contradicts Bailey et al. (2019), as no consistent assessment methodology is being applied. Another deviation from theory is that not all risks are identified on risk level, but rather at a supplier level.

The higher maturity in the "quality risk process" is likely driven by regulatory requirements, which requires the company to conduct a documented process. As also noted for Company Beta, the generalizability of assessment methods should imply that Company Gamma might be able to use the same assessment methodology to their more general risk management process. Thus, the authors argue that the company would benefit from adopting the same assessment structure for all their risks.

D.2.3 Risk mitigation

An overview of how the authors graded Company Gamma's risk mitigation process compared to the investigation model is shown in Table D.8. The overview is followed by the reasoning behind each grade.

Table D.8: Assessment of Company Gamma's risk mitigation process.

Investigation model: Risk mitigation	**Grade**
Structured process for choosing mitigation actions	2
Documented mitigation process	2
Considering strategic alignment	1
Considering cost versus benefit	1

Several of the pursued mitigation activities can also be observed in the investigation model, such as dual sourcing (NET1), geographically diversified sourcing (NET2), delivery agreements (CON3), excess inventory (BUF1), and considering the financial health of their suppliers (NET5). Moreover, due to their network design with multiple production sites, they also benefit from additional flexibility through excess capacity (BUF2) at other factories. The empirical findings also highlight some actions which were not part of the investigation model, such as mitigation risks from smart payment terms and the Code of Conduct.

While the interviewee mentioned that the output of the mitigation step is always documented in various documentation, the authors argue that there is still a lack of documentation in the overall risk mitigation step. As both a formal process and documentation is lacking, there is limited traceability on the connection between risks and mitigations, and why certain actions pursued made, thus making evaluation of the process troublesome. Moreover, as there is no process on how to determine appropriate mitigation actions, neither the strategic alignment nor the cost-benefit analysis is considered in any formalized manner.

D.2.4 Risk monitoring

An overview of how the authors graded Company Gamma's risk monitoring process compared to the investigation model is shown in Table D.9. The overview is followed by the reasoning behind each grade.

Table D.9: Assessment of Company Gamma's risk monitoring process.

Investigation model: Risk monitoring	**Grade**
Structured monitoring process	1
Documented monitoring process	1
Monitor development of identified risks	2
Monitor already treated risks	1
Monitor and continuously improve the process	1

When comparing to the investigation model, a gap can be observed in Company Gamma's risk monitoring step, which is more or less non-existent. Although they conduct some informal monitoring of identified risk, there is no formal process for this. A process is also lacking for evaluating treated risks and the process itself to allow for continuous improvement. The authors argue this is an area where Company Gamma could improve their risk management process.

D.2.5 Risk organization

An overview of how the authors graded Company Gamma's risk organization compared to the investigation model is shown in Table D.10. The overview is followed by the reasoning behind each grade.

Table D.10: Assessment of Company Gamma's risk organization.

Investigation model: Risk organization	**Grade**
Prioritized by management	3
Risk board	2
Cross-functional participation	3
Risk culture	4

Not many details were provided to accurately assess how management prioritizes risk management at the company. The interviewee did however mention that the risk topic has been much more emphasized since the company got unified under a single company name and that employees in general got more risk averse. It is also apparent that various management teams are discussing the risk topic as a regular part of their meetings.

Compared to the investigation model, Company Gamma is lacking a risk committee/board, as the risk topic is rather being discussed as part of a broader agenda at several management teams in the organization. However, this setup does not fully align with the theory, as the management teams are not solely focusing on the risk topic. Moreover, there is no direct connection between the management teams and the risk topics, where participants are being given ownership or responsibility of specific risks. Thus, the risk board aspect is not fully aligned with the investigation model at Company Gamma.

Similar to the investigation model, the risk management work is more or less characterized by cross-functional participation, as multiple functions are included, justifying a relatively high grade in this area. However, there some lack of cross-functionality was identified at the assessment step where only the quality function conducted a formal assessment. Furthermore, to justify the highest grade, the authors argue that other relevant functions should have a more active role, e.g. sales.

Lastly, a high grade is given to their overall risk culture. There is a general risk averse mindset where risks are considered important throughout the company, to not jeopardize the brand image.

D.3 Company Delta

D.3.1 Risk identification

An overview of how the authors graded Company Delta's risk identification process compared to the investigation model is shown in Table D.11. The overview is followed by the reasoning behind each grade.

Table D.11: Assessment of Company Delta's risk identification process.

Investigation model: Risk identification	**Grade**
Structured identification process	2
Documented identification process	2
Regularly scanning for risks	2
Holistic approach to risk identification	3
Involvement of tools	3

The authors view Company Delta's HACCP process as structured, but argue that there is room for improvement for more general risk identification. There is no formal process where they document concrete risks (as the supplier evaluation only focuses on the supplier-level), which is essential to enable structure in subsequent steps. The authors further argue that the company may lack some regularity in their general risk identification. Apart from their supplier evaluation, there are no clear guidelines on when concrete risks should be identified, causing this process to be rather ad hoc.

Company Delta considers all three overarching risk source categories in their risk management process. In terms of *supplier* risks, quality (SQU), sustainability (SSU), financial (SFI), operational (SOP) and logistical (SLO) risks were mentioned. Regarding *macro* risks, Company Delta can be argued to consider social (MSO) and environmental (MEN) risks from their notification services. Interestingly, the risk of complexity in the supply chain was also mentioned, from both unnecessary number of suppliers and complexity from involving additional actors (agents) in the supply chain, which was not part of the investigation model. This can be viewed as examples of *network* risks. During the interview, it was mentioned that not all risks are considered of equal importance, which was also formally taken into consideration in the supplier evaluation. In the authors' view, it was evident that quality, sustainability, and safety risks were prioritized at Company Delta, as they had a much more systematic process than more general risks.

Compared to the tools in the investigation model, Company Delta uses supplier scorecards, supplier audits, and HACCP as part of their risk identification. Moreover, a notification service in the form of RASFF was also used, although not part of the investigation model.

D.3.2 Risk assessment

An overview of how the authors graded Company Delta's risk assessment process compared to the investigation model is shown in Table D.12. The overview is followed by the reasoning behind each grade.

Table D.12: Assessment of Company Delta's risk assessment process.

Investigation model: Risk assessment	Grade
Structured assessment process	2
Documented assessment process	2
Criticality assessment and prioritization of risks	2
Assessment on risk level	2
Consistent methodology for all risks	1
Involvement of tools	3

A gap was identified at Company Delta's risk assessment stage. Although they pursue a well-documented and defined assessment for quality risks, including a criticality/prioritization assessment and tools, there exists no structured and documented process for other risks types, as these are handled ad hoc. A contradiction can thus be identified compared to the investigation model, as no standardized assessment methodology exists for all risks.

For more general risks, they are to some extent formally assessing risks at a supplier level as part of their supplier evaluation, but no similar process of assessing concrete risks exists. This results in another gap in Company Delta's assessment.

D.3.3 Risk mitigation

An overview of how the authors graded Company Delta's risk mitigation process compared to the investigation model is shown in Table D.13. The overview is followed by the reasoning behind each grade.

Table D.13: Assessment of Company Delta's risk mitigation process.

Investigation model: Risk mitigation	Grade
Structured process for choosing mitigation actions	1
Documented mitigation process	1
Considering strategic alignment	1
Considering cost versus benefit	1

Many examples of potential mitigation actions were discussed during the interview. Some of these can be found in the investigation model, such as multiple sourcing (NET1), excess inventory (BUF1), information sharing (COL1), dynamic contracts (CON4). In addition, Company Delta also complemented the investigation model with some new mitigation actions. The annual renewal of contracts can be seen as belonging to the *contracting* mitigation strategy. Moreover, maintaining a flexible production plan to mitigate downtime of machines can be seen as an example of the *planning* mitigation strategy. Lastly, reducing complexity in the supply chain through standardization of process (STA1) and products/components (STA2) was part of the investigation model, but in the interview it was also mentioned how Company Delta aims to reduce complexity

in their supplier network to mitigate risks. This can be seen as an example of a mitigation action belonging to the *network design* category.

In terms of deciding what mitigation action to pursue, the authors argue that Company Delta lacks a formal process, as this appeared to be based on the experience of the purchaser with no general guidelines and documentations involved. As a consequence, no formal way of involving the strategic and cost-benefit aspect detailed by Tang (2006) is incorporated.

D.3.4 Risk monitoring

An overview of how the authors graded Company Delta's risk monitoring process compared to the investigation model is shown in Table D.14. The overview is followed by the reasoning behind each grade.

Table D.14: Assessment of Company Delta's risk monitoring process.

Investigation model: Risk monitoring	**Grade**
Structured monitoring process	1
Documented monitoring process	1
Monitor development of identified risks	2
Monitor already treated risks	1
Monitor and continuously improve the process	1

A gap was identified when comparing Company Delta's risk monitoring with the investigation model. While they have a structured process of follow up on identified risks that arises from the supplier evaluation, no similar work is conducted for risks identified from other identification tools. Moreover, there exists no monitoring of how already treated risks and evaluate the process itself, which was mentioned as important in the literature review.

D.3.5 Risk organization

As the interviewed Purchaser was not able to provide many comments on the risk management work conducted apart from the purchasing perspective, the authors deemed it infeasible to grade the company in this regard. However, this might indicate a siloed approach towards risk management as a company-wide process evidently is missing.