Supply Risk Management as a means of achieving World Class Commodity Management

- *A single case study at Axis Communications AB*

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Along the journey there have been several individuals who have supported and challenged us. Our supervisors at Axis Communications AB; Anna Björkman and Robert Persson that always have been available to answer our questions, giving feedback and guidance into the Axis-universe. Beyond our supervisors, the employees at the sourcing department and other functions have been truly helpful, taking time for interviews and answering the survey. Furthermore, there has been a genuine interest in our thesis and everyone gladly offered input if needed. We also want to thank Robert Lindroth which was our initial contact with Axis and the one who presented this thesis opportunity to us.

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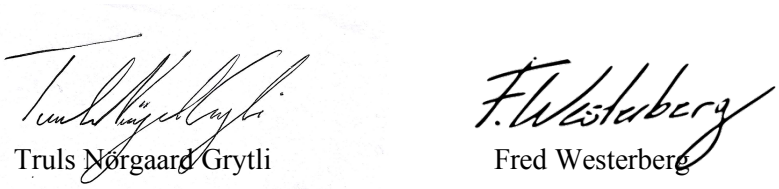

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Abstract

Background

Axis Communications AB is a network surveillance company based in Lund, Sweden, that has experienced steady growth for several years. Axis has no own manufacturing and instead utilize contracted manufacturers around the world. It is the sourcing department at Axis that are responsible for establishing contracts with these manufacturers as well as suppliers. The responsibility of handling contracts and the long-term relationship with the suppliers and contracted manufacturers are divided into different commodities. In order to improve this working method Axis' sourcing department has launched a goal to reach world class commodity management.

To be noted is that 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.

Problem Formulation

The sourcing department's goal of reaching world class commodity management includes several aspect were one were one was risk management. Axis have realized that there is a lack of structure in their current proactive risk management and is not satisfied with it. Therefore, external guidance, in form of this master thesis, was brought in. Axis' desire was to identify which proactive supply risk strategies, processes, tools and governance should be developed in order to reach world class commodity management.

Purpose

The purpose of this research and master thesis can be seen from two perspectives; (i) as an effort to develop the research area within SCRM in connection to sourcing with a live-case; and (ii) to assist Axis in their journey towards World Class Commodity Management through proactive SRM.

Methodology and Method

A constructive research approach was chosen for this master thesis with the use of both qualitative and quantitative data. The constructive research approach highlights the importance of testing the developed construct. Testing of the construct was done together with employees at Axis that would directly work with it and based on their feedback the construct was modified to a minor degree.

A single case study combined with survey was used as a research methods which resulted in empirical data from 15 interviews and survey data from 12 respondents. This data was then summarized into the empirical data chapter highlighting several aspects of Axis, e.g. organizational, governance, and the informal risk management process. The data was analyzed through explanation building and descriptive statistics to identify which aspects needed to be included in the construct.

Conclusion

The conclusion of the master thesis was that Axis should include more alignment, compliance, and a structured approach in their proactive supply risk management in order to reach world class commodity management. However, since Axis is a decentralized company with high level of individual freedom the introduction of more compliance based, structured SRM with a systematic approach could be challenging. Therefore, collaboration with employees, cross-functionality between departments, and adherence with the suggested process are key in order to achieve a higher level of proactive SRM. The

suggested proactive SRM process follows four steps: (i) risk identification; (ii) risk assessment; (iii) risk treatment; and (iv) risk monitoring. Moreover, a facilitating initial process step, mapping, is also suggested to provide a more thorough understanding of the supply chain and its components.

Currently Axis were using some tool in their risk management work and they should keep using these. However, since they were used in an unstandardized way predetermined parameters and guidance for their usage should be developed. Further, additional tool that Axis can use is presented in this master thesis which aims could lead to more informed decisions at the sourcing department in connection to proactive supply risk management.

The strategies that should be used for proactive supply risk management depends heavily on the situation. Therefore, more structure through a process is suggested so that they are selected in a data driven way. This aims to bring more alignment to the sourcing department so that knowledge based decisions can be made.

Keywords

Proactive Supply Risk Management; Risk Management; Supply Chain Management; Sourcing; Commodity Management; Single Case Study; Survey; Axis Communication AB

Decentralized and innovative organizations are in need of structure when it comes to Proactive Risk Management

A case study at Axis Communications AB of structured proactive supply risk management at a decentralized and innovative company in order to reach World Class Commodity Management.

By Truls Nörgaard Grytli and Fred Westerberg for the Division of Engineering Logistics at The Faculty of Engineering – LTH, Lund University

The development of proactive Supply Risk Management (SRM) processes, strategies, and tools in a decentralized and innovative organization can be challenging as it requires structure, compliance and a systematic approach. Nevertheless, it is needed and should be an important part of an organization's business.

We recommend a proactive SRM model which consists of four processes: (i) risk identification; (ii) risk assessment; (iii) risk treatment; and (iv) risk monitoring, with a supporting framework regarding governance and organization. The enablers of the solution are alignment, compliance, and continuity which is needed in order for organizations to reach best practice regarding their proactive SRM. Especially for those that are decentralized and innovative. Furthermore, the study is based on an in-depth analysis, comparing the activities of the company Axis Communications AB with a robust literature review of over 120 sources from academic journals and books on the topic of SRM.

The first step, *risk identification*, consists of two different scans: deep scan and continuous scan. The deep scan should cover all relevant areas where risk might be identified and the continuous scan should be a lighter version mainly focusing on updating risks. The output of this step is a risk list with categorization of all risks. One should be aware that the risk identification step determines the quality of the whole risk process. The next step, *risk assessment*, focuses on evaluating the identified risks. It is recommended that the evaluation activity includes a calculation of the risk value. The risk value can consist of several different, but predetermined, values that are multiplied. We suggest, but do not limit to, impact on revenue, probability and goodwill. Then the risks should be classified as well as prioritized. The output of the risk assessment step is a classification and prioritization list. The third step, *risk treatment,* selects appropriate risk mitigation strategies depending on the severity and type of risk. The goal is to eliminate or reduce the risk to an acceptable level. The input is based on the classification and prioritization list from the previous step. In order to create continuous improvement and learning, a database over the selected strategies and their outcome is suggested. The last step, *risk monitoring*, consists of keeping track of identified risks, selected treatment strategies, and their overall performance. Risks are to be monitored as they, by nature, can change. While monitoring of strategies and performance will lead to alignment, consistency, and comparability across the organization.

The governance and organizational framework that was developed highlights four concepts that are key for Axis to reach a higher level of proactive risk management. These concepts are: (i) top management support; (ii) risk culture and incentives; (iii) training and learning; and (iv) IT/IS support. These concepts will hopefully result in, what the authors have called, the supporting principles for proactive supply risk management. The principles are not activities or processes but are nevertheless important for proactive SRM. The principles are: (i) continuous improvement; (ii) alignment and cross-functionality; (iii) compliance; and (iv) risk awareness.

The solution is adapted to Axis situation and needs. But could, with modifications, be utilized in other companies which are also in need of improving and structuring their proactive SRM activities. The full study is published in the report "*Supply Risk Management as a mean of achieving World Class Commodity Management"* at The Faculty of Engineering – LTH, Lund University.

Table of Content

Abbreviations

AVL	Approved Vendor List
BIV	Business Interruption Value
BRT	Business Recovery Time
CB	Commodity Buyer
CE	Commodity Engineer
CM	Commodity Manager
COO	Country of Origin
CT	Commodity Team
CLC	Configuration and Logistics Center
COGS	Cost of Goods Sold
EMEA	Europe, the Middle East, Africa
EMS	Electronic Manufacturing Service
ERMET	Ericsson Risk Management Evaluation Tool
ERP	Enterprise Resource Planning
ETA	Event Tree Analysis
FTA	Fault Tree Analysis
IFS	Industrial and Financial Software
IS	Information System
RQ	Research Question
RM	Risk Management
SC	Supply Chain
SCR	Supply Chain Risk
SCRM	Supply Chain Risk Management
SE	Sourcing Engineer
SG	Steering Group
SM	Sourcing Manager
SOX	Sarbanes-Oxley Act
SRM[1]	Supply Risk Management
WCCM	World Class Commodity Management

[1] Not to be confused with Supplier Relationship Management. For this thesis SRM is an abbreviation for Supply Risk Management.

1 Introduction

This chapter introduces the research phenomenon supply risk management as well as the company Axis Communications AB to provide context and understanding for the reader. Further, the research purpose, problem formulation, focus and delimitation as well as the research questions will be addressed. The chapter aims to provide contextual information so that the reader can grasp the broad outline of the thesis.

1.1 Theoretical Background

In 2008, the World Economic Forum (2008) declared supply chain risk (SCR) as one of four emerging areas of risk which will affect the global landscape. The impact of disastrous events during the last two decades has displayed the vulnerability of supply chains (SC) in both the private and public sector, e.g. Tsunami 2001 in Thailand, Terrorist attack 2001 in New York and Earthquake 2008 in Japan (Wagner and Neshat, 2012; Fan and Stevenson, 2018). A recent example is the coronavirus outbreak which has disrupted SCs for several companies across the globe, initially due to manufactures and borders being closed in Asia (DHL, 2020a; Haren and Simchi-Levi, 2020; Ziady, 2020). The following months after the outbreak of covid-19, most of all countries closed their borders and imposed restrictions which have heavily impacted the SCs of the world (Haren and Simchi-Levi, 2020; Lau, 2020). Besides events such as covid-19, the overall increasing expectations from customers, shortened lead times and production cycles, and the volatile business environment as well as the number of involved stakeholders has led to a rise in complexity and exposure to risk in SCs (Giannakis and Louis, 2011; Tang and Musa 2011; Colicchia and Strozzi, 2012). Due to this complexity and vulnerability, mitigation strategies and the lack of needs to be addressed (Jüttner et al., 2003). Therefore, it is no surprise that the field of supply chain risk management (SCRM) is one of the fastest growing areas of interest in operations research both for practitioners as well as researchers (Colicchia and Strozzi, 2012).

Even if the popularity has increased, researchers still have faced issues in collectively agreeing upon definitions of SCR and SCRM (Ho et al., 2015; Fan and Stevenson, 2018). In order to base the thesis in one definition, the ones suggested by Ho et al. (2015) will be used. This is motivated by the fact that Ho et al. (2015) base their definition in a thorough literature review of the last decades research on SCR and SCRM as well as the fact that the article was published rather recently.

- **Supply chain risk** - "the likelihood and impact of unexpected macro and/or micro level events or conditions that adversely influence any part of a supply chain leading to operational, tactical, or strategic level failures or irregularities." (Ho et al., 2015, p.5035).

- **Supply chain risk management** - "an inter-organizational collaborative endeavor utilizing quantitative and qualitative risk management (RM) methodologies to identify, evaluate, mitigate and monitor unexpected macro and micro level events or conditions, which might adversely impact any part of a supply chain." (Ho et al., 2015, p.5036).

The SCRM process mainly consists of four steps: (i) risk identification; (ii) risk assessment; (iii) risk treatment; and (iv) risk monitoring (Norrman and Jansson, 2004). Within each of the four process steps, there are different strategies to achieve mitigation (Manuj and Mentzer, 2008). Moreover, according to Fan and Stevenson (2018, p.210) in their extensive literature review of SCRM, the main objective of

SCRM is to "not only to reduce costs and vulnerability but also to ensure profitability, business continuity, and potentially longer-term growth". Further, Giunipero and Aly Eltantawy (2004) suggests that the historical mitigation strategies of only utilizing multiple sourcing and increased safety stock within in sourcing/purchasing departments can result in lower SC efficiency and a more proactive approach with a cross-functional perspective is needed to sustain SCRM as a competitive advantage.

One of the main categories of risk within SCRM is supply risk which incorporates e.g. suppliers, material flows, and different agreements (Manuj and Mentzer, 2008). This can also be seen as the upstream SCRM, but also often called supply risk management (SRM) (Kern et al., 2012). SRM is needed in order to mitigate supply disruption which often results in lower profitability by impacting e.g. return on sales, competitive advantages or goodwill (Kumar et al., 2018). When investigating the different areas within SRM, which will be the focus of this thesis, several different risks which affect the supply flow have been researched and hence are of interest, see Table 1.1.

Table 1.1. Examples of different areas within supply risk management.

Areas within supply risk management	**Author(s)**
Suppliers	(Zsidisin, 2003a; Hamdi et al., 2018; Kumar et al. 2018)
Product characteristics and portfolio mix	(Gelderman and Van Weele, 2002; Khan et al., 2008; Tse and Tan, 2011)
Sourcing	(Yu et al., 2009; Christopher et al., 2011)
Distribution and storage	(Chaturvedi and Martínez-de-Albéniz, 2011; Croson et al., 2014)
Agreements and contracts	(Corbett et al., 2004; Gao, 2015; Shang and Yang, 2015)
Organizational structure and management	(Zsidisin, 2003b; Norrman and Jansson, 2004; Jüttner, 2005; Norrman and Wieland, 2020)

1.2 The Company Axis Communications AB

Axis Communications AB, hereafter referred to as Axis, is an international company based in Lund, Sweden that mainly operates in the IT and security industry. Axis has sales of over 1.2 billion USD and is part of the Canon Group. Axis has over 3600 employees in over 50 countries (Axis, n.d. a). Further, Axis is aimed at improving security through network video and audio solutions as well as protecting people, property, process optimization, and increasing business efficiency as well as information access (Axis, n.d. a). Axis offers several products and services, such as training and support, to these products (Axis, n.d. a). The products can roughly be classified into nine product categories: network cameras; video encoders; network video recorders; accessories; video management software; analytics & other applications; access control; network audio systems; and system devices (Axis, n.d. b). Axis provides a complete security or surveillance system, either by integrating with Axis' video management software or with a partner product (Axis, n.d. b).

The supply chain in its entirety and Axis' governing role can be seen in Figure 1.1. Axis has a contract manufacturing through EMSs and sources everything they deliver to distributors and not end customers, through the Configuration and Logistics Centers (CLCs). Therefore, Axis' sourcing department has a

larger area of responsibility than a traditional sourcing department would as they are responsible for manufacturing through the partnerships with the EMSs. As a result, the sourcing department is of high importance to Axis as well as to this thesis. The sourcing department is responsible for securing capacity and flexibility through contracts with suitable suppliers and EMSs. Thus, their area of influence is the upstream supply chain, with a focus on a strategic and tactical time horizon. Most of the operational activities, through call-offs on the established contracts once the product reaches a high-volume phase, are conducted by the supply department. Regarding basic components e.g. basic screws, the EMSs are responsible for securing supply. Further, Axis has a global SC with suppliers, manufacturing, and sales in Asia, Americas, and EMEA.

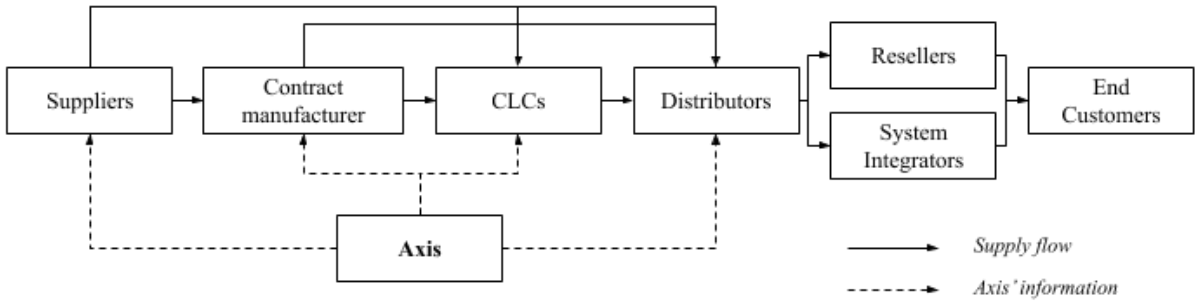


Figure 1.1. Axis' supply chain (Based on: Lindroth, R. personal meeting 20/12-19).

The sourcing department wants to constantly improve and strives to reach what they call "World Class Commodity Management" (WCCM) (Lindroth, R. 2019, personal meeting 20/12). The first draft of their own definition of WCCM is (Dzinovic, N. 2020, personal communication): *"World Class Commodity Management is a systematic, cross-functional and strategic approach to maximize the contribution from Axis suppliers. Through the process we develop and enable optimal supplier base in regards to Axis requirements within quality, cost, risk, flexibility, delivery, technical knowhow, time to market and sustainability".*

For comparison, Burt and Starlin (2002) suggest that World Class Supply Management is the continual process of improving all aspects of the organization's entire supply system, through top management support, with a cross-functional and strategic mind-set, to achieve a competitive capability. Currently Axis does not have a clear structure or process for how proactive SRM should be conducted within the sourcing department. Due to it being a key factor in achieving WCCM it is of great interest to develop this for Axis.

1.3 Problem Formulation

In combination with the introduction of the company Axis and the theory surrounding SCRM and more specifically SRM, a problem formulation has been created. The formulation is mainly based on Axis efforts to reach WCCM where Axis wants to investigate how they work with proactive SRM upstream with suppliers in the Commodity Process at the sourcing department. This identified need goes in line with Giunipero and Aly Eltantawy (2004) suggestions, that SRM should be seen as a competitive advantage and can improve SC performance as well as profitability.

Currently, Axis does not have a formalized and well-defined SRM process. The work related to risk is mainly performed on an ad-hoc basis as well as based on the employee's knowledge and perception of risk. However, issues are structurally reported twice a year to the management board as a part of the

commodity-strategy presentation performed by the commodity team, where risk is a small part of the presentation. Axis sees that there is a lack of systematic and structured SRM. Since Axis is not satisfied with the current situation, the problem formulation is how proactive supply risk strategies, processes, tools and governance should be developed in a structured and systematic manner in order to reach WCCM. It will be based on current research as well as an in-depth single case study at Axis.

1.4 Research Purpose

The purpose of this research and master thesis can be seen from two perspectives; (i) as an effort to develop the research area within SCRM in connection to sourcing with a live-case; and (ii) to assist Axis in their journey towards World Class Commodity Management through proactive SRM.

As pointed out by researchers, there is a need for extended research within SCRM and more specifically connected to live-cases where implications on practitioners can be analyzed (Hamdi et al., 2018; Norrman and Wieland, 2020). Therefore, the purpose of this thesis is in line with what the academia has suggested, which is to gain knowledge and develop conclusions based on case research at Axis and their SRM.

The other part of the purpose, to assist Axis in their development of proactive SRM as a means of reaching World Class Commodity Management will be performed by providing insights from academia regarding SRM strategies, processes and tools, in combination with an in-depth case study of Axis.

1.5 Research Question

The main research question is:

- RQ1: How should Axis' proactive SRM be set up in order to achieve World Class Commodity Management?

To be able to answer the main research questions, three additional research questions should also be answered:

- RQ1a: How should Axis proactive SRM-tools be applied in order to reach WCCM?
- RQ1b: How should proactive SRM processes be applied at Axis and which are suitable for the sourcing department in order to reach WCCM?
- RQ1c: How and which proactive SRM strategies should Axis choose in order to reach WCCM?

1.6 Focus and Delimitation

The focus area of the thesis is the proactive SRM aspects of Axis sourcing process with the goal of determining how the proactive SRM should be set up in order to support Axis' towards WCCM. The thesis is limited to proactive SRM and will therefore focus on the sourcing department. However, as SRM involves cross-functional aspects, the collaboration between the sourcing department and other departments at Axis such as supply or R&D will also be of interest, due to the systemic view of the authors. According to Arbnor and Bjerke (2008), researchers which apply the systemic view also need to consider the magnifying level of the research, i.e. the level of detail versus broadness. Regarding this thesis, the focus on SRM strategies, processes and tools within sourcing departments should be seen as an external systemic delimitation. A visualization of how the authors view the system is displayed in Figure 1.2, where the sourcing context is the system boundary but does not exclude the nodes of which it interacts with.

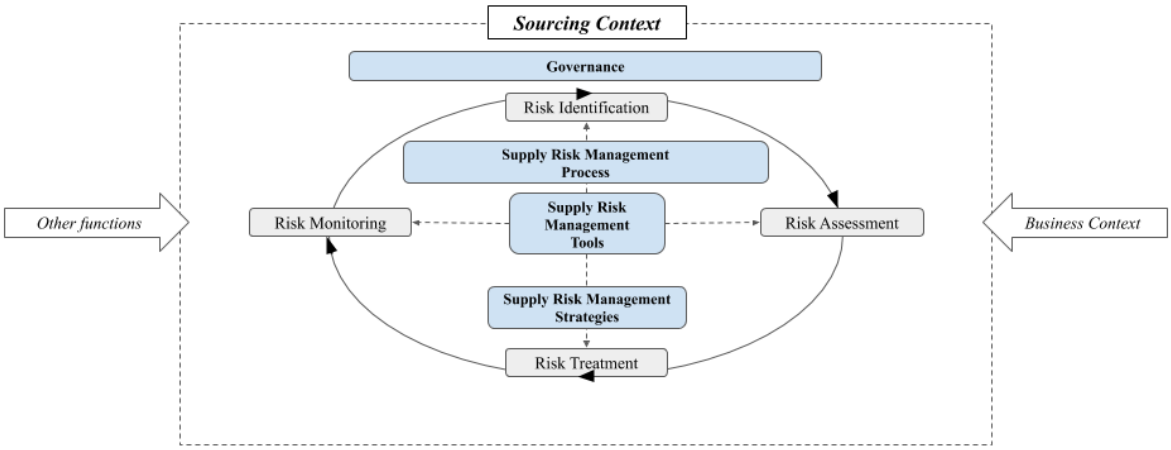


Figure 1.2. A visualization of the thesis' system

To be noted is that even if the focus is on SRM, theories surrounding SCRM processes, strategies and tools were deemed as necessary to incorporate as well. The incorporation of SCRM was mainly based on the fact that SRM is a part of SCRM, often described as the upstream section of SCRM (Zsidisin et al., 2004), and hence research on SCRM can cover aspects of SRM.

1.7 Report Outline

The thesis is divided into seven main chapters which are summarized in short below. To be noted is that 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.

Chapter 1: Introduction
This chapter introduces the research phenomenon SRM as well as the company Axis Communications AB to provide a context and understanding for the reader. Further, the research purpose, problem formulation, focus and delimitation as well as the research questions is addressed. The chapter aims to provide contextual information so that the reader can grasp the broad outline of the thesis.

Chapter 2: Methodology and Method
This chapter sets out to address the methodology and method of the thesis, i.e. how the work process was planned to be conducted with the use of, theoretically based, research methodologies. The structure of the chapter is as follows. Firstly, systems thinking is presented as the methodological view of the thesis based on the nature of the research questions as well as the author's view of reality. Secondly, the constructive research approach is presented as the author's research approach for the thesis, where the choice was based on the practical problem-solving nature of the thesis. Thirdly, single case study is presented as the research method as well as the different steps within the single case study methodology.

Chapter 3: Theoretical Framework
In this chapter the theoretical findings on the topic of SRM based on the literature review are presented. Firstly, the general concepts of the topic with definitions of key constructs will be introduced. Secondly, the main sources of risks and how the authors have categorized them are discussed. Thirdly, a risk management process, divided in four steps, as well as governance and management aspects are presented. Moreover, for each step tools will be described. Fourthly, the main sub-strategies regarding

supply risk mitigation will be highlighted. Lastly, the result of the chapter, i.e. the conceptual framework for SRM, is presented and visualized.

Chapter 4: Empirical Data

In this chapter, the empirical data which has been gathered is presented. Firstly, the sourcing department in general as well as it organizational structure. Secondly, the sources of risks which the sourcing department faces. Thirdly, the organizational structure and governance with a focus on SRM is accounted for. Lastly, the informal proactive SRM process is presented which includes sub-chapters of the four main steps of a RM process; (i) risk identification; (ii) risk assessment; (iii) risk treatment; and (iv) risk monitoring.

Chapter 5: Case Analysis

The case analysis is done using explanation building. The chapter is divided into eight parts. Firstly, an interpretation guide is presented. Secondly, the SRM practices at Axis will be compared to theory in six parts: (i) governance and organization; (ii) risk identification; (iii) risk assessment; (iv) risk treatment; (v) risk monitoring; and (vi) risk mitigation strategies. The analyses first describing Axis, followed by theory and a potential benchmark, then a mark is given and aspects to consider in the construct. Lastly, a summarizing chapter of the analysis is presented.

Chapter 6: Developed Construct: Proactive SRM Process

This chapter presents the developed construct based in the case analysis which compared the theoretical framework with the empirical data. Five different construct are presented, in the following order, according to the findings; (i) governance and organization; (ii) risk identification process; (iii) risk assessment process; (iv) risk treatment process; and (v) risk monitoring process. But firstly a summarized model of all constructs are presented to give an overview of the recommended SRM process.

Chapter 7: Conclusion

The thesis is concluded in this final chapter were firstly the findings are summarized and the research questions are explicitly. Secondly, additional finding that could be of interest to Axis are presented. Thirdly, the thesis contribution to theory are discussed. Fourthly the limitations of the thesis are described. Lastly, ideas for areas of future research are highlighted.

2 Methodology and Method

This chapter sets out to address the methodology and method of the thesis, i.e. how the work process was planned to be conducted with the use of, theoretically based, research methodologies. A broad view of the process, divided in the major steps, is visualized in Figure 2.1. The structure of the chapter is as follows. Firstly, systems thinking will be presented as the methodological view of the thesis based on the nature of the research questions as well as the author's view of reality. Secondly, the constructive research approach will be presented as the author's research approach for the thesis, where the choice was based on the practical problem-solving nature of the thesis. Thirdly, single case study will be presented as the research method as well as the different steps within the single case study methodology.

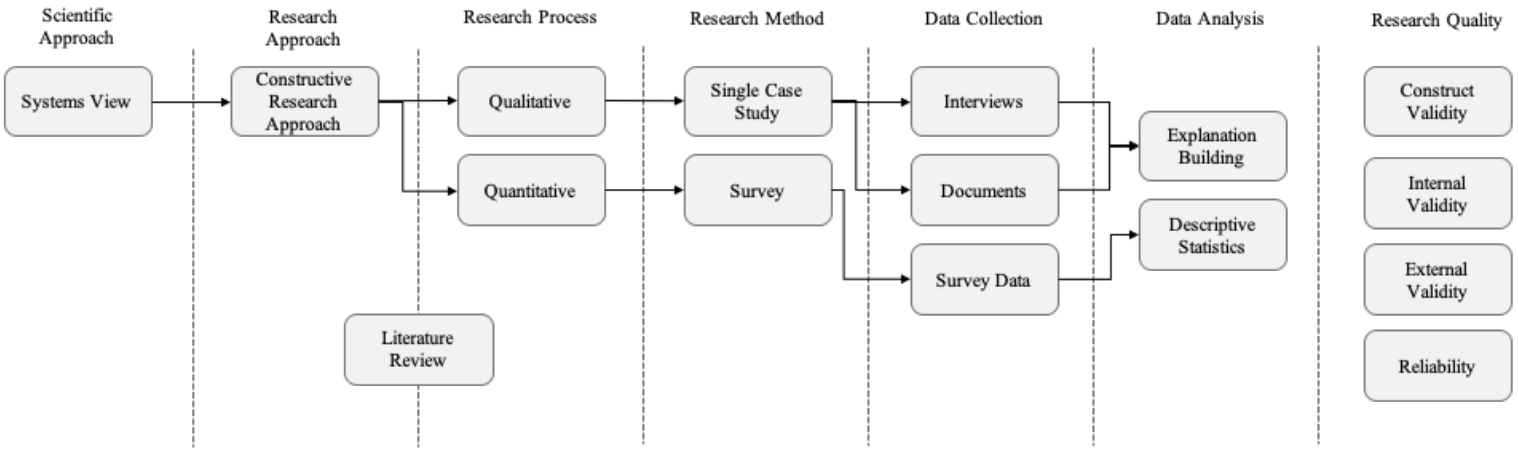


Figure 2.1. The Methodological Process (Based on Yin, 2004)

2.1 Methodological View

The methodological view of a research project is an important aspect to consider as it, acknowledged or not, affects the outcome of the research due to the authors presumptions of theory, methodology and reality, as well as the context in which the identified phenomenon to be analyzed brings (Arbnor and Bjerke, 2008). The choice of the methodological view itself is twofold, firstly as a connection to the nature of the research question(s), and secondly in connection to the authors' view of reality (Gammelgaard, 2004). Hence, in order to choose or identify the methodological view of this thesis, the authors' presumptions as well as the nature of the research question(s) was considered.

The research purpose was to propose a solution to Axis' identified problem regarding lacking proactive SRM strategies, processes and tools as a means of achieving WCCM. The solution needed to be practical and implementable in order to contribute with value to the focal firm. But also fulfil the second part of the purpose, to ensure that the research contributed to the development of the knowledge within SRM. Based on the authors' systems view of the world, the SRM at the sourcing department was also viewed as a system where the different functions such as feedback loops, links and goals work together as sub-systems to create a larger value than what they individually contribute with. Especially when considering the end goal of achieving WCCM, which incorporated not only isolated functions within the sourcing department but also the internal as well as the external connections between functions, departments, suppliers and customers. Further, the SRM at the sourcing department itself was considered as a part of a larger system, the Axis organization with different departments, which then in turn connects to global flows of several stakeholders with entangled risks, thus creating an even larger

system. Hence, the authors' view was in line with the suggested assumption of a layered structure, where individual parts creates systems which then also are a part of larger systems, which is a foundation of systems view (Checkland, 1999).

Moreover, the holistic approach of the systemic view implied that the focus of this thesis should not be on individual and fundamental parts of the SRM, but rather the system as a whole and the synergies which the different parts sum up to (Arbnor and Bjerke, 2008), which was in line with the authors' view. Harland et al. (2003) also argue that risk management requires a holistic approach and that it needs a combination of several different risk techniques, activities and processes, such as a system, in order to mitigate the risks. Additionally, Chopra and Sodhi (2004) argue that risks must be viewed as a system, where different risks affect one another as well as the fact that a successful mitigation strategy for one risk may lead to negative impacts for other risks.

Additionally, the choice of single case study as a research method with a constructive approach's goal of creating a practical solution to a problem also suited the systems view, as argued by Gammelgaard (2004, p.481) "The systems view is pragmatic in nature, and the search for an absolute truth is replaced by the search for a problem solution that works in practice.".

2.2 Research Approach

2.2.1 Constructive Research Approach

The constructive approach can be seen as a research approach within case research and was originally developed for business administration research but has found increasing interest in other areas of academia such as technical science, philosophy and operations research (Lukka, 2003; Oyegoke, 2011). The goal or definition of constructive research is "... managerial problem solving through the construction of models, diagrams, plans, organizations, etc." (Kasanen et al., 1993, p.245). The objective of the thesis was a rather practical implementation of research to a business problem, since the academic knowledge surrounding SRM was applied in order to solve Axis' dissatisfaction. But also that the academic body of knowledge regarding SRM was expanded by studying the phenomenon in a new setting. Hence, the constructive approach as a direction within case research was deemed as a suitable choice for this thesis.

The central elements to the constructive approach, suggested by Lukka (2003), are displayed in Figure 2.2 and can be seen as an extension to the paper of Kasanen et al. (1993).

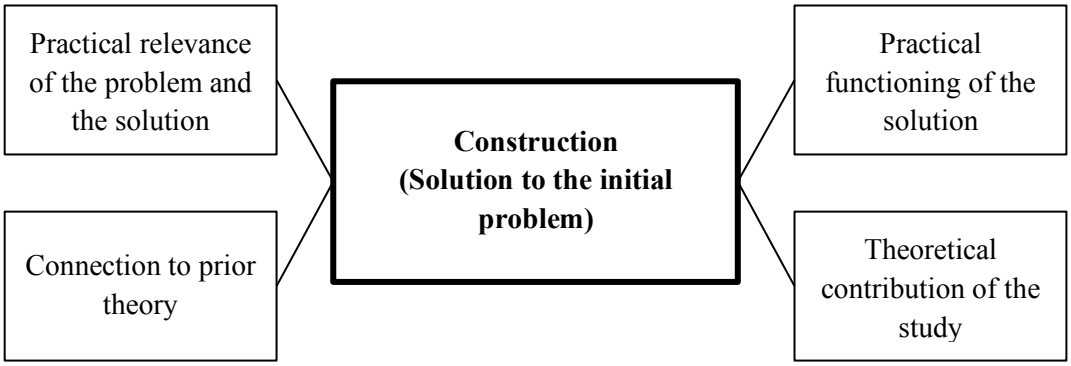


Figure 2.2. The central elements to the constructive approach. Adopted based on Lukka (2003)

The constructive approach as a method can be divided into several phases, which often are suggested to consist of six different steps but can vary from case to case (Kasanen et al., 1993; Lukka 2003; Oyegoke 2011). The thesis followed the six step structure suggested by Kasanen et al. (1993) due to it being the original source for the constructive approach, but the additional insights provided by Lukka (2003) and Oyegoke (2011) was also included.

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 the solution works.
5. Show the theoretical connections and the research contribution of the solution concept.
6. Examine the scope of applicability of the solution.

2.2.1.1 Step 1: Find a practically relevant problem which also has research potential

The process of identifying a relevant problem which also has research potential are twofold: (i) the problem should be of practical nature, often at a company or industry, which as e.g. expressed dissatisfaction with lead times, cost or risk management; and (ii) the practical problem should be confirmed by the literature review (Lukka 2003; Oyegoke 2011). In this thesis, the identified business-problem was of a practical nature and originated from a dissatisfaction at Axis' sourcing department related to the lack of SRM strategies, processes and tools. Moreover, a need for further research within SRM in connection with practitioners was also identified in the literature review (Zsidisin, 2003; Kern et al., 2012; Hoffman et al., 2013) which implied research potential.

2.2.1.2 Step 2: Obtain a general and comprehensive understanding of the topic

The second step of the constructive approach sets out to build an understanding of prior research and the topics connected to the investigated phenomenon (Lukka, 2003). The understanding of the selected topic SRM was be supported by a thorough literature review, reading and analyzing not only articles surrounding the broad topic but also articles and books on identified sub-topics e.g. sourcing risk, product characteristics and portfolio risk, inventory and storage risk, organizational and managerial risk, and distribution risk. Furthermore, due to the 15 interviews, the survey and additional material from Axis as well as theoretical benchmarks regarding SRM, potential innovations and solutions to the problem (Oyegoke, 2011), was be provided to the authors of the thesis.

2.2.1.3 Step 3: Innovate, i.e., construct a solution idea

According to research, the step of innovation and constructing a solution to the identified problem can be seen as the most crucial step to the process in the constructive approach (Kasanen et al., 1993; Lukka 2003; Oyegoke, 2011), as argued by Lukka (2003, p.87) "... if an innovative construction cannot be designed, then there is no point in going on with the project". This step should also be viewed as a co-operative phase where the researchers and practitioners collaborate in finding the best solutions based on the theoretical as well as practical perspective (Lukka, 2003). The actual development of the constructs was based on the conceptual framework's five main concepts of SRM and hence the construct was divided into five corresponding elements. The content of the elements were based on the analysis which compared the theory with the empirical data. The elements were then developed into four process maps with e.g. input, enablers, activities and output, which represented the four SRM steps, and one model which represented the governance and organization aspect. Furthermore, in order to succeed with this important step, the authors put emphasis on the relations with Axis and the employees at the sourcing department. The authors had several meetings and discussions with the employees at Axis during the development of the solution. The purpose of the meetings was to receive feedback on the

constructs applicability and suitability for Axis. Based on the feedback, minor changes were implemented such as goodwill as an variable for calculating the risk value[2].

2.2.1.4 Step 4: Demonstrate that the solution works

Kasanen et al. (1993) and Lukka (2003) suggests that the usefulness and applicability of the solution should be measured with three different tests: (i) weak market test which is passed if the organization adopts the solution; (ii) semi-strong market test which is passed if the solution is adopted amongst several companies; and (iii) strong market test which is passed if business units that has adopted the construct achieves higher financial performance than the companies which has not adopted the solution. However, Rautiainen et al. (2017) criticizes this suggestion as usefulness and practical application could be difficult to scientifically measure. Therefore, Rautiainen et al. (2017) argue for the use of the Relevance Diamond Diagram, see Figure 2.3, which is a development of Kasanen et al. (1993) market tests. The Relevance Diamond Diagram accounts for both value and decision relevance as well as a long and short-term perspective to measure the applicability of a solution created with the constructive research approach (Rautiainen et al., 2017). This thesis applied the suggested Relevance Diamond Diagram in order to achieve a higher quality as well as a more thorough evaluation. The evaluation of the different areas of the diamond can be performed qualitatively (Rautiainen et al., 2017) which also was the case for this thesis. Furthermore, Rautiainen et al. (2017) argue that the relevance test could be performed, beyond step four of the constructive approach, at step five as well as six. Hence, the relevance test was also carried out at step six when the final solution was constructed in order to reach higher credibility.

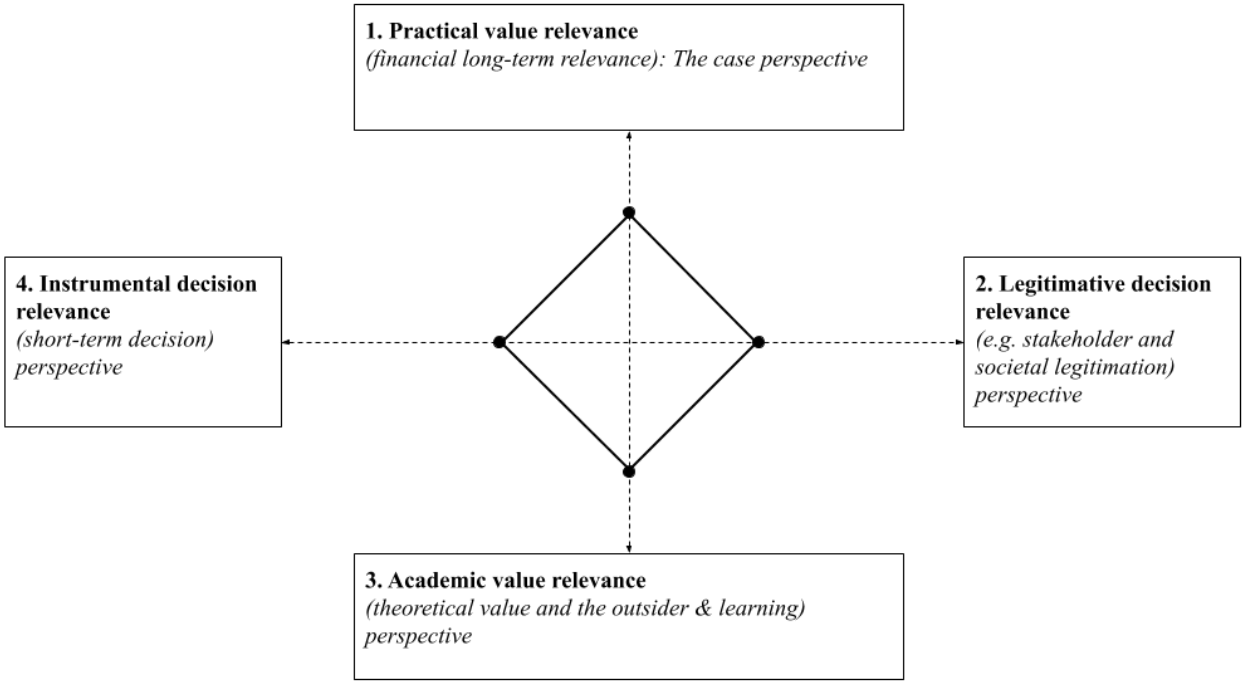


Figure 2.3. The Relevance Diamond Diagram. (Source: Rautiainen et al., 2017, p.28)

Rautiainen et al. (2017) present two main categories, value and decision relevance, that are divided into four different sub-relevancies: (i) practical value; (ii) legitimative decision; (iii) academic value; and (iv) instrumental decision. The different dimensions by Rautiainen et al. (2017) and how they were achieved are described below:

[2] See *Chapter 6.3 The Risk Assessment Construct* where goodwill is incorporated

i. **Practical value relevance**: The practical value can be viewed as the market-test aspect from Kasanan et al. (1993) but with focus on the focal firm and is passed if the organization finds the solution to add company value and adapts it. In the thesis, this was investigated in the meetings and discussions by employees at Axis, discussing the relevance and what value that could be added for the company by implementing the solution. The feedback given by both operational employees and managers was that they found value in the suggested constructs. Further, a project team has been planned to implement and adapt the construct at Axis, which implies that Axis believes the constructs had practical value. However, since the constructs and this thesis is the foundation of the project, its implementation and ultimate practical value cannot be evaluated retrospectively.

ii. **Legitimative decision relevance**: The legitimative decision relevance in relation to the construct can be viewed at different levels, e.g. from case managers to societal legitimacy or from company functions to the whole organization. The stronger the legitimative decision relevance, the higher up, i.e. societal or whole organizational level, the construct is seen as legitimate. Rautiainen et al. (2017) also argue that this relevance could be negative, e.g. the use is legitimized by a sales-function which sees improvements, but a project manager only sees increase in cost but with no improvement, hence no legitimacy. For this thesis, the societal aspect was neglected due to the time constraint for the study which made an investigation into societal legitimacy unfeasible. The company level legitimative decision relevance was analyzed by inviting different levels of employees to meetings which represented different hierarchical levels at sourcing. However, functions that may be affected by the construct could not be covered which is why isolated cases of negative legitimative decision relevance could not be excluded.

iii. **Academic value relevance**: According to Rautiainen et al. (2017) the academic value relevance can be analyzed at three different levels: (i) indications of potential academic relevance; (ii) publications; and (iii) institutionalization of the scientific results. The first level is indicated by prerequisite knowledge regarding methodology and theory, an existing research gap, plausible data collection and analysis method, and lastly, for the constructive approach, the innovation of a novel construct and its adaption. The second level is related to if the knowledge gained by the researchers makes an interesting contribution to the theory surrounding the studied phenomenon. If the research is published, it can be viewed as passing an academic market test. The third level is reached if the research achieves continuous citations and academic generalizability. For this thesis, the first level was deemed as reached due to the acceptance of method, knowledge surrounding the field by the supervisor at LTH and the acceptance of the construct by Axis. The second level could be argued as reached if the thesis got published. The third level was deemed as infeasible due to requirements of citations, but generalizability could be argued.

iv. **Instrumental decision relevance**: The instrumental decision relevance has a short-term focus which is reached if the solution provides information, knowledge or facilitates decisions to make short-term improvements e.g. throughput time. For this thesis, the instrumental decision relevance was difficult to measure since the implementation of the construct was beyond the scope of the thesis. However, potential direct improvements of Axis SRM was implied as all employees which discussed the construct could see direct applications and development of their proactive SRM.

2.2.1.5 Step 5: Show the theoretical connections and the research contribution of the solution concept

According to Lukka (2003), there are mainly two different ways in which the construct created contributes to theoretical knowledge: (i) the novel construction itself, which if it contributes with new innovation and ideas or fills a gap in research, will naturally build on prior theory; and (ii) the positive relationships behind the construction, which is more focused on the application and development of existing theoretical knowledge regarding structures, processes and features of the case. The authors contributed to theoretical development by finding interesting connections and patterns between the theoretical framework and the empirical data from the case. Additionally, the innovation of a construction to solve Axis' problem was performed which has not been done before in this exact context.

2.2.1.6 Step 6: Examine the scope of applicability of the solution

In terms of applicability, the suggested implementation and analysis of the implementation suggested (Kasanen et al., 1993; Lukka 2003; Oyegoke 2011) was difficult to perform during the work of this thesis as the time constraint was 20 weeks. Therefore, in dialog with the university supervisor, some form of discussion or meetings regarding the construct before the final presentation was suitable to evaluate the practical applicability as well as implementability of the suggested solution. The meetings and discussion acted as a forum to evaluate and thereafter improve the solution to incorporate the last step which is the scope of applicability. The evaluations were performed four weeks ahead of presenting the thesis. The phase of the thesis consisted of: (i) creating, inviting to and conducting the discussion meetings; (ii) evaluate the feedback; and (iii) incorporate possible modifications to the solution.

2.2.1.6.1 Discussion meetings

The development of the discussion meetings was dependent on the completion of the SRM-solution, as it was set out to test the applicability of the solution. The meetings consisted of discussions regarding the main topics of the solution e.g. the feasibility, if it was understandable, did it bring value to the employees and potential improvements. Moreover, during the meetings the authors went through the developed constructs step-by-step to identify possible areas of improvement. There was two different kind of meetings: one with sourcing managers were the focus was on a strategic and overall level; and another with operational staff, i.e. the employees that would work according to the constructs, were the focus was on an operational level and the constructs applicability in day-to-day activities. The meetings were booked through Axis' calendar which made it easy to find available time slots that suited the employees. During the meeting, one of the authors documented what was being discussed and the other held the presentation.

2.2.2 Literature Review

There are several ways of conducting a literature review but in this thesis, Rowley and Slack's (2004) five step process was followed. The steps of the process are: (i) scanning documents; (ii) making notes; (iii) structuring the literature review; (iv) writing the literature review; and (v) building the biography. Note that the term documents refer to academic and professional journal articles, books, web-based resources, and other possible sources. The first step of the process consists of scanning the wide range of available documents to understand what needs to be included (Rowley and Slack, 2004). The authors of this thesis performed this by combining the key words "Supply Risk Management" and "Supply Chain Risk Management" in search engines such as Google Scholar and LubSearch, Lund University's own search engine. Then a citation pearl growing strategy was utilized to find additional relevant articles. Citation pearl growing is a technique for finding new articles by using the citations of a few

initial articles to find additional relevant articles (Rowley and Slack, 2004). The initial articles can be seen in Table 2.1.

Table 2.1. Overview of key literature examples

Literature within SCRM
Smeltzer, L.R. and Siferd, S.P., 1998. Proactive supply management: the management of risk. *International Journal of Purchasing and Materials Management*, *34*(4), pp.38-45.
Jüttner, U., Peck, H. and Christopher, M., 2003. Supply chain risk management: outlining an agenda for future research. *International Journal of Logistics: Research and Applications*, *6*(4), pp.197-210.
Christopher, M. and Peck, H., 2004. Building the resilient supply chain. *The international journal of logistics management*, *15*(2), pp.1-14.
Norrman, A. and Jansson, U., 2004. Ericsson's proactive supply chain risk management approach after a serious sub-supplier accident. *International journal of physical distribution & logistics management*, 34(5), pp.434-456.
Zsidisin, G.A., Ellram, L.M., Carter, J.R. and Cavinato, J.L., 2004. An analysis of supply risk assessment techniques. *International Journal of Physical Distribution & Logistics Management*, *34*(5), pp.397-413.
Tang, C.S., 2006. Perspectives in supply chain risk management. *International journal of production economics*, *103*(2), pp.451-488.
Manuj, I. and Mentzer, J.T., 2008. Global supply chain risk management strategies. *International Journal of Physical Distribution & Logistics Management*, *38*(3), pp.192-223.
Tang, O. and Musa, S.N., 2011. Identifying risk issues and research advancements in supply chain risk management. *International journal of production economics*, *133*(1), pp.25-34.
Ho, W., Zheng, T., Yildiz, H. and Talluri, S., 2015. Supply chain risk management: a literature review. *International Journal of Production Research*, 53(16), pp.5031-5069.
Fan, Y. and Stevenson, M., 2018. A review of supply chain risk management: definition, theory, and research agenda. *International Journal of Physical Distribution & Logistics Management*, 48(3), pp.205-230.
Literature within supply risk management
Zsidisin, G.A., 2003a. A grounded definition of supply risk. *Journal of Purchasing and Supply Management*, *9*(5-6), pp.217-224
Corbett, C.J., Zhou, D. and Tang, C.S., 2004. Designing supply contracts: Contract type and information asymmetry. *Management Science*, *50*(4), pp.550-559.
Yu, H., Zeng, A.Z. and Zhao, L., 2009. Single or dual sourcing: decision-making in the presence of supply chain disruption risks. *Omega*, *37*(4), pp.788-800.
Croson, R., Donohue, K., Katok, E. and Sterman, J., 2014. Order stability in supply chains: Coordination risk and the role of coordination stock. *Production and Operations Management*, *23*(2), pp.176-196.
Hamdi, F., Ghorbel, A., Masmoudi, F. and Dupont, L., 2018. Optimization of a supply portfolio in the context of supply chain risk management: literature review. *Journal of Intelligent Manufacturing*, *29*(4), pp.763-788.
Kumar, M., Basu, P. and Avittathur, B., 2018. Pricing and sourcing strategies for competing retailers in supply chains under disruption risk. *European Journal of Operational Research*, *265*(2), pp.533-543.
Namdar, J., Li, X., Sawhney, R. and Pradhan, N., 2018. Supply chain resilience for single and multiple sourcing in the presence of disruption risks. *International Journal of Production Research*, *56*(6), pp.2339-2360.

The second step of the process was conducted by taking notes of relevant information in the illustrated, and later additional articles, in the form of short sentences and the corresponding page number. This was done to easier find the relevant information at a later stage as suggested by Rowley and Slack (2004). The third step, to structure the review, was done by creating a folder system of the various topics with the relevant articles on each topic located in their corresponding folder. To follow the fourth step,

writing the literature review, an understanding of how the sub-topics correspond to each other was required (Rowley and Slack, 2004). This was done by creating a mind map, which a simplification of can be seen in Figure 2.4.

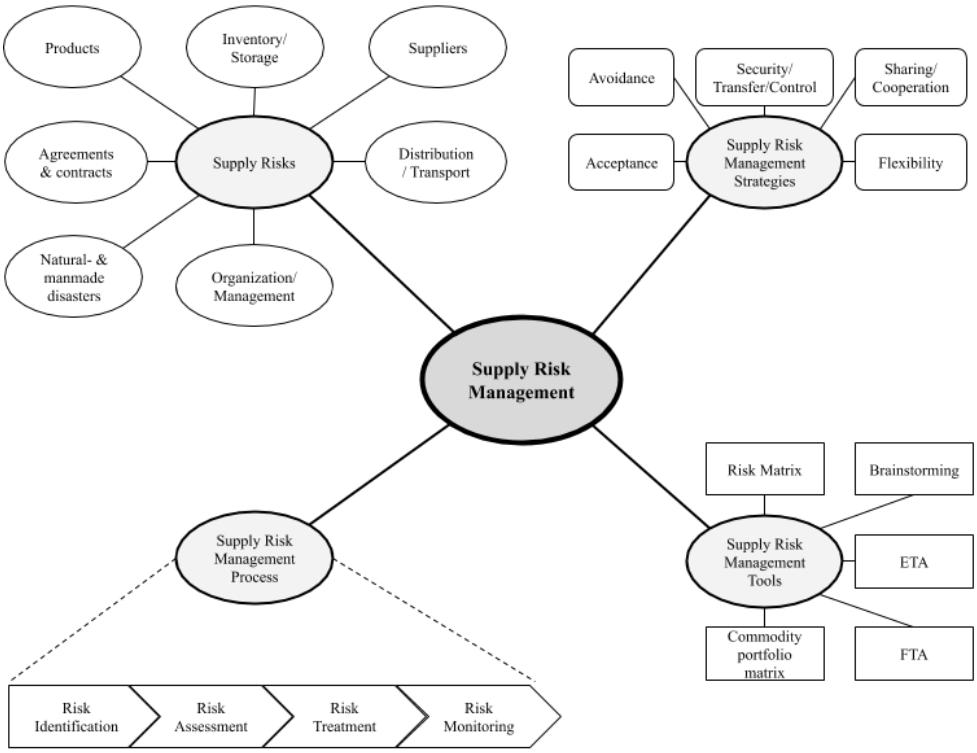


Figure 2.4. Simplified mind map of the Supply Risk Management topic

Furthermore, a structure for the theoretical framework was constructed using headings and listing the relevant articles below, as suggested by Rowley and Slack (2004). The last step, building the biography, was conducted continually during the process of writing the theoretical framework as additional concepts and ideas were identified, which is in line with the theory developed by Rowley and Slack (2004).

2.3 Case Study

Due to that the proposed research questions are *how* type questions, case research is the most suitable research method (Voss, 2002; Yin, 2009) and were therefore used. The process that was followed is one presented by Yin (2009) and has six steps, where all, except the initial one, are performed in an iterative fashion. The six steps are: (i) plan; (ii) design; (iii) prepare; (iv) collect; (v) analyze; and (vi) share. The process is illustrated in Figure 2.5.

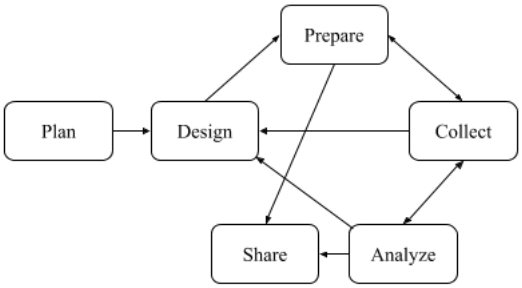


Figure 2.5. Case Study Research Process (Based on: Yin, 2004)

2.3.1 Planning the Case Study

In the first process step the researcher should make it clear that he or she follows a rigorous methodological path (Yin, 2004). This path started with an extensive literature review and coming up with the research questions. Worth remembering is that the literature review is not about determining answers regarding what is already known within the area, it is instead about developing better and more precise research questions about the topic (Yin, 2004). The final research questions were developed after the author's literature review and an initial research question, in collaboration with the supervisors at both Axis and LTH.

2.3.2 Designing the Case Study

The design of a study, which also is the second step of Yin's process, is what links the collected data, and the subsequent conclusions, to the initial research questions (Yin, 2004). Yin suggests that in order for the design's quality to be maximized, four conditions should also be maximized. These conditions are: (i) construct validity; (ii) internal validity; (iii) external validity; and (iv) reliability (Yin, 2004). But before these conditions are discussed, the actual case study design will be presented. This is done by describing the unit of analysis and a discussion regarding the number of cases that the study had.

2.3.2.1 Unit of Analysis

The unit of analysis helps to define what a "case" for a study will be as it states what will be investigated and should therefore be closely connected to the research question (Yin, 2004). Further a case study can either be holistic or embedded, i.e. single or multiple units of analyses (Yin, 2004). In this thesis the unit of analysis was holistic, and the single unit of analysis was "supply risk management strategies, processes, and tools".

2.3.2.2 Multiple or Single Case Study

There are multiple ways of conducting a case study depending on what the research goal is (Ellram, 1996; Yin, 2004). For instance, conducting a single case study, which is the most common form of case study, is appropriate for capturing the circumstances of an everyday or commonplace situation and for a unique or extreme case, among other things (Yin, 2004). A multiple case study is useful comparison and thus can provide robust conclusions. However, conducting a multiple case study requires extensive time and resources (Yin, 2004). Moreover, due to the ongoing Covid-19 pandemic the initially planned multiple case study could not be conducted as potential participating companies could, of natural causes, not prioritize the collaboration of this thesis.

Due to this factor, as well as the time restraint of this thesis and a desire by the authors to deep dive into commonplace case, with a not so developed proactive SRM, a single case study and Axis' sourcing department was selected. Yin's (2004) case designs as well as the one that was selected by the authors can be seen in Figure 2.6. To counter that a single case might not always be as robust as a multiple case study the authors mixed a single case study with a survey as suggested by Yin (2004). The survey helped the authors to collect richer data and facilitated the analysis. The survey questions can be found in Appendix 1.

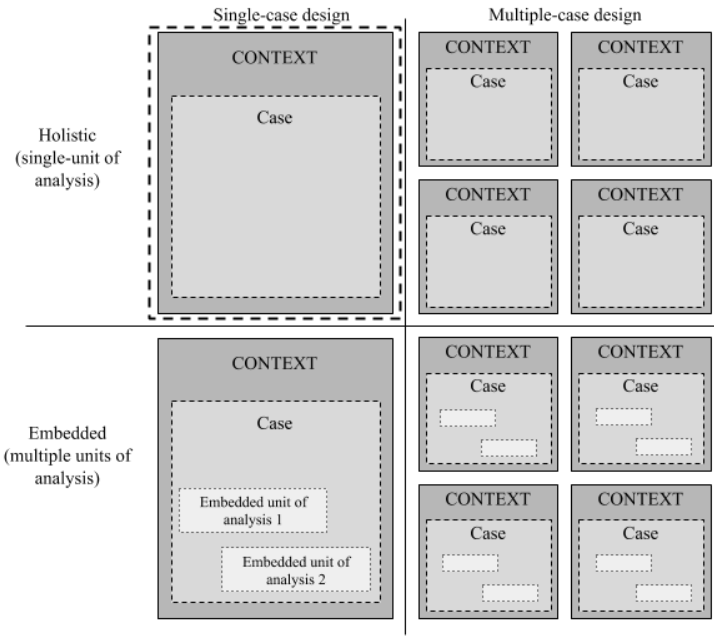


Figure 2.6. Basic types of designs for case studies and the author's design choice in the dashed box (Adapted from Yin, 2004, p.46)

2.3.2.3 Research Quality

For research methods such as case study, four conditions need to be maximized in order to achieve the highest quality possible (Yin, 2004). These criteria are: (i) Construct validity; (ii) Internal validity; (iii) External validity; and (iv) Reliability. The criteria are explained and tactics for testing them are shown in Table 2.2. The tactics was implemented during the corresponding phases as described by Yin (2004).

Table 2.2. Explanation and tactics for the four criteria
(Based on: Kidder and Judd, cited in Yin 2004, p.40; Yin, 2004, p.41).

Criteria	**Explanation**	**Case Study Tactic**	**Phase of Research in Which Tactics Occur**
Construct validity	"Identifying correct operational measures for the concepts being studied"	• Use multiple sources • Establish chain of evidence • Have key informants review draft case study report	Data collection Data collection Composition
Internal validity	"Seeking to establish a causal relationship, whereby certain conditions are believed to lead to other conditions, as distinguished from spurious relationships"	• Do pattern matching • Do explanation building • Address rival explanations • Use logic models	Data analysis
External validity	"Defining the domain to which a study's findings can be generalized"	• Use theory in single-case studies • Use repetition logic in multiple-case studies	Research design
Reliability	"Demonstrating that the operations of a study – such as the data collection procedures – can be repeated, with the same results"	• Use case study protocol • Develop case study database	Data collection

2.3.2.3.1 Tactic to Achieve Construct Validity

The different sources that was used in this thesis are interviews, survey data, and documents, e.g. financial reports or internal presentations. To achieve construct validity 14 people at Axis was interviewed and 12 people was surveyed, where less than half of them were also interviewed. The surveyed individuals were selected due to them having direct insights to the investigated issues. Having many interviewees made it possible for the authors to perform triangulation as proposed by Yin (2004) and thus establish a chain of evidence. This chain was important in order to create a logical and true link between what is suggested in the conclusion and what is presented earlier in the thesis (Yin, 2004). To achieve this, the authors was unbiased in the data gathering and analysis phases by having an anonymous survey and similar questions to all interviewees, see Appendix 3 for interview questions. Moreover, the thesis and drafts of it was reviewed, at various stages, by: a supervisor at Lund University; an examiner; peers; stakeholders at Axis; and interviewees to ensure its quality as suggested by Yin (2004).

2.3.2.3.2 Tactic to Achieve Internal Validity

To ensure internal validity in the thesis, rival explanations and possibilities was investigated so that other, non-accounted for factors, did not affect the result (Yin, 2004). Yin (2004) also states that pattern matching, one of the selected analytical techniques for the thesis, increases internal validity through comparing empirical patterns with predicted ones. The predicted pattern in this thesis is the theory that is presented in Chapter 3. Moreover, using both qualitative and quantitative data is a strong analytical strategy (Yin, 2004) and was therefore used in this thesis. The case was analyzed and an explanation of how or why something happened was be developed, as suggested by Yin (2004). This tactic is, according to Yin, a special type of pattern matching and is called Explanation Building. Another way to increase internal validity is to use logic models (Yin, 2004). Yin describes that logic models "deliberately stipulate a complex chain of events over an extended period of time" (p.149). However, this technique has not been used in this thesis and the authors argue that internal validity still was achieved since three of the Yin's four tactics or techniques were used.

2.3.2.3.3 Tactic to Achieve External Validity

To achieve external validity the generalizability of the findings must be shown (Yin, 2004). By utilizing survey to complement the single case study the authors hoped that the result could be generalized to a broader theory, as it should according to Yin (2004). The results of this study aimed to be just that, generalizable to a broader theory, so that the external validity could be increased.

2.3.2.3.4 Tactic to Achieve Reliability

To ensure reliability, i.e. that if another researcher would conduct the study in this thesis they would reach the same findings, a thorough case study protocol was developed and the case was be documented in depth (Yin, 2004) which can be seen in Chapter 4. With whom and when an interview was conducted was also documented, see Appendix 2, as well as the full interview guide, see Appendix 3. Furthermore, the complete survey can also be found in Appendix 1. This ensured that the process could be replicated in hope of increasing the reliability of the thesis.

2.3.3 Preparing to Collect Data

The third step of the process, *Prepare*, begins with having the appropriate skills as a case study investigator (Yin, 2004). Examples of these skills, according to Yin (2004), are: to be able to ask good questions; to be a good listener; to be adaptive and flexible; to have relevant knowledge about the subject area; and to be unbiased. Furthermore, preparations for protecting eventual human subjects, i.e. interviewees in this thesis, was also required. Which could be in the form of getting consent from

participants and protecting their privacy and confidentiality (Yin, 2004). This was done by anonymizing the interviewees answer and asking for their permission when recording the interviews. Moreover, additional information in the form of documents, e.g. financial reports, was also be collected to broaden the understanding of the case companies as suggested by Yin (2004). For collecting quantitative data through the survey the questions for the survey was developed. These questions were developed so to facilitate the qualitative data analysis and nonessential questions were excluded as argued for by Janes (2001). Moreover, to remove the issue that the sample population does not represent the entire population, as described by Janes (2001) all relevant Axis employees were surveyed.

2.3.3.1 Preparing an Interview Guide

Regardless if the interview is face-to-face or through telephone/video link a solid interview guide is important so that the same evidence can be collected across cases. Moreover, the interview itself can be unstructured, semi-structured or structured (Ellram, 1996; Gill et al., 2008). For this thesis the semi-structured format was used since it allowed the interviewee to go into more depth on subjects while not diverging too much due to our predetermined questions (Gill et al., 2008). Thus, the author's questions were, when deemed appropriate, adapted to fit into the conversation while still following a consistent line of inquiry.

Furthermore, the funnel method, i.e. firstly asking broad open-ended questions and as the interview progresses the questions become more and more specific (Voss et al., 2002), was utilized to structure the interview guide. Additionally, to eliminate biases and to get more richness in the data 14 different people was interviewed, as previously stated. Voss et al. (2002) argues that a balance between time and richness of data needs to be found which the authors believe they did.

The interview questions were clarified as needed after the initial interviews as suggested by Voss et al. (2002). Furthermore, the number of questions that will be asked can vary depending on the interview (Yin, 2009). For example, Ellram (1996) had almost 70 questions in her article. It was the aim of the authors to have interviews that last for one to two hours, as suggested by Voss et al. (2002), and the interviews lasted approximately for one and a half hour. The number of questions was regulated by that time constraint while still aiming to cover the essential topics. The interview guide in its entirety can be seen in Appendix 3.

2.3.4 Data Collection

The interviews were face-to-face or over Teams depending on what was practical for the interviewees as suggested by Creswell (2007). However, a drawback of telephone interviews is the lack of informal communication, such as body language, that can be interpreted (Creswell, 2007). Therefore, the authors of this thesis tried to have as many of the interviews face-to-face as possible and when this was not possible video camera was used. With the permission of the interviewees the authors recorded the interviews so that misinterpretation could be minimized.

Both authors were present during all interviews to further reduce the risk of misinterpretation. Moreover, one of the authors took notes while the other asks the questions during the interviews, as suggested by Voss et al. (2002). Furthermore, while asking the general open-ended questions it is important to have the underlying motive of those questions in mind but not to show them, which the authors tried to, so that our biases did not influence the interviewee's answer (Yin, 2004). Creswell (2007) further highlights the importance of sticking to the questions, completing the interview within

the specified time, to be respectful and courteous, and being a good listener during the interviews. All these factors the authors had in mind when conducting the interviews.

The survey was sent out through email to the 12 Axis employees that will directly work with the developed construct, i.e. it was a self-administered survey (Janos, 2001). To be noted is that, not getting enough answers on the survey could result in the findings being invalidated (Janos, 2001). However, the answer rate of the survey was 100%, arguably making the survey reliable.

Documents, e.g. financial reports, functioned as a valuable complement to the interviews (Yin, 2004) and was collected mainly through searches on Axis intranet[3]. Moreover, any other internal documents that the Axis representatives believe to be useful and were willing to share with the authors was of course also be collected.

2.3.5 Data Analysis

Yin (2004) states that a clear strategy, stating what to analyze and why, should first be developed. This is presented in this chapter. The goal of the analysis was to draw empirically based conclusions by examining, categorizing, tabulating, testing, or in any other way linking the evidence together to gain insights (Yin, 2004) that will assist in developing a recommendation to Axis. To find similarities and discrepancies from the interviews the answers were mapped against each other. Moreover, the empirical data was then analyzed by comparing relevant aspect of SRM and SCRM theory to Axis in order to identify discrepancies or similarities between the two, i.e. explanation building. Then a mark was given depending on how much in line Axis were to the corresponding theory. To be noted is that when introducing benchmarks in the analysis, the company Ericsson was used as well as in theory in order to suggest some tools which Ericsson has developed. The authors chose Ericsson since they have a well-developed risk management organization (Norrman and Wieland, 2020) and that Axis and Ericsson share some important similarities. For instance, Ericsson is similar to Axis in terms of operating within the electronics industry, makes use of Electronic Manufacturing Services (EMS), and has a global supply chain which was considered important to enable comparison. While. the companies differ regarding the maturity of their RM where Ericsson have been working for over 20 years with proactive RM, Ericsson is also a significantly larger company, and can also be viewed as a more hierarchical and compliance oriented organization (for more information regarding Ericsson see Norrman and Jansson, 2004; Norrman and Wieland, 2020).

The collected empirical data from Axis is of both qualitative and quantitative nature which is one of Yin's (2004) four analyzing strategies. Moreover, since the quantitative data was subjected to descriptive statistics and the qualitative data was central to the case study the authors followed a strong analytical strategy according to Yin (2004). The quantitative data was key in better explaining and understanding the qualitative data from the interview which Yin (2004) also suggests.

2.3.5.1 Development of Recommendation

When the data was collected as well as analyzed, the findings and insights from the case analysis was applied to Axis' situation to develop a practical and applicable solution. The development of the recommendation consisted of four main steps: (i) develop SRM strategies; (ii) develop SRM processes; (iii) develop SRM tools; and (iv) compile final solution based on the first three steps. The applicability was then examined during meetings with Axis representatives, as discussed in Chapter 2.2.1.6. The

[3] *See Chapter 4.1.7 The Intranet "Galaxis"*

development of SRM strategies, processes and tools was a critical phase of the thesis, as it consisted of trying to answer the research questions and fulfill the purpose of the thesis. The three different parts, i.e. SRM strategy, process and tools, was not developed individually as the authors view them to be part of a larger system which would produce greater value than the single entities of the system.

Further, it was important to make sure that there were no contradictions between the strategies, processes and tools, but rather synergies so that the solution would be practical and applicable to Axis' business context. It aimed to cover the long-term focus of Axis, to provide processes which would assist the sourcing department in identifying, assessing, mitigating and monitoring supply risks. Moreover, the tools were selected so that they could support the selected strategies, and processes. Therefore, co-operative elements between the authors and Axis, to ensure that the solution was suitable was present continually. The cooperation between the authors and Axis took form in meetings, Microsoft Teams[4] calls, or emails depending on what would be discussed.

2.3.6 Share Case Study

The final step of Yin's process is to share the result of the study (Yin, 2004). It is important to acknowledge who the audience of a report is and modify the language and content accordingly (Yin, 2004). For this thesis the audience was mainly the academics at Lund University and the practitioners at Axis. Therefore, a balance between the theoretical and the practical was necessary and therefore the constructive research approach was utilized. Furthermore, the authors tried to find a balance between including enough information for the reader to reach the same conclusions as the authors and not too much to bore or confuse the them as suggested by Yin (2004). While trying to find this balance the authors had a close collaboration with the supervisors at both Lund University and Axis so that both parties were satisfied with the outcome. Lastly, the thesis was reviewed by supervisors, examiners, and peers and rewritten iteratively to ensure high quality.

[4] *Microsoft Teams* is a unified communication and collaboration platform that combines persistent workplace chat, video meetings, file storage (including collaboration on files), and application integration. Available at: https://www.microsoft.com/en-us/microsoft-365/microsoft-teams/group-chat-software

3 Theoretical Framework

In this chapter the theoretical findings on the topic of SRM based on the literature review will be presented. Firstly, the general concepts of the topic with definitions of key constructs is presented. Secondly, the main sources of risks and how the authors have categorized them are discussed. Thirdly, a risk management process, divided in four steps, as well as governance and management aspects are presented. Moreover, for each step tools will be described. Fourthly, the main sub-strategies regarding supply risk mitigation will be highlighted. Lastly, the result of the chapter, i.e. the conceptual framework for SRM, is presented and visualized.

3.1 Theoretical Baseline

In order to establish a baseline for the theoretical framework, the most general concepts of the researched phenomenon is addressed before presenting the more detailed and deeper theoretical concepts related to the unit of analysis. Further, an explanation regarding reactive and proactive SCRM theory will also be discussed.

3.1.1 General Concepts

The literature surrounding SCRM and SRM, which has been reviewed for this thesis, provides several definitions of the subjects, which is why single definitions have been chosen, see below. There are many ways to define risk and some are more qualitative (March and Shapira, 1987; Sitkin and Pablo, 1992), while others are more quantitative (Mitchell, 1995; Kaplan and Garrick, 1981). All these proposed definitions have merit and are presented in highly cited articles. However, the definition by Mitchell (1995) has been selected for this thesis due to it being quantitative and can be used as a foundation for additional theory, e.g. the risk matrix which is discussed by many researchers (Hallikas et al., 2004; Norrman and Jansson, 2004; Ho et al., 2015; Fan and Stevenson, 2018). The definitions by Ho et al. (2015) were selected since the article was recently published and that the definitions are based on a thorough literature review on the last decades of SCRM research. Definitions on supply risk and SRM are scarcer than SCR and SCRM as well as the fact that no literature review on the subjects were identified. Therefore, definitions by or co-created with the researcher George A. Zsidisin was selected because he has, during the last 20 years, extensively published articles on the subject supply risk and SRM with a high number of citations. To be noted is that SRM is a part of SCRM, hence often called upstream SCRM (Kern et al., 2012) which is why theories and definitions surrounding SCRM also are incorporated.

- **Risk** - "... a combination of the probability of that loss P ($Loss_n$) and the significance of that loss to the individual or organization, I ($Loss_n$)" (Mitchell, 1995, p.116). Risk can then be described with the function: $Risk_n = P(Loss_n) \times I(Loss_n)$.

- **Supply chain risk** - "the likelihood and impact of unexpected macro and/or micro level events or conditions that adversely influence any part of a supply chain leading to operational, tactical, or strategic level failures or irregularities." (Ho et al., 2015, p.5035).

- **Supply chain risk management** - "an inter-organizational collaborative endeavor utilizing quantitative and qualitative risk management methodologies to identify, evaluate, mitigate and monitor unexpected macro and micro level events or conditions, which might adversely impact any part of a supply chain." (Ho et al., 2015, p.5036).

- **Supply Risk** - "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, 2003, p.222).

- **Supply Risk Management** - "supply risk management consists of purchasing organization efforts that reduce the probability of occurrence and/or the impact that detrimental supply events have on the firm." (Zsidisin and Ellram, 2003, p.15-16).

3.1.2 Proactive vs. Reactive SCRM

Another aspect which should be discussed is the focus on reactive versus proactive SRM in the theoretical framework and the overall thesis. The purpose is to develop governance, strategies, processes and the use of tools in order to create a more structured SRM at Axis. Consequently, the focus is on proactive SRM and hence how Axis can or should work with SRM in order to be better prepared. Additionally, it should be noted that the definitions in the literature of reactive and proactive are mainly connected to SCRM but are deemed as transferable to SRM due to the similarities of the subjects.

Reactive SCRM is the default position which a company has when a risk occurs, trying to respond to the results of the risk (Dani, 2008). As described by Kersten and Wente (2012, p.89) "This means that all activities that are done to cope with a risk, e.g., a disaster like the Tohoku Earthquake and Tsunami, are part of reactive SRM." Often, the reactive SCRM is performed in an ad-hoc approach (Jüttner et al., 2003; Jüttner, 2005). Proactive SCRM is the effort of an organization to eliminate or minimize the probability of risk and the potential consequences before the risk materializes (Kersten and Wente, 2012; de Oliveira et al., 2017). An important aspect of proactive SCRM is for companies to identify and assess the risks which the SC faces in order to select feasible, long-term and proactive mitigation strategies (Norrman and Jansson, 2004; Zsidisin et al., 2004). However, even if it is not the focus of this thesis one should not neglect the importance of reactive SCRM as pointed out by Norrman and Jansson (2004, p.453) "Even if much resources are invested in risk analysis and assessment, accidents might appear where and when least expected and then an efficient crisis organization must be in place to minimize the consequences".

3.2 Sources of Supply Risk

Numerous factors are associated with supply risk and discussed by many researchers. Risk can broadly be divided into three categories: (i) risks in the environment; (ii) risk within the SC; and (iii) internal company risks (Christopher and Peck, 2004; Jüttner, 2005; Lin and Zhou, 2011). To be noted, there exists other categories for risk sources such as Chopra and Sodhi's (2014) nine (disruptions, delays, systems, forecast, intellectual property, procurement, receivables, inventory, and capacity), and Svensson's (2000) two (qualitative and quantitative). However, it is the initial three that will be used in this thesis. The more prominent sub-risks for each of the three selected categories are illustrated in Figure 3.1. Each sub-risk will be discussed in depth to provide a more thorough understanding of the issues that an organization may face. However, one must remember that the individual risks are often interconnected and thus can exacerbate each other (Zsidisin, 2003; Chopra and Sodhi, 2004) and when companies are part of a network some risks may be decreased while others are increased due to the dependencies between the firms (Hallikas et al., 2004; Jüttner, 2005). Lastly, both components of risk,

probability of loss and significance of loss, should be considered when discussing risk sources (Mitchell, 1995; Chopra and Sodhi, 2004; Jüttner et al., 2005).

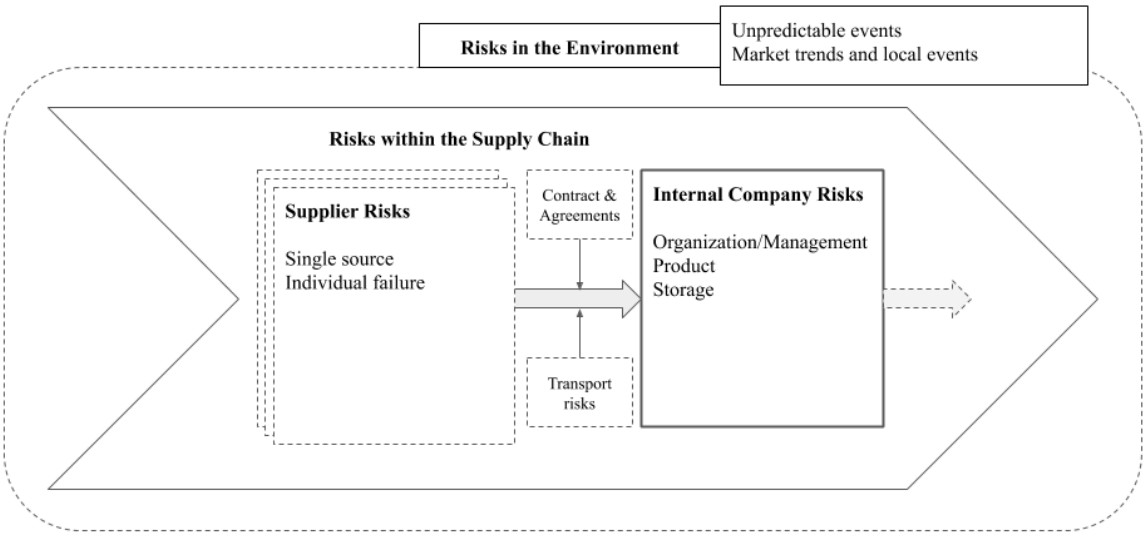


Figure 3.1. Visualization of sources of supply risk (Adapted from Jüttner et al., 2003, p.202).

3.2.1 Risks in the Environment

These events may impact the focal firm directly or indirectly through upstream SC actors and have a wide range of causes, where some are easier to predict than others (Christopher and Peck, 2004).

3.2.1.1 Unpredictable Events as a Supply Risk

Sometimes events occur which are difficult to be foreseen such as: weather, e.g. the hurricane Harvey was estimated to have resulted in economic losses somewhere in between $70 and 190 billion, and thus affecting major parts of the US economy (Holmes, 2017); fires, e.g. Ford had to shut down three factories, temporarily lay off 8000 employees, and lost approximately $1.6 billion dollars in sales due to a fire at a supplier of critical components to some of their more popular car models (Levin, 2018; Pecorari, 2018); epidemics, such as the recent coronavirus with its origin in China (Haren and Simchi-Levi, 2020; Ziady, 2020); and terrorist attacks (Jüttner et al., 2003), most notably being the 9/11 attack on the USA. Events such as these are difficult to prepare specifically against but knowing that they may happen is important, as they can have high impact consequences (Xie et al., 2011).

3.2.1.2 Market Trends and Local Events as Supply Risks

Man-made macro events are sometimes easier to foresee (Christopher and Peck, 2004) such as labor strikes (Chopra and Sodhi, 2004), Brexit (Gysegom et al., 2019), and trade-wars between China and USA (Bailey, 2019), that all affect flow of goods. But regardless, they can be difficult to hedge against. Outsourcing, globalization, and E-business are market trends that have resulted in these complex international networks between firms that are highly dependent on each other (Harland et al., 2003) which causes and even aggravates the above-mentioned risks. Furthermore, some market trends naturally affect some industries and companies more than others, which can result in loss of business, failure to meet customer demand, and negative effect on the bottom line (Zsidisin, 2003). These market trends could have many explanations, but some are a market shortage of specific components and a general price increase for a commodity (Zsidisin, 2003).

An additional risk that becomes more critical for supply chains is cyber risk (Boyson, 2014, Lamba et al., 2017). Which has even resulted in the management construct cyber supply chain risk management, that is a combination of the fields of cybersecurity, enterprise risk management, and supply chain

management (Boyson, 2014). Cyber risk, or sometimes called information security risk, means that a third party, that could or could not be part of the SC, wants to steal data or knowledge and/or affect the company's operations (Manuj and Mentzer, 2008, Boyson, 2014, Lamba et al., 2017). As more actors, i.e. through networks between firms, have access to a company's information the greater the risk of it being accessed by somebody that should not (Spekman and Davis, 2004, Boyson, 2014). The reason for this is that the integrity of a firm's data and IT system are only as strong as its weakest link (Spekman and Davis, 2004). The source of a data security breach could both come from outside, i.e. a hacker, or from the inside, through somebody leaking information (Spekman and Davis, 2004).

3.2.2 Risks within the Supply Chain

The risks described in this chapter can affect the upstream supply of goods in the SC (Christopher and Peck, 2004). Moreover, it is worth taking into consideration that it, naturally, is a risk to be dependent on other actors in e.g. a SC (Harland et al., 2003).

3.2.2.1 Suppliers as Supply Risks

An unforeseen increase in procurement cost from a supplier, also known as Procurement Risk, has mainly two culprits: fluctuating exchange rate and supplier price hike (Chopra and Sodhi, 2004) which naturally becomes more prominent when single sourcing, i.e. only using a single supplier for a product, commodity or component (Wagner and Johnson, 2004; Yu et al., 2009), is utilized. Additional risks from using only one supplier are that there is a risk that the supplier cannot handle demand fluctuations, has quality issues, problems with their suppliers, or does not remain technologically competitive (Zsidisin, 2003; Wagner and Johnson, 2004; Hamid et al., 2018) which naturally affects the buying company. An example described by Chopra and Sodhi (2014) was how Toyota lost billions of dollars in sales due to having a SC that relied on a single supplier for a component that was used in several car models. Giunipero and Aly Eltantawy (2004) also stresses the risks involved with supplier failures for companies that outsource and utilizes consolidation, partnerships, and alliances. An example of this is described by Zsidisin (2003) when an earthquake in Taiwan affected all suppliers in the region which had effect throughout many different SCs. Thus, a risk could not only be to have one supplier but also to have several in the same geographical area. Further, integration within the SC, with e.g. suppliers, does not always lead to increase in performance and instead a selected number of integration elements should be focused on (Fabbe-Costes and Jahre, 2008).

Moreover, suppliers can also become a risk if they are not transparent with how they operate (Manuj and Mentzer, 2008), which can be exemplified by a recent event. 27 major companies, among them are Nike and Apple, have unknowingly employed suppliers that used forced labor, which makes the major companies guilty of importing these goods to several countries, where the US is one of them (Cosgrove, 2020). What the consequences for these companies will be are unclear as the events are still ongoing, but Cosgrove (2020) speculates that international and governmental reactions as well as reputational damage are likely. In conclusion, both the procurement strategy itself, i.e. how, what, and where to procure something from, and the thereafter selected suppliers can become a risk for the focal firm.

3.2.2.2 Agreements and Contracts as Supply Risks

The contracts and agreements in a buyer-supplier relationship is important since it determines the relationship between the two parties and is a key factor in implementing successful SCM (Norrman, 2008). There are many types of contracts and some involve profit sharing (Shang and Yang, 2015; Fan and Stevenson, 2018), which is common in industries with high paced trends, since both the supplier and retailer are facing high risks (Shang and Yang, 2015). These contracts need to have "mutually beneficial profit-sharing parameters", i.e. how much each party gets from the deal, so that the

relationship lasts and does not become a liability later on (Shang and Yang, 2015). Moreover, risk sharing is important to address in the contract so that e.g. overstocking and excessively frequent ordering can be mitigated (Gao, 2015).

3.2.2.3 Distribution and Transportation as a Supply Risk

Perfectly fine goods can still become an issue if they are not transported from the supplier to the buyer at the right time (Wilson, 2007). Goods can be delayed for several reasons, e.g. extensive handling or inspections during border crossings and changing transport mode (Chopra and Sodhi, 2004). Furthermore, having long international transports from one part of the world to another not only makes the SC less reactive, it also makes the transport vastly more expensive (Chopra and Sodhi, 2014). Furthermore, it can also increase the likelihood of something happening to the cargo in transit, such as pirates of the coast of Somalia as exemplified by Xie et al. (2011).

3.2.3 Internal Company Risks

The risks described in this chapter are those that stem from inside the focal firm and are divided into three components: (i) organization and management; (ii) product; and (iii) inventory and storage.

3.2.3.1 Organization and Management as a Supply Risk

One major risk when it comes to supply is how the organization is set up. When set up improperly it may lead to overreactions or to taking actions to unnecessary events, resulting in chaos, as described by Jüttner et al. (2003). Jüttner et al. (2003) further exemplifies chaos inducing factors as second-guessing decisions, having distorted information, improper understanding of the SC itself, and the bullwhip effect, i.e. amplified demand order variability up the SC caused by irrational decision making (Lee et al., 1997). Moreover, risks can also be caused by a lack of ownership between the buying and selling organization which then leads to a lack of responsibility and thus can cause stockouts, obsolescence, etc. (Jüttner et al., 2003; Hoffman et al., 2013). Furthermore, Jüttner (2005) describes how control mechanisms, such as rules and policies, for a buying firm can become a risk if they are improper and exemplifies this with a firm that does not react appropriately to a reduction in demand.

Another interesting aspect of risk taking is that the company's performance can influence how risk averse the organization is (Mitchell, 1995). Mitchell describes how successful companies become risk averse, to not lose their position, while failing companies instead become more prone to risks, to avoid falling further behind. However, an interesting aspect is that the more a company exceeded their target the less danger there is from it (Mitchell, 1995). Thus, a company then can afford to lose without jeopardizing its survival.

3.2.3.2 How the Product Can Become a Supply Risk

The degree of perceived risk can be affected based on the product's strategic importance, technical complexity, and of its total value (Mitchell, 1995) where the more standardized a product is the lesser the risk there are (Caniels and Gelderman, 2005). Which is also famously discussed by Kraljic (1983, p.111) that categorizes different products in a two-by-two matrix depending on "importance of purchasing" and "complexity of supply market", see Figure 3.2. The second axis has later been called "supply risk" as it describes how easy it is to get supply of the product or component (Gelderman and Van Weele, 2003; Caniels and Gelderman, 2005; Padhi et al., 2012) therefore making it highly relevant to this thesis. Furthermore, Harland et al. (2003) describes that increased product variety and performance, together with more technically complex solutions, has led to increasingly complex products overall. Therefore, since one company cannot shine in every aspect, outsourcing has become a solution for some companies which itself leads to other risks (Harland et al., 2003).

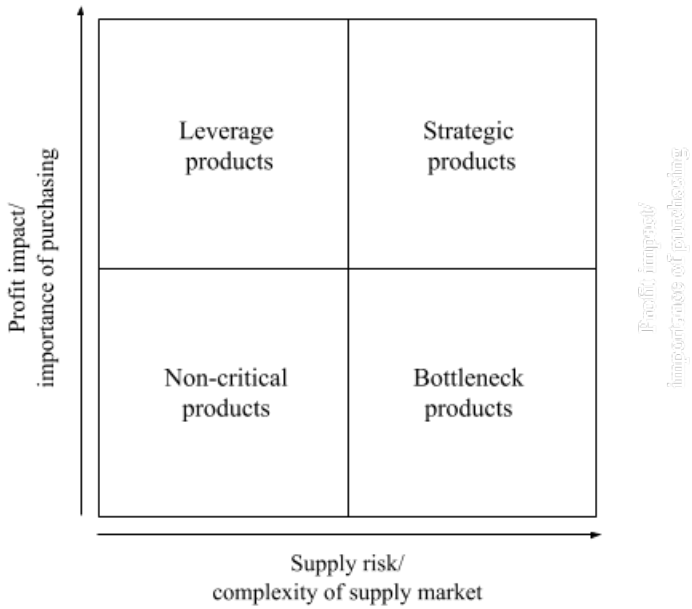


Figure 3.2. The Kraljic Matrix. (Source: Kraljic, 1983, p.111; Caniels and Gelderman, 2005, p.143)

3.2.3.3 Inventory and Storage as a Supply Risk

Holding both too little inventory and too much inventory could be a risk (Chopra and Sodhi, 2004; Manuj and Mentzer, 2008; Ho et al., 2015). Having too little is naturally connected with not being able to meet demand from the customers which in turn leads to loss of sales. However, having an excessive amount of inventory hurt financial performance (Chopra and Sodhi, 2004; Manuj and Mentzer, 2008) and can function as an ocean to hide the real issues that the company may have (Khojasteh, 2016). Moreover, if the prices of the goods fall while having excessive stock, the company can face serious losses. Chopra and Sodhi (2004) describes that inventory risk is affected by three factors: (i) the value of the product; (ii) its rate of obsolescence; and (iii) uncertainty of demand and supply. Therefore, having excessive stock of high value, high rate of obsolescence products can be a risk, while not as much for low cost, low rate of obsolescence products (Chopra and Sodhi, 2004). An example of mismanaged inventory is Cisco in 2001 that had to write off $2.5 billions worth of inventory due to a lack of communication between its SC partners (Spekman and Davis, 2004). However, as the number of products increases, the inventory risk increases, and thus inventory risk as well. Moreover, if excessive stock is pooled in one location it can make the entire SC more fragile (Jüttner, 2005; Chopra and Sodhi, 2014).

3.2.4 Summary of Supply Risks

To summarize the above discussed risk and their respective sources Table 3.1 is presented.

Table 3.1. A selection of supply risk sources.

Risk Categories	Sub-Risks	Sub-Risk Components	Reference
External SC Risk	Unpredictable Events	Natural disasters	Jüttner et al., 2003
		Epidemics	Norrman and Jansson, 2004; Jüttner, 2005
		Fire	Jüttner et al., 2003; Chopra and Sodhi, 2004
		Socio-political actions	Jüttner et al., 2003; Chopra and Sodhi, 2004
	Market Trends and Local Events	Man-made disasters	Jüttner et al., 2003
		Labor Strike	Chopra and Sodhi, 2004
		Commodity price increase	Zsidisin, 2003
		Market shortages	Zsidisin, 2003; Chopra and Sodhi, 2004
		Globalization	Harland et al., 2003
		E-business	Harland et al., 2003
		Information	Manuj and Mentzer, 2008; Spekman and Davis, 2004
Risks within SC	Suppliers	Single source	Zsidisin, 2003; Chopra and Sodhi, 2004; Yu et al., 2009
		Individual supplier failure	Harland et al, 2003; Giunipero and Aly Eltantawy, 2004
		Geographical concentration of suppliers	Zsidisin, 2003
	Distribution and Transportation	Delays	Chopra and Sodhi, 2004; Hallikas et al., 2004; Wilson, 2007
		Long transport time	Chopra and Sodhi, 2014
	Agreements and Contracts	Profits are shared unequally	Shang and Yang, 2015
		No risk sharing	Gao, 2015
Internal Risks	Products	Product complexity	Mitchell, 1995; Harland et al., 2003; Giunipero and Aly Eltantawy, 2004
		Product importance	Mitchell, 1995
	Organization and Management	Chaos	Jüttner et al., 2003; Hoffman et al., 2013
		Lack of ownership	Jüttner et al., 2003
		Organization's performance	Mitchell, 1995
	Inventory and Storage	Incorrect amount in storage	Chopra and Sodhi, 2004; Ho et al., 2015
		Excessive pooling of inventory	Chopra and Sodhi, 2014

3.3 Supply Risk Management Processes

A risk management process can take many shapes and forms. But the one presented in this thesis has four major steps in it, as suggested by Zsidisin et al. (2005). In terms of applicability to SRM, Kern et al. (2012) exemplifies the use of this risk management process in an SRM context. These steps are: (i) risk Identification; (ii) risk Assessment; (iii) risk Treatment; and (iv) risk Monitoring, and the process is illustrated in Figure 3.3. Moreover, the ISO 31000 (ISO, 2018) also uses equivalent steps in their risk management process which reinforces the author's process selection. To be noted is that many researchers use different terms in their risk management process but that the process itself is often very similar and include the same aspects that will be presented in this thesis (de Oliveira, 2017). Each process step, with corresponding tools, will be discussed in detail but firstly, the governance and organizational aspects of the risk management process will be introduced.

Figure 3.3. The Risk Management Process (Adapted from Norrman and Jansson, 2004, p.442).

3.3.1 Risk Process Governance and Organization

An important part of a successful risk process is the governance and organization of the risk process in a company, which is the foundation of the process and coordinates the different steps as well as facilitates the decision-making (Jüttner et al., 2003; Manuj, 2013). There must also be a willingness and incentives for the employees to engage in the risk management process steps (Smeltzer and Siferd, 1998). Supporting the importance of culture, Dani (2009) argues that a culture and attitude which provides resources and motivation for employees to engage in risk management activities is one of the most important enablers for a proactive risk management strategy. Christopher and Peck (2004) suggest that SCR must be acknowledged in the top management and that it should be properly represented at the board as well as integrated in the corporate culture. In line with this, Christopher et al. (2011) argue that the risk culture is a prerequisite for achieving successful risk mitigation. Risk culture which is spread across the whole organization can only be led from the board level. Hence, the support of top management and the employee's involvement is key in achieving success (Burt and Starling, 2002).

Further, Manuj (2013) identified different barriers for the development of SRM in companies. Related to organization and management is the single-minded focus of top management measurements e.g. per piece cost of sourcing, bonuses tied to per-unit cost reductions or majority of supplier relationships engagements with almost only lowering the cost as focus. The organizational aspect is also of importance, as argued by Christopher and Peck (2004, p.22) "A supply chain risk management team should be created within the business and charged with regularly updating the supply chain risk register and to report to the main Board through the supply chain director on at least a quarterly basis. The team will need to be cross-functional and to be able to audit risk...". An example of SCRM being integrated in the governance and organizational aspect is Ericsson which went from managing risk on a more corporate level to working with risk management and SCRM more cross-functionally (Norrman and Jansson, 2004), see Figure 3.4. This change of incorporating risk at more levels of the organization, by e.g. implementing the risk management council with representatives from multiple functions, was one of the key factors in improving Ericsson's SCRM (Norrman and Jansson, 2004). At Ericsson the key corporate functions regarding activities related SCRM, or SRM, was the sourcing, supply and security department while the more operational activities were related to business areas (Norrman and Wieland, 2020).

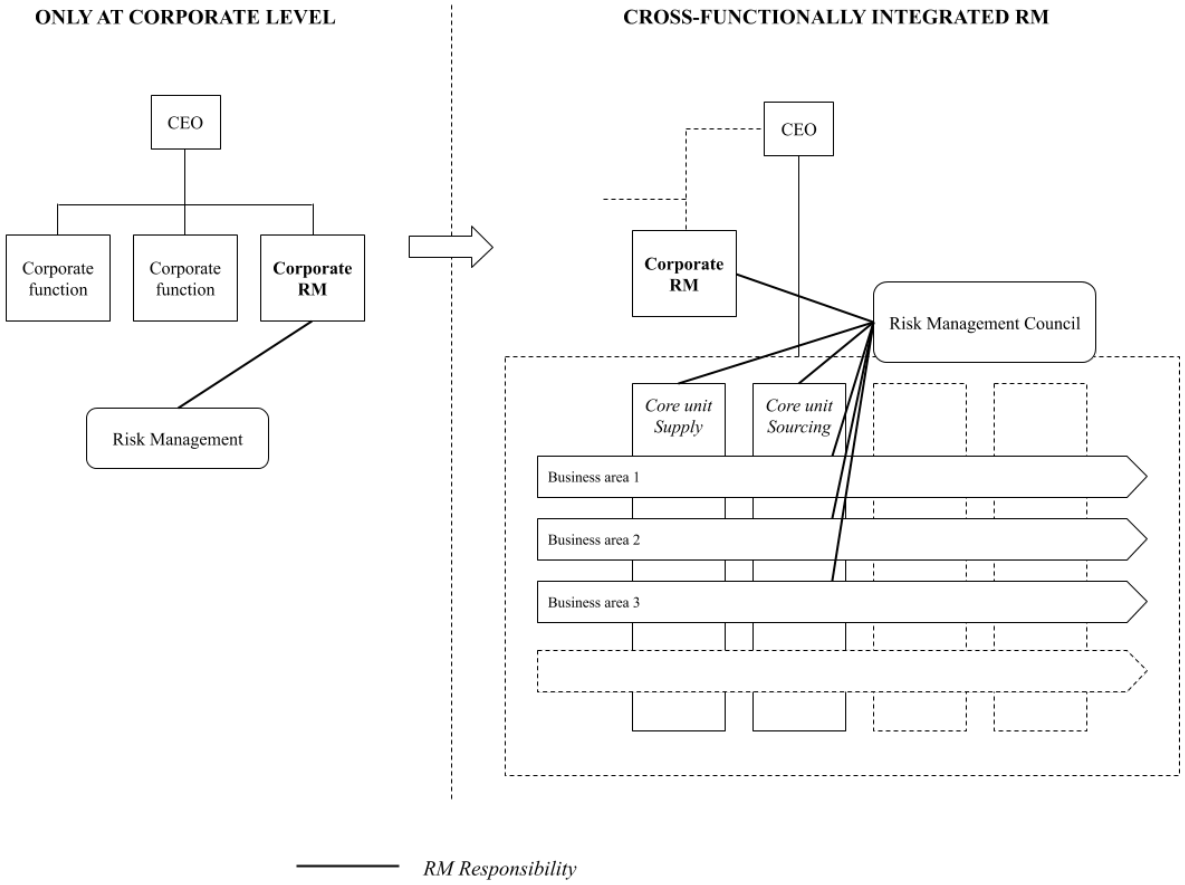


Figure 3.4. Visualization of Ericsson's organizational change regarding risk management (Source: Norrman and Jansson, 2004, p.443-444)

The top management at Ericsson also updated and implemented several ISO standards connected to risk as well as increased focus on compliance and CSR which proved to be critical in order to improve formalization, top management support and turning risk into a part of the organizational culture (Norrman and Wieland, 2020). Further, management at Ericsson identified that investments in capabilities such as information systems (IS) and learning were major enablers in order to bring their SCRM to the next level (Norrman and Wieland, 2020). Capabilities such as an IS provided Ericsson with opportunities to improve their SCRM, and enabled a transition from manual to automated work as well as resulted in new tools e.g. the internally developed "site@risk"**,** see Figure 3.7 (Norrman and Wieland, 2020). Ericsson's investment in IS and a global ERP system also enabled increased use of data driven tools within several functions e.g. supply and sales, that resulted in increased visibility, cross-functionality as well as the speed of which bottlenecks could be identified ahead of crises (Norrman and Wieland, 2020). A key factor that influenced the development of Ericsson's capabilities was learning how to use tools effectively which was based in experiences of earlier disruptive events and training (Norrman and Wieland, 2020). Learning and training has also been a key aspect of not losing the established risk culture in times with less disruptive events, which is why training is present at all organizational levels and are taken very seriously (Norrman and Wieland, 2020). Other actions to improve SCRM were that the sourcing and supply departments increased their formalized cross-functional meetings in order to e.g. set collective targets on single-sourced components and suppliers (Norrman and Wieland, 2020). The increased organizational formalization and structure also enabled the risk culture to move from a few heroes to a more formalized line but, to be noted, was achieved after several years of continuous commitment (Norrman and Wieland, 2020).

Additionally, Hallikas et al. (2004) suggest that the process should not only be of cross-functional nature within the company, but that utilization of the SC network and facilitating mutual and collaborative efforts in the risk process steps will enhance the performance of the overall SC. This is also supported by Jüttner (2005) which in her research found that companies have interrelated risks between parties in the network which argue for the need of cooperation in risk identification, assessment, mitigation and monitoring within the SC.

3.3.1.1 Risk Management Maturity Model

In this section a maturity model to assess an organization's risk management maturity level is presented. The model is based on the ISO 31000 and thus can be used to assess a RM process according to the best practices defined in risk management references (Proença et al., 2017). The main goal of the RM maturity model, according to Proença et al. (2017), is to increase the business value of an organization which sequentially will increase as an organization goes from a lower maturity level to a higher one, as illustrated in Figure 3.5. The maturity model has six levels, 0–5, where level 0 is that the organization does not conduct any RM processes or tasks at all (Proença et al., 2017). To move from one level to the next, the organization must comply with all the criteria from the previous level(s). Maturity assessment criteria can be seen in Appendix 4. All levels are presented and described below (Proença et al., 2017):

- Level 0: Non-existing RM
- Level 1: Initial RM
- Level 2: Managed RM
- Level 3: Defined RM
- Level 4: Quantitatively Managed RM
- Level 5: Optimizing RM

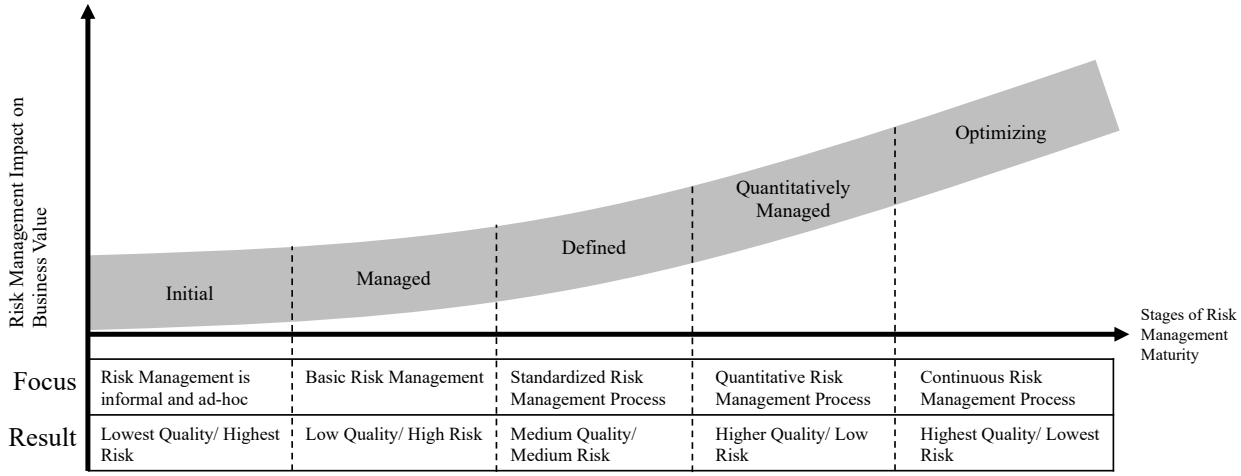


Figure 3.5. Risk Management Maturity Curve (Adapted from Proença et al., 2017, p.105)

To move from level 0 to level 1 basic RM activities needs to be performed with the intention that RM is managed across the organization (Proença et al., 2017). Moreover, the organization needs to be aware that RM is a relevant function for the entire organization. At maturity level 1, *Initial*, the organization knows that there is a need for RM processes. At this level it is possible that the organization conducts some form of RM activities, but they are "mostly ad hoc and chaotic" and they tend to be reactive rather than proactive (Proença et al., 2017, p.105). The RM results are often difficult to replicate and hard to predict since they tend to depend on the competences of the individuals in the organization.

When the organization reaches maturity level 2, *Managed*, they should make an effort to plan and perform the activities of the RM process that is in line with the RM policy, which has been developed together with the organization's stakeholders (Proença et al., 2017). The activities are assigned to people with capabilities, clear responsibilities, and sufficient resources to produce somewhat repeatable results. However, the RM activities tend to be influenced by the old ways of working instead of the formal process. Overall, the organization lacks standardized RM across the organization and the RM can differ vastly from department to department (Proença et al., 2017).

At maturity level 3, *Defined*, the RM process is understood by the employees and described in standard procedures, tools, and methods (Proença et al., 2017). There should be a central attitude towards RM and the RM process should be used to establish consistency across the organization. Furthermore, the RM process is improved over time (Proença et al., 2017).

When the organization reaches maturity level 4, *Quantitatively Managed*, they use "quantitative and statistical methods to manage, measure, and evaluate the risk management process" (Proença et al., 2017, p.105).

At maturity level 5, *Optimizing*, the organization follows all criteria of ISO 31000. Moreover, RM processes are constantly improved by using data from the previous maturity levels (Proença et al., 2017). All employees should have a high commitment to RM, and it is seen as a strategic tool for the company. Since the organizations at this maturity level is constantly improving and innovating their RM process, they contribute scientifically to the development of RM as a domain (Proença et al., 2017).

3.3.2 Risk Identification

Risk identification is a continual step in the process (Tchankova, 2002) and the goal of it to identify as many potential risks and their sources as possible (Ho et al., 2015; Fan and Stevenson, 2018). It is the identification of risk that triggers any further risk management action (Kern et al., 2012). This process step is important since without it, risk management activities cannot be performed (Fan and Stevenson, 2018) and it is easier to protect oneself against something that is known. Therefore, risk needs to be scanned for often so that early signs of risk in the SC or its environment can be identified (Kern et al., 2012). However, due to the finite resources of an organization, a structured identification process is required (Kern et al., 2012). Furthermore, to utilize the resources in an efficient way, risk observations should be performed in the context of known sources of risks and exposed areas of the SC. Therefore, knowledge about the existing SC, important processes, and the critical components is necessary (Kern et al., 2012). Fan and Stevenson (2018) concurs with this view and further argue that the drivers of risks, i.e. probability and impact, are important in the identification step. By having a firm grasp of them they are not only easier to identify but risk treatment plans to reduce or eliminate them can also be developed (Fan and Stevenson, 2018).

Furthermore, due to the fact that the only risks that can be assessed and managed are those that have been identified, the risk identification step becomes a critical determiner of the quality of the entire risk management process (Kern et al., 2012). Moreover, the second step, Risk Assessment, is highly dependent on the identification step for the same reasons.

3.3.2.1 Risk Identification Tools

There are many ways to identify risks (Kasap and Kaymak, 2007). However, researchers seem to prefer complex analytical procedures while practitioners prefer simpler and proven methods (Fan and Stevenson, 2018). Instead of simply stating that risks should be identified, the authors of this thesis present five tools, in hope that they will provide a more concrete understanding of how the process step could be conducted.

3.3.3.1.1 Supply Chain Mapping

A visualization of a SC's flow of goods, information, and money is called a supply map (Tummala and Schoenherr, 2011). Before a risk identification begins it is useful to produce a supply map since it can facilitate SC analyses, monitoring of SC strategies, and help in SC redesign or modifications (Gardner and Cooper, 2003). A basic example of a SC map can be seen in Figure 3.6. Gardner and Cooper (2003) has many more additional arguments why mapping of a SC can benefit an organization and how it can be done, the interested reader is recommended to read their article for thorough review of the subject.

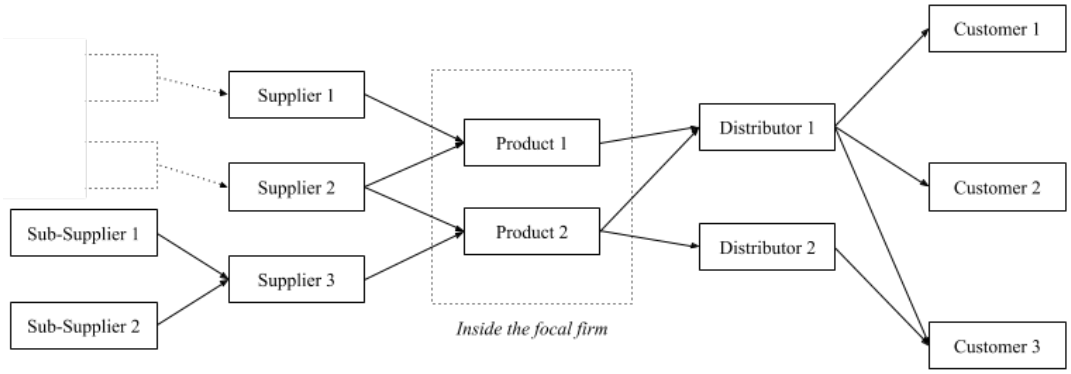


Figure 3.6. Example of a SC map (Adapted from: Gardner and Cooper, 2003, p.57)

A practical and more detailed example of SC mapping can be found at Ericsson that formally mapped and tracked all their supplier sites. This was done to more effectively collect data for risk identification and risk assessment (Norrman and Wieland, 2020). Ericsson also automated their visualization of their SC map using a database of components for each finished product and an in-house developed geo-mapping tool, site@risk. To keep the data on components, manufacturing, and supplier sites relevant, it was updated annually (Norrman and Wieland, 2020). By having up-to-date data and this tool the user could enter an incidents location and within minutes a visual map of affected plants and offices (internally, and for suppliers and sub-suppliers) could be produced. This map made it easy for Ericsson to determine the area impact of an incident and thus its impact on finished products (Norrman and Wieland, 2020). A visualization of Ericsson's map, with masked supplier names, can be seen in Figure 3.7. Note that later Ericsson further improved data on their 30 000 components by using an annual supplier survey (Norrman and Wieland, 2020). This gathered information on the risk landscape, with geographical coordinates for all production sites and their alternatives, lead time for ramping up production or switching manufacturing site, and qualifying new processes and tools, among other information (Norrman and Wieland, 2020).

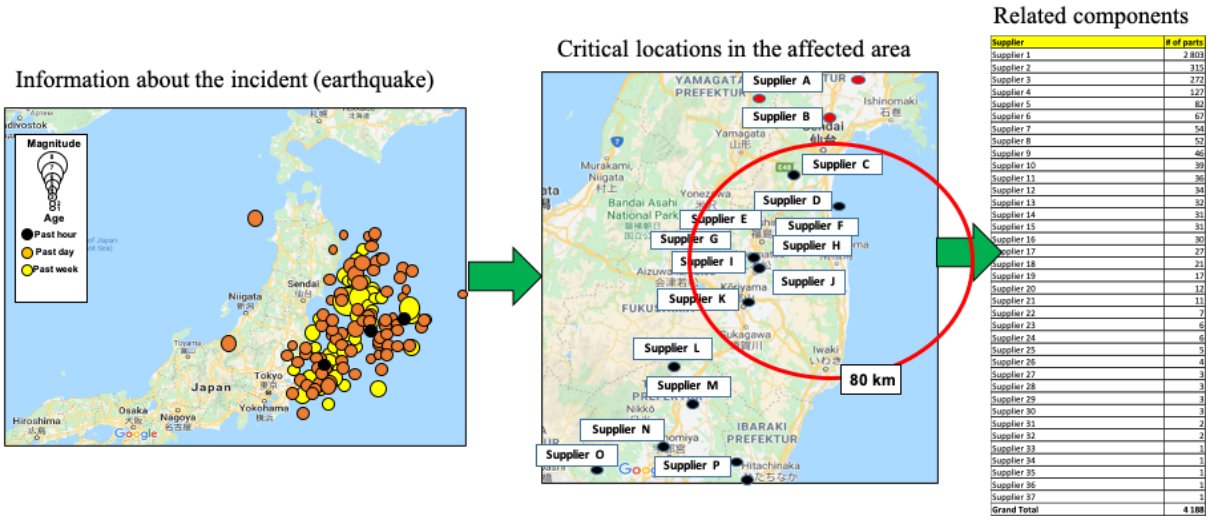


Figure 3.7. Ericsson's geo-map tool in action during the 2011 Japanese earthquake (Source: Norrman and Wieland, 2020, p.6[5])

3.3.2.1.2 Brainstorming session

Brainstorming is useful when the goal is to identify a wide range of new risks (Kasap and Kaymak, 2007). It is an interactive and team-based approach where group members verbally identify risks and build on each other's ideas (Kasap and Kaymak, 2007). However, its success is dependent on the participating members experience and skills as well as the facilitators proficiency (Kasap and Kaymak, 2007).

3.3.2.1.3 Cause-Effect Diagram

The cause-effect diagram goes under several names e.g. Fishbone diagram or Ishikawa diagram, and is a useful tool for identifying and analyzing SC risks (Lin and Zhou, 2011). Moreover, it is used both by researchers and practitioners (Fan and Stevenson, 2018). This framework, see example in Figure 3.8, is easy to use and highlights the relationships between the risks and their respective causes (Lin and Zhou, 2011). The example in Figure 3.8 has four major causes, six secondary causes, and 17 tertiary causes. Furthermore, the advantages with a cause-effect diagram is that it helps team members think in a very structural way when brainstorming about the causes for risks and facilitates the finding of root causes for risks, while the diagram is being developed (Ilie and Ciocoiu, 2010). Moreover, when a diagram is lopsided it can indicate that more information is needed in the sparse areas or the fact that more risk causes stem from the denser area (Ilie and Ciocoiu, 2010). Furthermore, an overall thin or sparse diagram can indicate a general lack of understanding of the SCRs.

[5] To be noted this page number corresponds to the page number of the article itself and not the journal, as it had not been published at the time of writing this thesis.

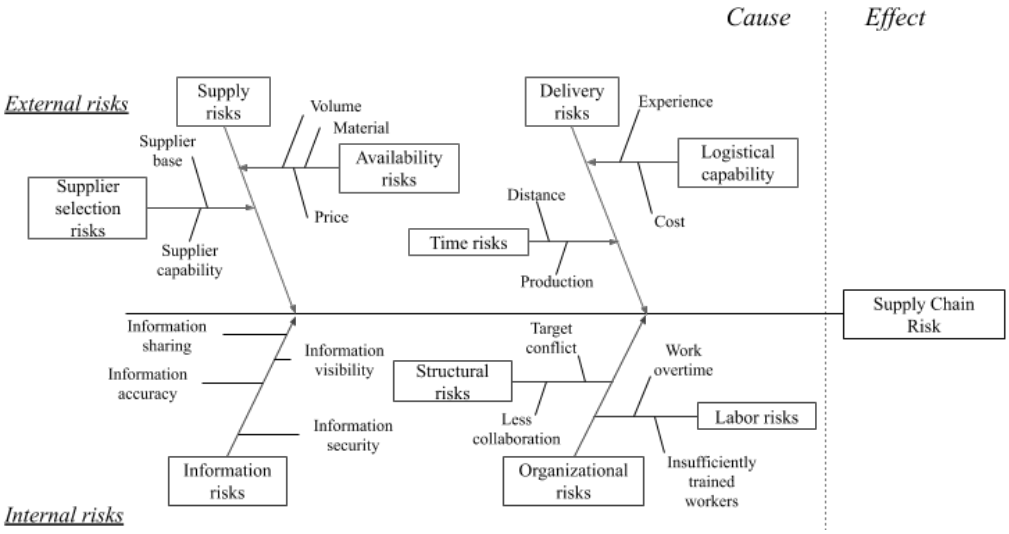


Figure 3.8. Example of a cause-effect diagram (Adapted from: Lin and Zhou, 2011, p.177).

3.3.2.1.4 Fault Tree Analysis (FTA)

Another risk identification tool that maps risks is the Fault Tree Analysis (Norrman and Jansson, 2004). FTA is a logic diagram that evaluates the probability of an accident by combining the probabilities of the causes of that accident (Tanaka et al., 1983). In other words, an FTA is a "logic model that represents combinations of events which leads to the top (undesirable) event" (Tanaka et al., 1983, p.454). The events, shown as a circle with individual probabilities of occurring, are combined using "OR" gates and "AND" gates, resulting in the top events, shown as rectangles, which can be seen in Figure 3.9. Worth remembering is that FTA diagrams start with asking the question "What can cause X?" and then work backwards (Mullai and Paulsson, 2002).

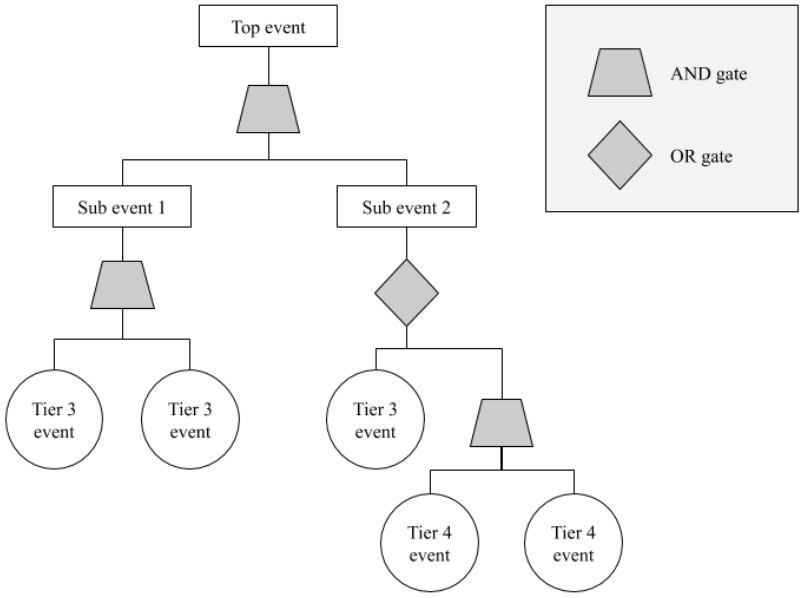


Figure 3.9. Example of a FTA diagram (Based on: Tanaka et al., 1983, p.454).

3.3.2.1.5 Event Tree Analysis (ETA)

Risks can also be identified by using an Event Tree Analysis diagram which is also a logic diagram just like FTA (Norrman and Jansson, 2004). However, ETA identifies and quantifies possible outcomes after the initiating event occurs (Mullai and Paulsson, 2002). An example of an ETA diagram can be seen in Figure 3.10.

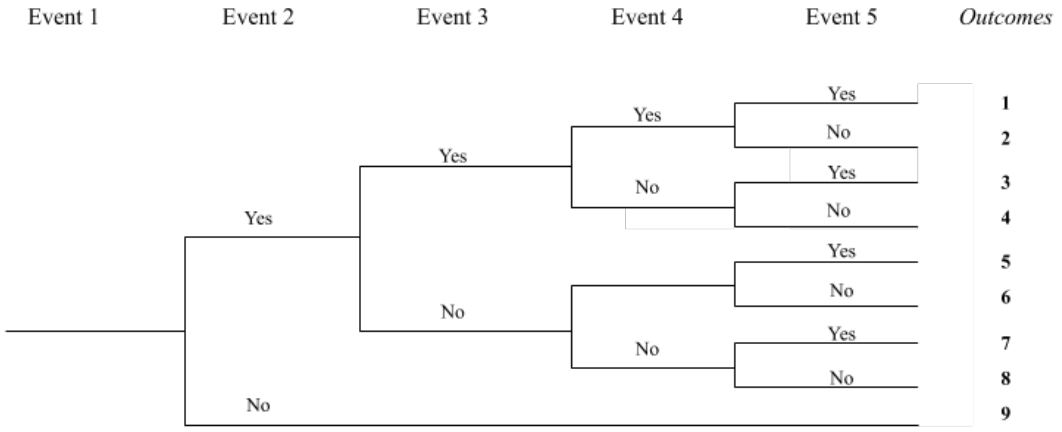


Figure 3.10. Example of an ETA diagram (Based on: Andrews, and Dunnett, 2000, p.231).

3.3.3 Risk Assessment

The objective of this process step is to understand an identified risk to such a degree that an informed decision of what to do can be made (Kern et al., 2012). Such a decision could be to avoid the risk, reduce its likelihood or impact, accept it, or prepare some form of contingency plan. Furthermore, for the SRM to be effective the assessment needs to be comprehensive while still being quick and cost efficient (Fan and Stevenson, 2018). However, this is often a trade-off where more data could provide a better understanding, while too much data causes excessive workload for commodity managers and only marginally more accurate probabilities. A general risk assessment process can contain several steps, e.g.: (i) establishing loss potential; (ii) identifying potential losses; (iii) understanding the likelihood of potential losses; (iv) assigning significance of losses; and (v) appraising overall risk (Zsidisin et al., 2000). Naturally, the assessment can be formal or informal as well as quantitative or qualitative (Zsidisin et al., 2004). Examples of formal risk assessment categories from two IT companies can be seen in Table 3.2, while informal can vary from buyer to buyer without any formal direction from management within a company, as described by Zsidisin et al. (2000).

Table 3.2. Risk assessment categories (Adapted from Zsidisin et al., 2004, p.402-404)

Computer Manufacturing Company	**Cellular Phone Manufacturing Company**
1. Additional cost for cancellation due to lack of planning	1. Design
2. Additional cost for transport due to lack of planning	2. Cost
3. Additional cost for material obsolescence	3. Legal
4. Unexpected material price increase due to allocation	4. Availability
5. Unexpected material price increase due to yield problems	5. Manufacturability
6. Unexpected material price increase due to change of specification	6. Quality
7. Missing parts due to late deliveries	7. Supply Base
8. Missing parts due to supplier quality defects	8. Environmental, health & safety impacts
9. Missing parts due to instability in supplier's country	
10. Currency risk	
11. Contractual risk	
12. Investing in supplier improvement	
13. Additional costs due to single sourcing during ramp-up phase	

Regardless of how it is done, the outcome of the risk assessment process step should be a classification and prioritization of all identified risks (Kern et al., 2012; Fan and Stevenson, 2018). Illustrating time, place, likelihood, and impact of risks can facilitate this process according to Kern et al. (2012) and help the organization manage its limited funds (Fan and Stevenson, 2018). Moreover, understanding the inter-relationships and domino effect of risks in a SC is important when prioritizing the identified risks (Fan and Stevenson, 2018). Then the risks that sets of the domino effect can be mitigated and several risks can be mitigated at once (Fan and Stevenson, 2018). Finally, risk treatment can only be done properly if the assessment step has been done thoroughly so that the type of risk, its sources, and its possible impact is known (Kern et al., 2012).

3.3.3.1 Risk Assessment Tools

There are several different risk assessment tools, also referred to as techniques (Zsidisin et al., 2004), which organizations and researchers have developed e.g. risk matrix, comprehensive outsourcing risk evaluation (CORE) system and SCR assessment process (Hallikas et al., 2004; Norrman and Jansson, 2004; Zsidisin et al., 2004; Zsidisin et al., 2010). Zsidisin et al. (2010) argue that companies should implement and make use of formal risk assessment tools, which all individuals that are responsible for upstream supply flows should apply, in order to facilitate early discovery of risk and dissemination of supply risk knowledge.

3.3.3.1.1 Risk Matrix/Diagram

One common risk assessment tool found in research as well as applied in practice is the risk matrix or risk diagram (Hallikas et al., 2004; Norrman and Jansson, 2004; Ho et al., 2015; Fan and Stevenson, 2018). On a general level the risk matrix measures the probability of a risk to occur and the impact if it were to occur (Fan and Stevenson, 2018). Hallikas et al. (2004) suggest that the probability and impact should be measured separately on a five-class scale, see Table 3.3, and when assessed, the risks should be visualized in a risk diagram, see Figure 3.11, in order to get an overview as well as direct attention to the risk(s) which are high on both axes.

Table 3.3. Impact and Probability assessment scale. Source: (Hallikas et al., 2004, p.53)

Impact assessment scale			**Probability assessment scale**		
Rank	*Subjective estimate*	*Description*	*Rank*	*Subjective estimate*	*Description*
1	No impact	Insignificance in terms of the whole company	1	Very unlikely	Very rare event
2	Minor impact	Single small losses	2	Improbable	There is indirect evidence of event
3	Medium impact	Causes short-term difficulties	3	Moderate	There is direct evidence of event
4	Serious impact	Causes long-term difficulties	4	Probable	There is strong direct evidence of event
5	Catastrophic impact	Discontinue business	5	Very probable	Event recurs frequently

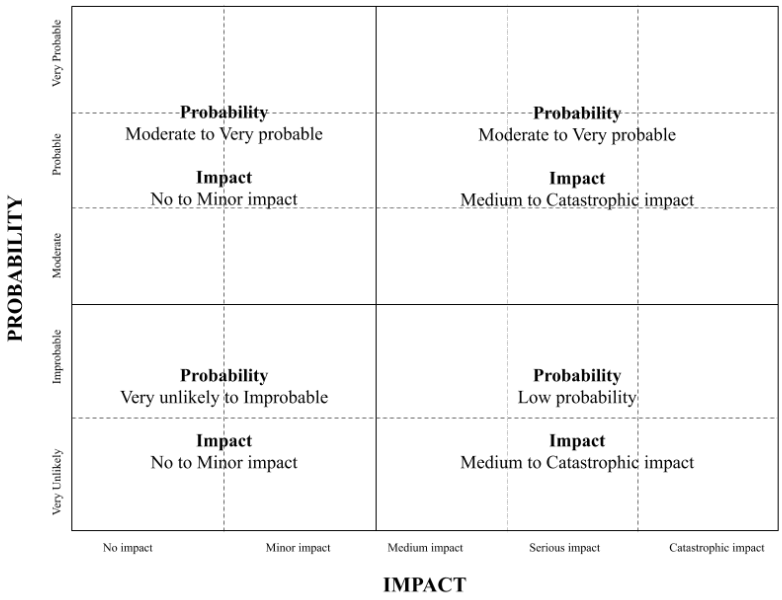


Figure 3.11. Risk Matrix (Based on: Hallikas et al., 2004, p.53)

By applying the suggested tool, the company could share information and knowledge throughout the SC regarding the risks as well as their probability and impact which enables the different parties to make as informed decisions as possible (Hallikas et al., 2004).

3.3.3.1.2 Ericsson Risk Assessment Tools

Norrman and Jansson (2004) display the risk assessment process at Ericsson, where the tool ERMET, see Figure 3.12, is utilized in order to evaluate both internal and external risks which may affect the organization. The focus of the assessment process are suppliers and critical sub-suppliers, but also internal focus in combination with contingency planning. Example areas of in-depth analysis are financials, natural and man-made hazards, employees and property protection (Norrman and Jansson, 2004). Ericsson tried to apply the evaluation measures impact and probability often suggested in research (e.g. Hallikas et al. 2004; Zsidisin et al., 2004; Xie et al., 2011), but found it difficult to apply due to the issues with assessing probability and translating impact in an understandable manner which led them to develop the concept business interruption value (BIV) (Norrman and Jansson, 2004). The BIV is calculated by multiplying gross margin with business recovery time (BRT), plus extra cost e.g. idle capacity, inventory holding and aims to incorporate goodwill (Norrman and Jansson, 2004). When calculated the BIV is sorted in four different categories depending on the value: (i) severe: higher than or equal to $100 million; (ii) major: equal to $50 million up to $100 million; (iii) minor: equal to $10 million up to $50 million; and (iv) negligible: lower than or equal to $10 million. More recently, Ericsson has added the parameters maximum tolarable outage and component's recovery time (Norrman and Wieland, 2020). Moreover, they use more sophisticated computer tools that are cross-functionally combined to build bridges between sourcing and other departments. The R&D department is also involved much earlier in the by e.g. assessing the SC risks when developing a product (Norrman and Wieland, 2020).

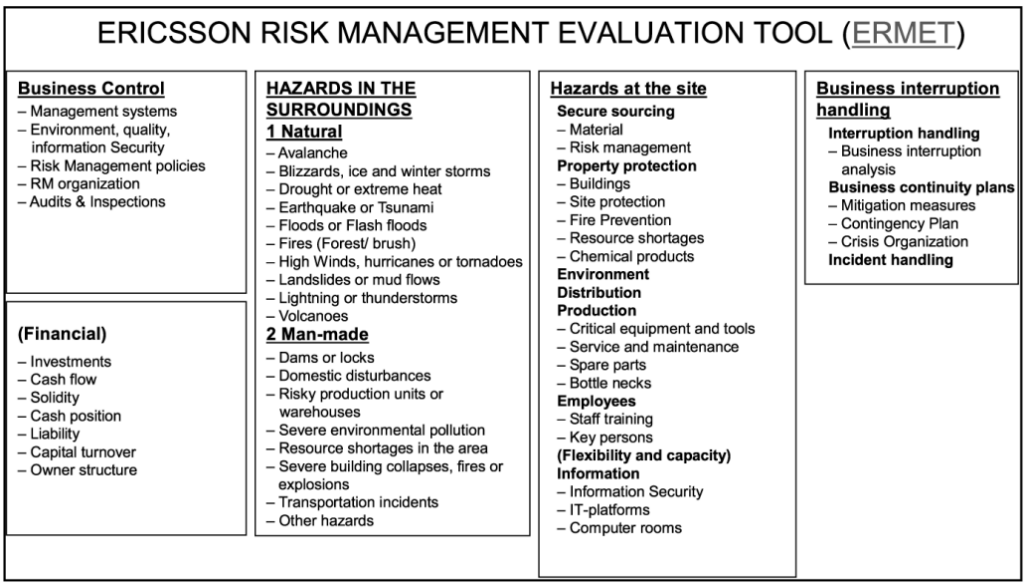


Figure 3.12. Overview of Ericsson's ERMET tool. (Source: Norrman and Jansson, p.446)

Another assessment tool called Ericsson's Blue, see Figure 3.13, mainly focused on assessing risk exposed sites, e.g. warehouses, supplier-hubs and EMSs, but also later supply flows, regarding activities related to e.g. distribution, configurations and postponement (Norrman and Wieland, 2020). Ahead of assessments Ericsson sends out self-assessment questions two months before the visits, and when at the site, specific issues and potential mitigations are discussed and lastly the score card would be compiled, rating from the color red (poor), to blue (excellent) (Norrman and Wieland, 2020).

Emergency Response and Crisis management	Σ 100	Blue Rating	Recommendation
1. Emergency Response	x	**	2015.1
2. Crisis Management	x	***	
3. Emergency response Management	x	**	2012.3
4. Incident Management	x	***	
Business Continuity Management	**Σ 50**		
5. Business Continuity Plan	x	***	
Loss Prevention	**Σ 303**		
6. Loss Prevention Organization	x	***	
7. Smoking	x	***	
8. Hot Work / Permit to Work	x	***	
9. Housekeeping	x	***	
10. Internal Loss Prevention Inspections	x	***	
11. Electrical installations	x	**	2012.5, 2015.2
12. Electrical appliances	x	***	
13. Lamps & Lighting	x	**	2015.3
14. Battery charging	x	**	2015.4
15. Maintenance/storage machineries, tools, fixtures, spare parts, etc.	x	***	
16. Heated Machineries	x	**	2015.5
17. Handling and storage of Flammables gases/chemicals	x	***	
18. Safeguards against sabotage risks	x	***	
19. Utilities	23	***	
Loss Control	**Σ 500**		
20. Building construction & site layout	x	0	2015.6
21. Fire separations	x	**	2012.8
22. Fire alarm systems	x	***	
23. Water sprinkler systems	x	*	2015.7, 2015.8, 2015.9
24. Fire Water Supply	x	*	2015.10
25. Special extinguishing systems	x		
26. Smoke evacuation systems	x	***	
27. Fire services & accessibility	x	*	2015.11
28. Manual Fire Fighting Equipment	x	**	2015.12
29. Natural Hazards – Earthquake & volcano	x	***	
30. Natural Hazards – Windstorm/ Tornado/ Hurricane	x	**	#
31. Natural Hazards – Rain / Hail / Snow/ Ice	x	*	#
32. Natural Hazards – Flooding	x	*	#
33. Natural Hazards – Lightning	x	***	
Miscellaneous risks	**Σ 50**		
34. IS/IT and test labs	x	***	
35. External hazards	x	***	
36. Other risks	x	***	

This site scores 843 points of total 1003 which equals 84,05%.

*** Blue - Excellent
** Green - Good
* Yellow - Insufficient
0 Red - Poor

Figure 3.13. The risk assessment tool Ericsson's Blue. (Source Norrman and Wieland, 2020, p.12)

3.3.3.1.3 Other tools

A part of Harland et al. (2003) supply network risk tool incorporates risk assessment, which is divided into five main categories: (i) likelihood of occurrence; (ii) stage in the life cycle where the risk is likely to be realized; (iii) exposure to risk; (iv) likely triggers of the risk; and (v) likely loss if the risk occurs. Further, Harland et al. (2003, p.54) argue that "Assessment of risk must involve the exposure and triggers to risk, and take into account intangible, non- regulated consequences and losses as well as clearly identifiable financial, tangible implications.".

Zsidisin et al. (2004) found, in their research, that companies utilize several different supply risk assessment tools. One of the case companies' supply risk assessment tool or process consisted of 13 categories that all were evaluated in an eleven-step process, see Figure 3.14. The risks connected to commodities were estimated on the impact on earnings before interest and taxes (EBIT) and then reported on a quarterly basis to the coordinator of the risk assessment (Zsidisin et al., 2004).

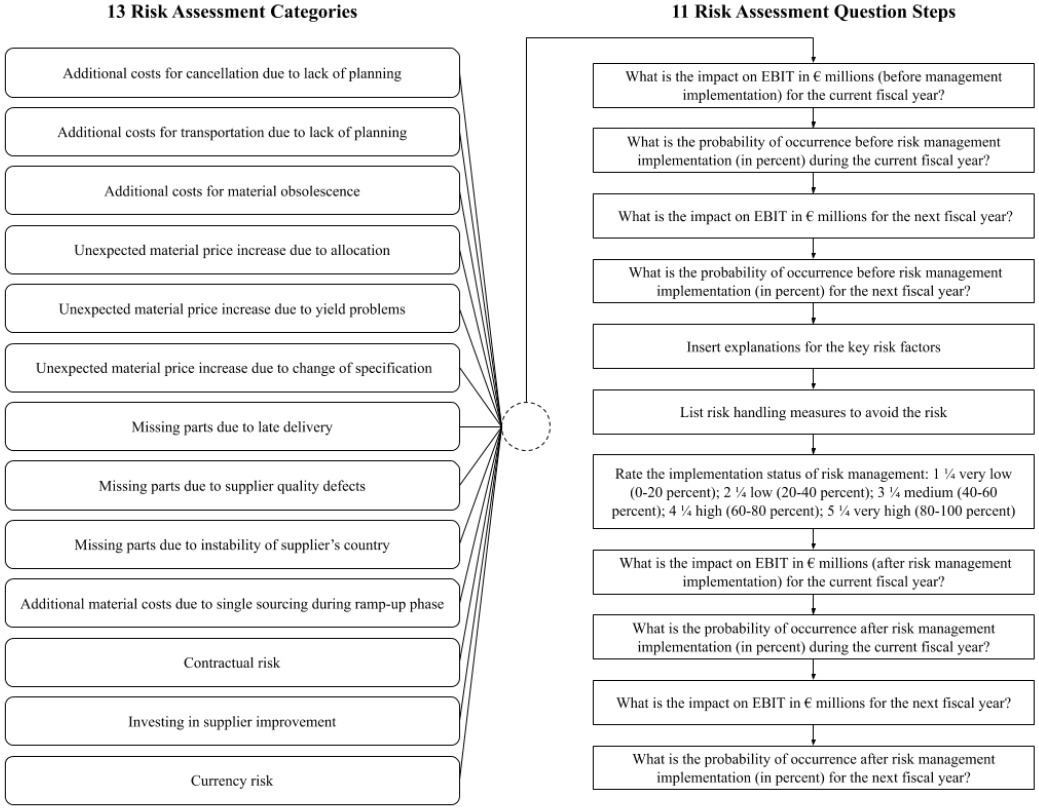


Figure 3.14. Example of supply risk assessment tool. (Based on: Zsidisin et al., 2004, p.402-403)

Companies utilize both qualitative and quantitative methods of assessing supply risk in businesses (Zsidisin et al., 2000). An example of a qualitative tool is the Delphi method which is an anonymous consensus-building tool and has been applied to various fields but has also successfully been applied to risk assessment (Linstone and Turoff, 1975). The Delphi method is based in anonymous contributions to a question which needs to be answered without face-to-face disruptions and is then summarized and evaluated by a coordinator which can identify what the group believes is the correct direction or decision and then communicate it (for more reading see e.g.: Linstone and Turoff, 1975; Gordon, 1994). In terms of practical application to risk assessment, Harland et al. (2003) argue that the implementation of the Delphi method should be a part of modern risk management. Xie et al. (2011) suggest that the Delphi method is valuable when assessing probabilities of risk when based on lacking information. According

to Zsidisin et al. (2000) engineered groups by applying e.g. the Delphi method will not only include the individual but affect the organizations action and by reaching group consensus it may lead to the best management of the risk.

There also exists more advanced quantitative mathematically based assessment tools e.g. Monte Carlo simulations or other simulation software (Kleindorfer and Saad, 2005; Xie et al., 2011). Furthermore, beyond academic and in-house developed tools, there exists software programs developed by private entities which assists organizations in their risk management with both identification, assessment, treatment and monitoring such as DHL's software resilience360 (DHL, 2020b).

3.3.4 Risk Treatment

The third step of the SRM process is risk treatment, which is to develop and choose suitable mitigation strategies for the identified and assessed risk (Norrman and Jansson, 2004). Depending on the situation, uncertainty and magnitude of the risk, different strategies are suitable and as companies have limited resources it is important to understand which strategy to deploy, which to change and which to wait with (Fan and Stevenson, 2018). The specific mitigation strategies will be discussed in chapter 3.4 Supply Risk Management Strategies.

How companies approach the risk treatment process can differ, but an example is Ericsson's process, described by Norrman and Jansson (2004, p.449) as *"templates start with describing the risk source and its probability and consequence, and continue with a summary of different mitigations strategies, their costs and how they affect the risk situation. To compare the cost of different preventive actions with the business interruption value is regarded as very important. Finally, responsible persons are appointed"*. Fan and Stevenson (2018) argue that the research on the effectiveness of the different strategies and when as well as how to select the strategies are scarce. On the topic of effectiveness, few to none were identified, but research touching upon how and when to select strategies has been identified.

3.3.4.1 Choosing Strategy

The decision-making of risk strategies is complex as it is affected by many factors e.g. technical, political, social, as well as economical and therefore needs full commitment and participation of all concerned parties (Mullai, 2009). But, even if it is complex, the selection of a suitable and correct strategy is vital, as argued by Kern et al. (2012, p.66) "*...only suitable and well-executed risk mitigation activities can directly contribute to risk performance in the form of lower probabilities for specific risks or a reduced impact of occurred risks affecting the supply chain*".

Additionally, an important aspect to consider when developing SRM strategies is that they should be aligned with not only functional and corporate goals, but also with the global SC strategy (Jüttner, 2005; Manuj 2013). To enable the selection of effective mitigation strategies for supply risk, companies must first identify and understand the different risks which they face both as individual risks, but perhaps even more important as an interconnected system of risks (Chopra and Sodhi, 2004). The selection of the correct risk management strategy is also emphasized by Manuj and Mentzer (2008) who suggests three different factors which influence the choice of SCRM strategy and must be accounted for:

i. **Temporal focus:** The temporal focus is the long- or short-term focus of the company where a short-term focus often implies lower risk management and a higher focus on strategies which

generates fast returns of value. The long-term focus is more linked to SCRM due to the continuous improvement aspect and development of e.g. supplier relationships.

ii. **Supply chain flexibility:** The flexibility of the SC is connected to the company's ability to react and adapt to uncertainties e.g. changes in supply. Hence, a flexible SC can perform its decisions and reallocate resources quicker than their counterparts which is desirable in an environment with high uncertainty and supply risk.

iii. **Supply chain environment:** The SC environment can be predominantly high or low in risk, both for supply and demand. Therefore, when it comes to selecting appropriate mitigation strategy(s), the company should try to achieve a fit between the selected strategy(s) and the risk levels of its SC environment.

Manuj and Mentzer (2008) also argue that the team composition in the company affects the relationship between the antecedents and the selected strategy(s). A visualization of the mitigation strategy selection and its context can be seen in Figure 3.15.

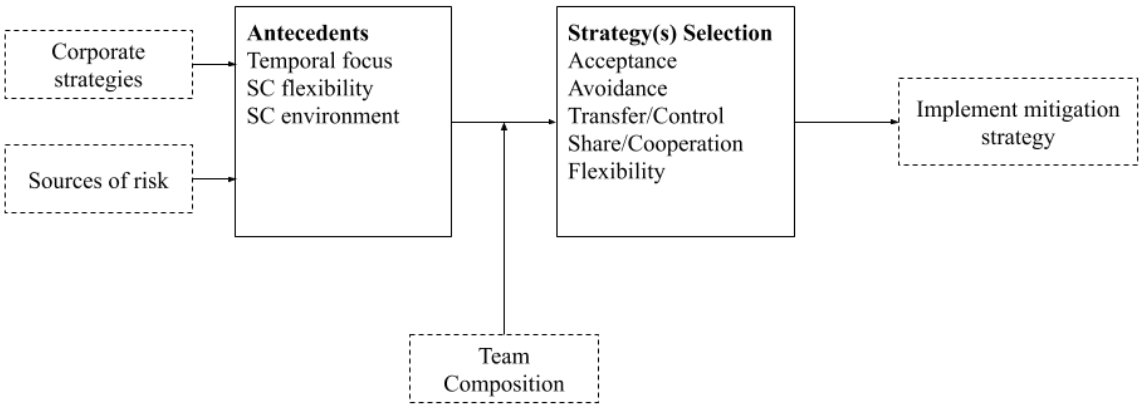


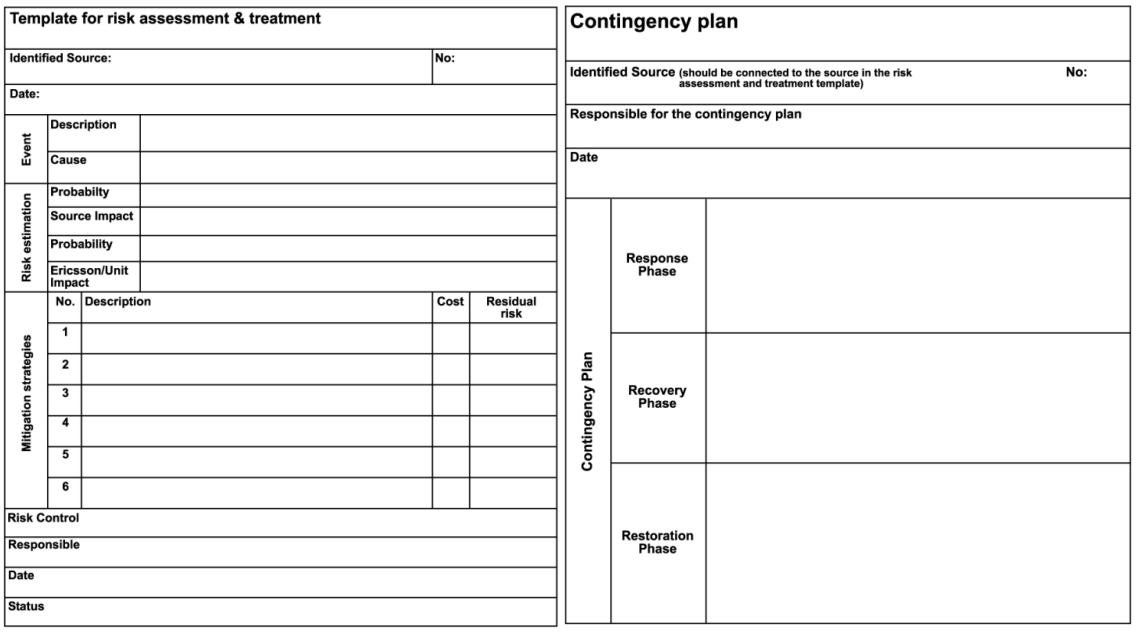
Figure 3.15. Simplified process of mitigation strategy selection (Based on: Manuj and Mentzer, 2008, p.202)

Christopher et al. (2011) suggests the implementation of four broad mitigation strategies in order to proactively reduce the global sourcing risk: (i) network re-engineering; (ii) collaboration between global sourcing parties; (iii) agility; and (iv) creating a global risk management culture. To be noted is that many companies implement mitigation strategies for recurring, low-impact disruptions but neglect the low-probability, high-impact events (Chopra and Sodhi, 2004).

3.3.5 Risk Monitoring

As risk is not a static phenomenon, companies should always continuously monitor the status of the chosen mitigation strategy(s) and its related risk(s) as the risk may change in nature and hence would need a different mitigation approach (Fan and Stevenson, 2018). Continuous risk monitoring also acts as a safeguard towards new risk and, if properly executed, will alert companies at an early stage which enables better risk management (Hoffman et al., 2013). One practical and formal risk monitoring example was identified from Ericsson, where monitoring is required when the risk-level is considered high or very high and not mitigated which continues until the risk-level is lowered to an acceptable level (Norrman and Jansson, 2004). This was also formalized in documentation, see Figure 3.16, and

internally monitored in terms of who was responsible and how the SC partners followed up on their commitments (Norrman and Jansson, 2004).



Template for risk assessment & treatment

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

Contingency plan

Identified Source (should be connected to the source in the risk assessment and treatment template)		No:
Responsible for the contingency plan		
Date		
Contingency Plan	Response Phase	
	Recovery Phase	
	Restoration Phase	

Figure 3.16. Documentation from Ericsson's risk management process (Source: Norrman and Jansson, 2004, p.448)

Another aspect of risk monitoring is to evaluate and review the performance of the selected mitigation strategies, which Ericsson incorporated in a review in their "Ericsson's Catergory Risk Review Template", see Figure 3.17. (Norrman and Wieland, 2020). The review was at first performed on a quarterly basis and then later a bi-annual basis. Both the strategic and cross-functional aspects are considered, hence analyzing both the implementation and the development of the risk management in Ericsson's sourcing categories (Norrman and Wieland, 2020). The different areas which are analyzed for the sourcing categories are: (i) getting the right supplier; (ii) having the right product, components and services; (iii) having contractual protection; and (iv) developing a robust supply (Norrman and Wieland, 2020). For the development of mitigation strategies Ericsson analyzed areas such as: (i) shortening the suppliers component recovery time; and (ii) developing dual sourcing, which led to increased structured and proactive risk management (Norrman and Wieland, 2020). Even though risk monitoring is identified as an important step of the risk management process, the research on the topic and especially risk monitoring processes and tools are scarce (Blackhurst et al., 2008; Ho et al., 2015; Fan and Stevenson, 2018).

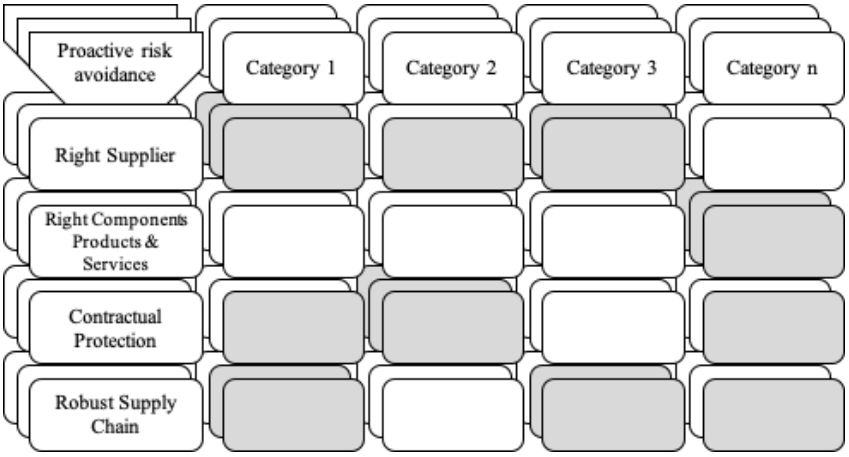


Figure 3.17. Ericsson's Category Risk Review Template
(Source: Norrman and Wieland, 2020, p.10)

3.4 Supply Risk Management Strategies

The literature and research on SCRM and hence SRM strategies have rapidly increased and developed since the 2000s (Fan and Stevenson, 2018). Consequently, the research covers many subtopics and areas within risk mitigation for supply risks, proposing several different strategies depending on the business context. Jüttner (2005) proposes six different SC strategies trends which have risk implications, based in the contemporary research as well as business practice: (i) the globalization of SCs; (ii) reduction of inventory holding; (iii) centralized distribution; (iv) reduction of the supplier base; (v) outsourcing; and (vi) centralized production. Therefore, valid and relevant SRM strategies are needed (Jüttner et al., 2003; Chopra and Sodhi, 2014)

Firstly, a definition of the concept risk mitigation strategy should be provided, "Risk-mitigating strategies on the other hand, are those strategic moves organizations deliberately undertake to mitigate the uncertainties identified from the various risk sources" (Jüttner et al., 2003, p.200). Secondly, in order to provide a theoretical baseline for this chapter, an overview of the different mitigation strategies from the literature review are provided, see Table 3.4.

To be noted is that the SRM strategies can be viewed as both mitigation strategies where actions are taken proactively, but also contingency strategies where actions are taken in connection to a disruptive event (Tomlin, 2006). Other researchers often refer to this as reactive or proactive strategies (e.g. Smeltzer and Siferd, 1998; Norrman and Jansson, 2004; Hoffman et al., 2013).

Table 3.4. The SRM strategies in the identified literature.

Author	Avoidance	Acceptance	Buffering/Safety stock	Insurance	Contract and agreements	Supplier development	Information sharing/ Transparancy	Postponement	Multiple sourcing	Localized sourcing	Standardization of components
Miller (1992)	x			x							
Dorfman (1998)				x							
Li and Kouvelis (1999)					x						
Lonsdale (1999)					x				x		
Zsidisin et al. (2000)			x		x	x	x		x		
Jüttner et al. (2003)	x		x		x		x	x	x	x	
Zsidisin (2003b)						x				x	
Banks (2004)				x							
Chopra and Sodhi (2004)		x	x				x		x	x	
Giunipero and Aly Eltantawy (2004)			x			x	x				
Norrman and Jansson (2004)			x	x	x	x	x				
Wagner and Johnson (2004)						x	x				
Yang et al. (2004)		x						x		x	x
Kleindorfer and Saad (2005)	x				x		x				
Handfield et al. (2006)					x	x	x				
Tomlin (2006)		x	x								
Boone et al. (2007)								x			
He and Zhang (2008)					x						
Manuj and Mentzer (2008)	x				x			x	x	x	
Blome and Henke (2009)											
Matook et al. (2009)						x	x				
Yang and Yang (2010)								x			x
Manuj (2013)							x		x	x	x
Christopher et al. (2011)										x	
Walkolbinger and Cruz (2011)					x		x				
Xie et al. (2011)		x									
Chopra and Sodhi (2014)		x	x							x	
Silbermayr and Minner (2014)									x		
Ho et al. (2015)						x	x		x	x	
Hajmohammad and Vachon (2016)	x	x			x	x					
Fan and Stevenson (2018)	x	x			x	x	x			x	

3.4.1 Avoidance

Risk avoidance is often connected to a specific location, product or supplier which the focal company drops in order to avoid the potential negative impact and reduce the probability of risk to zero (Miller, 1992; Jüttner et al., 2003; Hajmohammad and Vachon, 2016; Fan and Stevenson 2018). Manuj and Mentzer (2008) refers to this avoidance strategy as "Type 1", which is for companies to not accept operations considering a product or in a geographical market as well as with suppliers or customers. If operations are active in an unwanted market, contracts can be terminated as a way of avoiding the risk (Hajmohammad and Vachon, 2016). However, Manuj and Mentzer (2008) also suggest a "Type 2" strategy, which is reducing the frequency and probability of risk events, e.g. offshoring quality issues which are followed by thorough supplier and production audits and approval. Hence, the different strategies are applicable for different scenarios where Type 1 is completely avoiding risk events if possible and Type 2 is when risk markets or partnerships cannot be excluded but is avoided as much as possible through proactive engagements (Manuj and Mentzer, 2008). According to Kleindorfer and Saad (2005), to avoid risk is always preferable than to mitigate after the fact that a risk event has occurred and conclude that avoidance should proceed prevention.

3.4.2 Acceptance

Companies are not always able or willing to mitigate identified risks as the level of risk acceptance often is context-based (Fan and Stevenson, 2018) and could be linked to e.g financial situation, strategic direction or that the risk is at an acceptable level in accordance with the organizational risk taking. The risk acceptance can also be passive, i.e. knowingly choosing not to do something, which often is the default approach for companies, even if it is not appropriate (Tomlin, 2006). However, since mitigation strategies are not free Tomlin (2006) points out that passive risk acceptance although can be appropriate for some risks. Hajmohammad and Vachon (2016) identified that companies, when applying the acceptance strategy, perform damage control through budgeting for the expected cost associated with an accepted risk. Furthermore, acceptance of risk also originates from the fact that many managers are reluctant to invest in SRM as it affects the cost efficiency of the company and that supply risks often are considered beyond their reach (Chopra and Sodhi, 2014). However, companies should always identify the level of risk, which is accepted in relation to risk probability, impact as well as trade-offs such as cost efficiency (Chopra and Sodhi, 2004; Yang et al., 2004). Xie et al. (2011) suggest that the level of risk acceptance should be anchored in cross-functional teams with senior management included, in order to either establish which magnitude of risk that is unacceptable, tolerable or acceptable, see Figure 3.17.

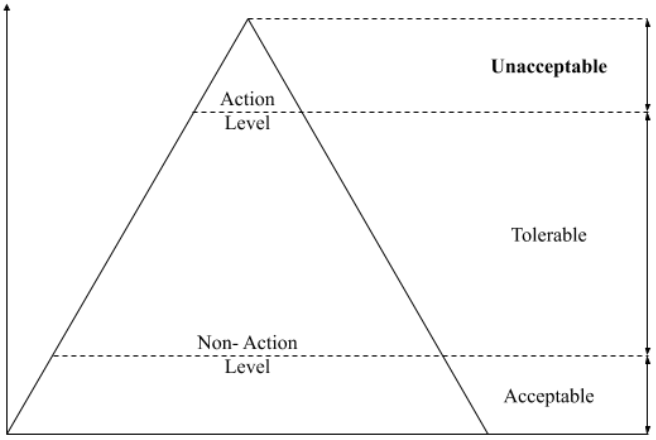


Figure 3.18. Risk magnitude and acceptance. (Based on Xie et al. 2011, p.479)

3.4.3 Buffering/Safety stock

The mitigation strategy of increasing inventory is often performed in order to prevent stock-outs of important components or products in case of disruptive events at e.g. suppliers (Zsidisin et al., 2000; Chopra and Sodhi, 2004; Chopra and Sodhi, 2014). Inventory mitigation can both be performed continuously, always carrying excessive stock to mitigate potential future disruptions, or momentarily keeping extra inventory based on key information regarding future disruption, e.g. labor strikes or political turmoil (Tomlin, 2006). The first approach of continuously keeping extra safety stock as a means of mitigating risk is deemed as a non-attractive option due to the extra cost and lowered efficiency without knowing when disruption might occur (Chopra and Sodhi, 2004; Giunipero and Aly Eltantawy, 2004; Tomlin 2006; Chopra and Sodhi, 2014). Further, Chopra and Sodhi (2014) argue that e.g. pooling inventory could be useful for recurrent risk but making the SC more vulnerable to disruptive risk. However, strategic stockpiling in connection with proper risk awareness, i.e. increased safety stock based on robust information and analysis, is a commonly used approach in practice and transferring risk by transferring inventory (Jüttner et al., 2003; Norrman and Jansson, 2004). Chopra and Sodhi (2004) suggest three different factors when selecting risk mitigating inventory strategy: (i) the value of the product(s); (ii) the products rate of obsolescence; and (iii) uncertainty of demand and supply, where e.g. low-value commodity products are suited for buffering while keeping high inventory of high-value products gets very expensive. Further, Chopra and Sodhi (2004) also suggest, as a mitigation approach, that predictable and lower-value products should be in a decentralized location while unpredictable and higher-value products should be in a centralized location.

3.4.4 Insurances

The insurance market acts as transfer of risk, where the risk exposure is moved from the focal company to the insurance company, for which the focal firm pays a premium (Miller 1992; Banks, 2004). A company can select full insurance which covers the total exposure of a risk, hence the whole potential monetary loss, or partial insurance where the company only transfers a part of the risk, therefore only covering a part of the potential monetary loss (Banks, 2004). In order to select appropriate insurances the SC should be mapped, both in terms of potential risk sources but also the financial value of the objects a firm wishes to insure and what the value of interruption or loss would be (Dorfman, 1998). To be noted is that proper risk management, with thorough identification, assessments, mitigation, monitoring and documentation, can potentially lower the premium cost as well as simplify the insurance claim process in the event of a disruption (Norrman and Jansson, 2004).

3.4.5 Contract and agreements

Contracts between suppliers and a focal firm can and are often used in order to mitigate, share or transfer different forms of supply chain risks (Manuj and Mentzer, 2008; Walkolbinger and Cruz, 2011; Fan and Stevenson, 2018). But contracts can also be used as a tool, more than what is included in the contract, for lowering risk as e.g. Zsidisin et al. (2000) found that companies secured supply by setting up contracts with back-up suppliers. When it comes to the contract, there are many different types of risk sharing areas, e.g. over or under production, price uncertainty and quality, where the contracts acts as an formal agreement of how and when risk should be shared between the supplier and the focal firm (Li and Kouvelis, 1999; He and Zhang, 2008; Walkolbinger and Cruz, 2011). The inclusion of risk sharing in contracts, often related to suppliers or outsourcing environments, has been proven to increase the SC performance and decrease the impact of disruption on the SC (Walkolbinger and Cruz, 2011). Another aspect, as a means of mitigating risk for the focal firm, is to impose contractual obligations on the supplier with potential penalties (Jüttner et al., 2003; Kleindorfer and Saad, 2005). Another aspect

of contracts and agreements is if risk is integrated in the contract, besides explicit risk sharing contracts. In their research, Norrman and Jansson (2004, p.451) display how Ericsson expanded their risk management from the focal firm to incorporate the upstream SC by including risk related requirements in their supplier contracts e.g.:

- the supplier shall report incidents
- the supplier shall actively work with risk management with its contractors and suppliers
- the supplier shall establish and maintain a secure sourcing plan including regularly updated business continuity and business contingency plans.

Lonsdale (1999) argue, besides the importance of risk sharing contracts, that the pre-contractual phase is critical where an organization should be risk aware, e.g. managing dependency risk by making sure that the supplier uses the firm's equipment and produces its design in order to reduce potential switching cost. Additionally, the frequency of renegotiations can also be of importance, especially in innovative industries with e.g. rapid changes in technologies and prices (Handfield et al., 2006).

3.4.6 Supplier development

Supplier development can be defined as "any activity that a buyer undertakes to improve a supplier's performance and/or capabilities to meet the buyer's short-term or long-term supply needs." (Handfield et al., 2006, p.37-38). In relation to supply risk, supplier development can be used in order to mitigate e.g. quality issues, capacity issues or technology issues, and not only proactively reduce the risks but also perhaps gain an advantage with a better supplier base (Zsidisin et al., 2000; Zsidisin, 2003b; Wagner and Johnson, 2004; Matook et al., 2009). Giunipero and Aly Eltantawy (2004) argue that today's complex and global SCs have led companies to adopt more towards developing long-term relationships with key suppliers.

Handfield et al. (2006) suggest the use of a tool, see Figure 3.18, to choose the suppliers in which to engage in supplier development, as it often is a process which requires a lot of resources, e.g. financial, time and personnel. It does not only take commitment from the buyer, but also the supplier to achieve a successful development project, and as it creates expected outcomes as well as that it should be justified from both sides, a supplier development engagement needs to be monitored and controlled (Matook et al., 2009). To be noted is that extensive supplier development is not always the correct solution, and the option of engaging in supplier development should be carefully considered (Zsidisin, 2003b) and there are other options such as switching supplier or bringing back outsourced activities in-house (Handfield et al., 2006). The tool in Figure 3.18 is similar to one very commonly used tool called Kraljic's Matrix which has a larger focus on the product portfolio and can be found in chapter 3.2.3.2, see Figure 3.2.

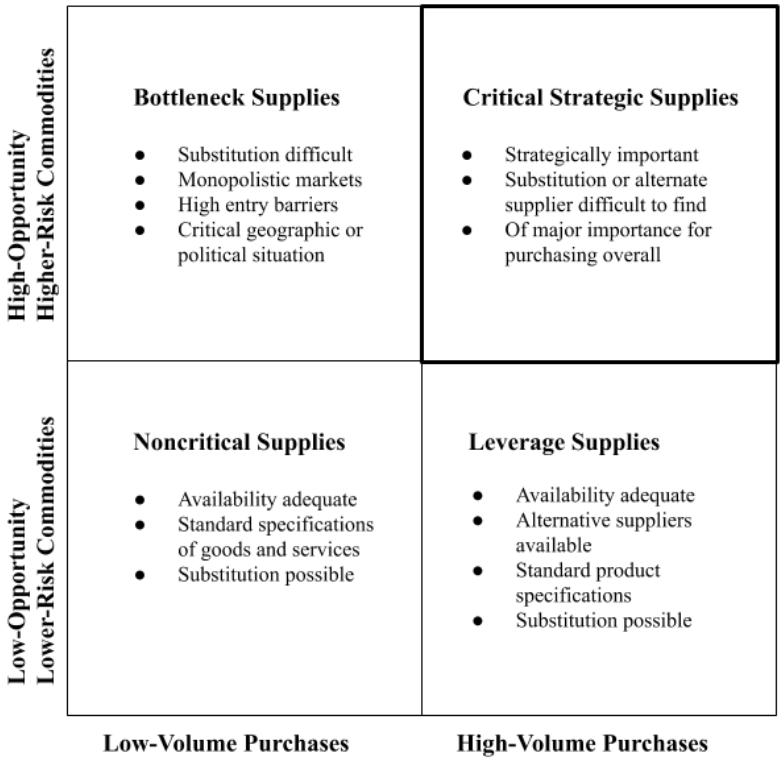


Figure 3.19. The Commodity Portfolio Matrix.
(Source: Handfield et al., 2006, p.39)

3.4.7 Information Sharing/Transparency

The strategy of increasing information sharing and transparency between suppliers and buyers in the SC acts as a form of mitigation as it promotes joint problem solving, implementation of best practice and supports identification as well as assessment of risk (Zsidisin et al., 2000; Wakolbinger and Cruz, 2011). If seamless information sharing is achieved, regardless of organizations or other barriers, risk can be properly identified, quantified and assessed which enables proactive risk management and mutual benefits (Matook et al., 2009; Manuj, 2013). It is important that all parts are aware of the exposure towards risk and understand what the identified risks imply which is not possible if the information is not shared (Jüttner et al., 2003; Chopra and Sodhi, 2004). Furthermore, as suggested by Wagner and Johnson (2004), good supplier relationships are characterized by mutual information sharing and transparency. However, sharing vulnerable information to a supplier or buyer is difficult where parties may have incentives to hold back that type of information due to e.g. fear of losing negotiation power, losing contracts or taking advantage of the information (Zsidisin et al., 2000; Giunipero and Eltantawy, 2004; Kleindorfer and Saad, 2005; Handfield et al., 2006). Deliberately holding back information from parties in the SC complicates successful incorporation of risk in decision-making which is an unwanted attribute in risk management (Manuj, 2013).

3.4.8 Postponement

The strategy of postponement often involves companies delaying decisions related to e.g. configuration, manufacturing, designing, labeling or distributing products in order to gain flexibility and make decisions based on better as well as more information (Jüttner et al., 2003; Manuj and Mentzer, 2008). By delaying e.g., the final product, companies are more able to handle sudden disruptions and change their operations at the last minute in order to get on top of the event (Yang and Yang, 2010). This was

exemplified when Nokia was able to change their chip supplier after a disruption at their main supplier which was enabled due to that the final customization stage was postponed (Yang and Yang, 2010).

Yang et al. (2004) identified four main postponement strategies, see Figure 3.19, of which companies may wish to implement. Boone et al. (2007) added two postponement strategies to the ones suggested by Yang et al. in their research: (i) price; and (ii) product design postponement, and argue that different type of SCs, i.e. high/low demand or supply uncertainty, match with different postponement strategies.

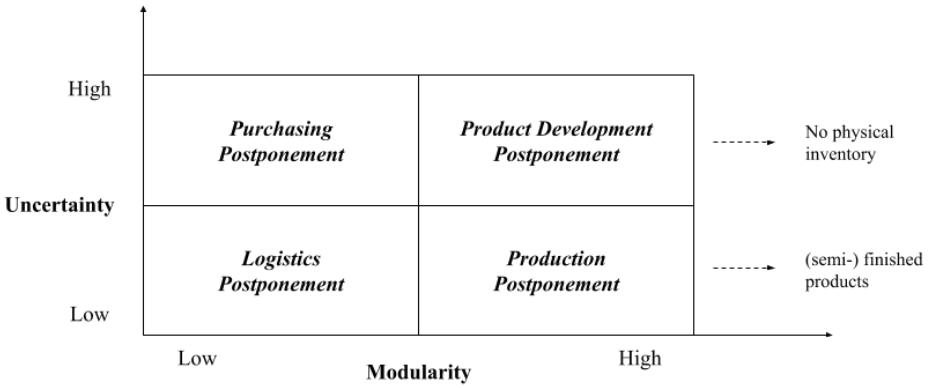


Figure 3.20. Model for the management of uncertainty through postponement (Source: Yang et al., 2004, p.1053)

Researchers and practitioners has seen the increase and success of postponement for several decades (Yang et al., 2004; Boone et al., 2007; Manuj and Mentzer, 2008; Yang and Yang, 2010), and as argued by Yang et al. (2004, p.1052) "the benefits of postponement include saving transportation, assorting, storage and obsolescence costs by delaying a product's variety, volume, weight and/or value increases, and, more importantly, final configuration". However, the implementation of postponement strategies is often connected with large financial investments and can be quite complex in a global SC setting due to e.g. the long distances, transportation options as well as delays (Manuj and Mentzer, 2008).

3.4.9 Single or Multiple sourcing

Single and multiple sourcing both have positive and negative implications on supply risk, depending on e.g. the strategic importance for the supplier as well as the buyer (Manuj and Mentzer, 2008; Blome and Henke, 2009). On one side, by having multiple sources, companies limit the risks associated with being dependent on one single supplier e.g. price fluctuations, capacity issues and macro disruptions (Miller, 1992; Jüttner et al., 2003; Manuj and Mentzer, 2008; Silbermayr and Minner, 2014). Multiple sourcing also increases the capacity of the SC because the focal firm has more than one supplier which can offer extra capacity if needed (Zsidisin et al., 2000). On the other side, multiple sourcing also increases the risk of the buyer not being of highest priority at the suppliers since the demand is spread out on several suppliers (Blome and Henke, 2009). Multiple sourcing also requires higher investments (Manuj and Mentzer, 2008). But, there are also several risks with single sourcing, e.g. the disruption event at Philip's plant which caused Ericsson a $400 million loss due to single sourcing while Nokia handled it well due to multiple sourcing (Silbermayr and Minner, 2014). However, the upside is that single sourcing enables long-term supplier relationship commitments and the risk mitigation capabilities within the partnership also increases (Blome and Henke, 2009). The single and multiple sourcing can also be divided in relation to volumes, an example is Motorola which successfully had multiple suppliers for high-volume products and single supplier for low-volume products (Chopra and Sodhi, 2004). In terms of which is best according to researchers, Ho et al. (2015) based in their literature

review, argue that dual sourcing outperforms single sourcing in the presence of disruption but that the benefits of multiple sourcing was not significant.

A different approach, a mix of single and multiple sourcing related to both products and capabilities, are displayed by Lonsdale (1999, p.182) when analyzing HP's policies: "This dual sourcing is not dual sourcing of the same components, however. HP's policy is that they dual source types of technological capability. Therefore, products are single sourced, but a capability is retained elsewhere so HP can swap suppliers in a relatively short period of time and with limited disruption and cost".

In terms of tools, Blome and Henke (2009) suggests the use of their "Matrix of Dependency", see Figure 3.20, in order to map the level of dependency between suppliers and buyers. Companies should aim for mutual dependency for strategic services or items and can settle with low, but still somewhat mutual, dependency in terms of commodity services or items (Blome and Henke, 2009).

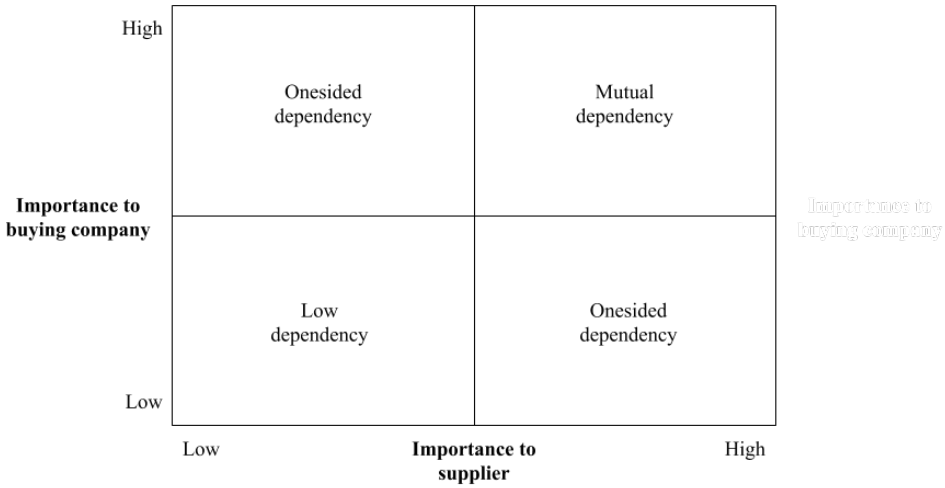


Figure 3.21. Matrix of Dependency
(Source: Blome and Henke, 2009, p.131)

3.4.10 Localized sourcing

Sourcing is not only to be analyzed in the perspective of how many suppliers that are utilized but also the geographical location of the suppliers which can be divided into two different categories: (i) local sourcing; and (ii) global sourcing (Christopher et al., 2011). Jüttner et al. (2003) suggests that localized sourcing, but with a small percentage of the total demand, could be used as a mitigation strategy in order to get quick access to important products in case of disruption at main suppliers while also cutting lead times and distance. Yang et al. (2004) found that having very regional suppliers were used by many manufacturing companies, e.g. Toyota and Honda, in order to achieve stable and reliable supply. Manuj (2013) found that companies move towards more regional sourcing in order to acquire better knowledge and understanding of the risks which their SC were facing instead of having a globally dispersed sourcing. However, as displayed by the billion-dollar loss in sales in the Toyota case, becoming regionally based can be devastating. Toyota sourced one important part which was used in almost all of their cars in one region in Japan which were heavily disrupted by the tsunami in 2011 resulting in production all over the globe to almost stop (Chopra and Sodhi, 2014). The other aspect, global sourcing, can be beneficial due to that companies get access to e.g. knowledge, markets and capacity but can face increased risk due to e.g. currency fluctuations and long transit time (Zsidisin, 2003b; Chopra and Sodhi, 2004; Manuj and Mentzer, 2008).

3.4.11 Standardization of components

The product design is often connected to companies' ability to provide accurate forecasts, keeping control and cost management where standardization and lowered customization favors these aspects (Manuj, 2013). When standardizing components and achieving a higher level of modularity it also enables easier postponement of final assembly, increases the flexibility and the ability to handle risks and sudden disruptions to a SC (Yang et al., 2004; Yang and Yang, 2010). However, there is always a trade-off in terms of e.g. the offering towards customers, sales and innovation which could be limited by standardization and modularization, but some level of standardization in companies with global SCs should be considered (Manuj, 2013).

3.5 Conceptual Framework for SRM

Based on the presented theory the authors of this thesis have created a conceptual theoretical framework, see Figure 3.22, that will be used in bridging the empirical data with the theoretical. The framework will also support the process of creating a solution for Axis. The model is built upon the four major steps in the risk management process: (i) risk identification; (ii) risk assessment; (iii) risk treatment; and (iv) risk monitoring, in combination with identified tools and SRM strategies in the literature. This is complemented with the sources of risk as well as the governance and organizational aspects.

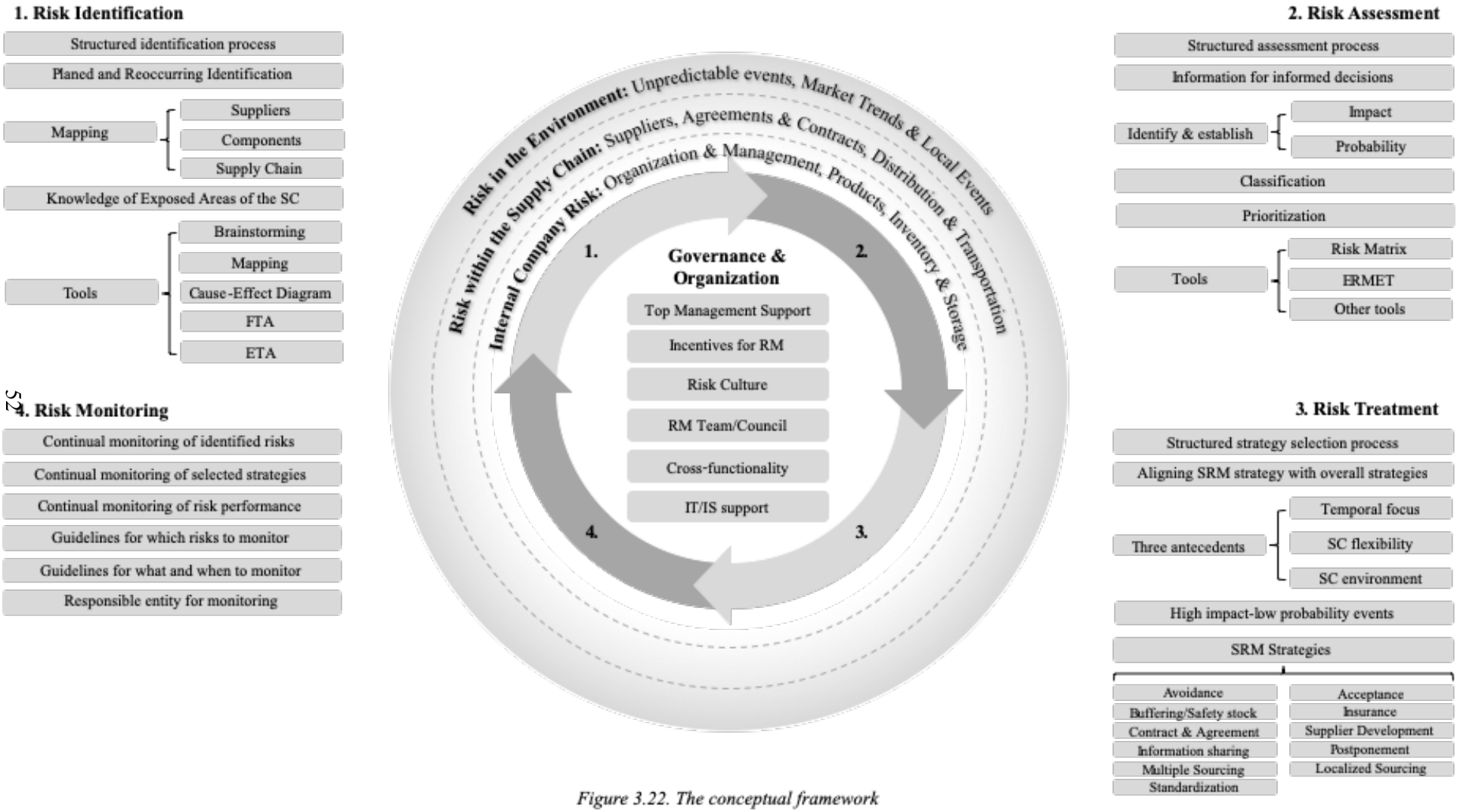


Figure 3.22. The conceptual framework

4 Empirical Data

In this chapter, the empirical data which has been gathered will be presented. Firstly, the sourcing department in general as well as it organizational structure. Secondly the sources of risks which the sourcing department faces. Thirdly, the organizational structure and governance with a focus on SRM will be accounted for. Lastly, the informal proactive SRM process will be presented which includes sub-chapters of the four main steps of a RM process; (i) identification; (ii) assessment; (iii) treatment; and (iv) monitoring.

4.1 Sourcing at Axis in General

Axis' global SC can on an overall level be broken down into five parts: Plan, Source, Make, Deliver, and Reverse. The first part, Plan, deals with forecasting the customer demand and planning. Source is the part of the process that sources products and components from EMSs and suppliers. Make takes place in at the CLCs. Deliver is the deliverance from CLCs to the distributors that are Axis' customers. Finally, reverse is the return of Axis products for e.g. return, repair or scrap. The forward flow of goods is illustrated in Figure 4.1.

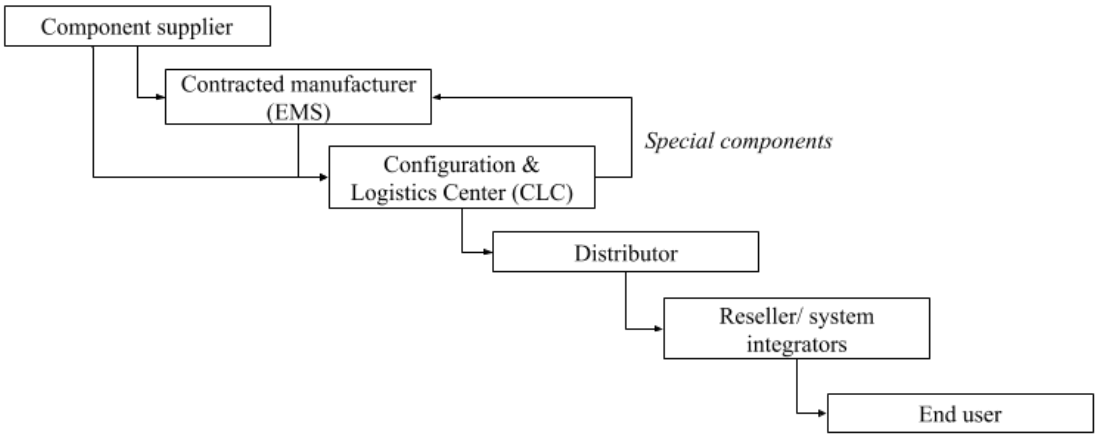


Figure 4.1. The forward flow of goods in Axis SC.

Axis' sourcing department's area of responsibility is from the component suppliers up until the goods enter the CLCs. The department's main task is to make sure that Axis has the right supplier base now as well as in the future. Additionally, the sourcing department establish purchasing agreements, price, terms, and call-off agreements with the component suppliers and the EMSs. It is later the supply department at Axis and the EMSs that call-off from these agreements and not the sourcing department. However, because the sourcing department has a long-term mindset, they are the ones that find new suppliers, develop existing ones, and maintain relationships. This is illustrated in Axis' own general workflow process for the sourcing department, see Figure 4.2 and as can be seen, RM is not included in this process. However risk is included in the mission of the sourcing department, which in Axis' own words are: "*By providing optimal supplier base we assure total supply chain costs are minimized, quality standards are maintained, minimizing risks and service level to R&D remain high to be able to meet Axis time to market requirements. We shall always use our Core Values as our guideline both internally and externally in our approach*".

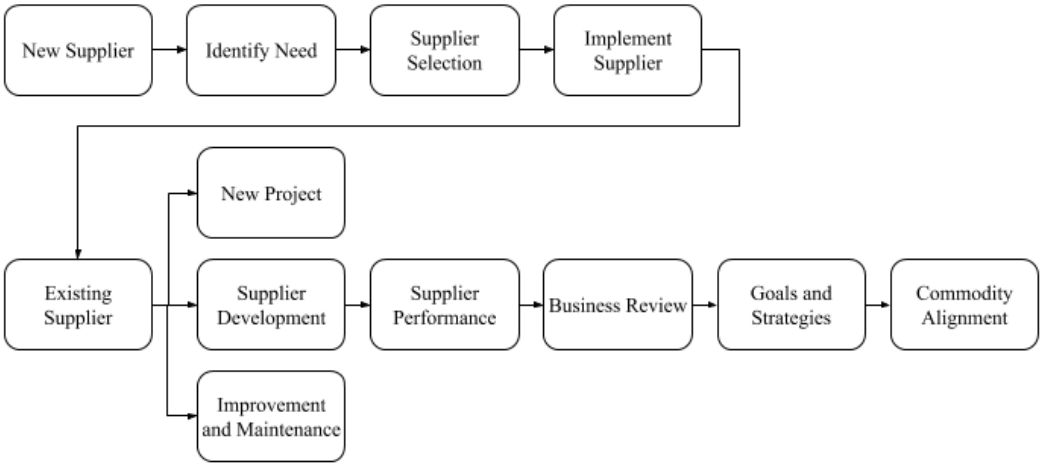


Figure 4.2. Axis' Sourcing Process.

4.1.1 Axis' Suppliers and Partnership

Axis has many different suppliers of varying size and located around the world. The suppliers are divided into different categories, see Figure 4.3, depending on which products or technology they have, if they handle critical components, and how important they are to Axis in relation to revenue. In terms of Axis' EMSs, they manufacturer all Axis' products and are responsible for sourcing some of the standard-components. Due to the level of outsourcing that Axis has in terms of manufacturing, storage, and distribution, long-term relationships with suppliers and EMSs are considered as very critical. Further, Axis recently has increased the scope of inhouse standard components e.g. standard electronics components, in order to regain more control. A more detailed description of the partnership levels including: (i) category purpose; (ii) category management structure; (iii) supplier performance; (iv) capabilities; and (v) financial requirements, can be found in Appendix 5.

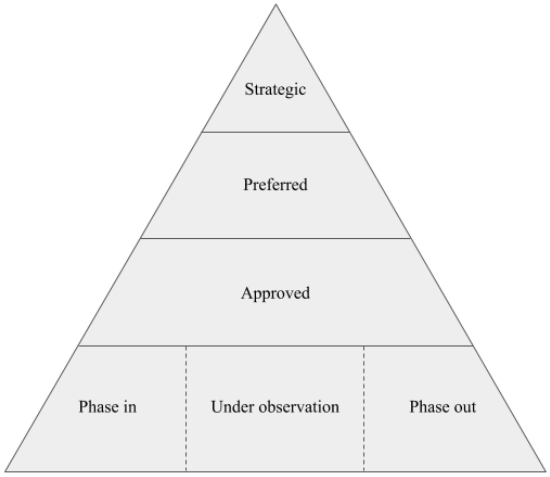


Figure 4.3. Axis' partnership level.

Even if Axis establishes and has strong relationships, especially with strategic suppliers, they have a policy regarding the level of turnover of which Axis can represent at a supplier. The revenue that Axis brings should not exceed a given percentage due to the supplier becoming reliant on the business which Axis stands for. Furthermore, there is also a percentage of which Axis should not go below in terms of representative turnover at a supplier since they want to stay relevant to the supplier. The policy also includes the percentage of the total commodity spend of which a supplier should represent, and this should not go above a certain percentage due to Axis becoming too reliant on the specific supplier. The

main goal of this policy is to keep or enable healthy, mutually beneficial and long-lasting relationships with the suppliers. This policy will from here on be called the “turnover policy”.

4.1.2 Governance and Organizational Structure

At Axis, the sourcing organization is divided into nine different commodity areas which are responsible for different key functions related to sourcing. The organization, with a focus on the nine commodity areas, can be seen in Figure 4.4. Note that the roles project purchasers and sourcing engineers does not reside within a team but work in all areas. An exception being for the commodities optics, electronics, new business, electro mechanics, and mechanics which have a dedicated project purchaser or sourcing engineers.

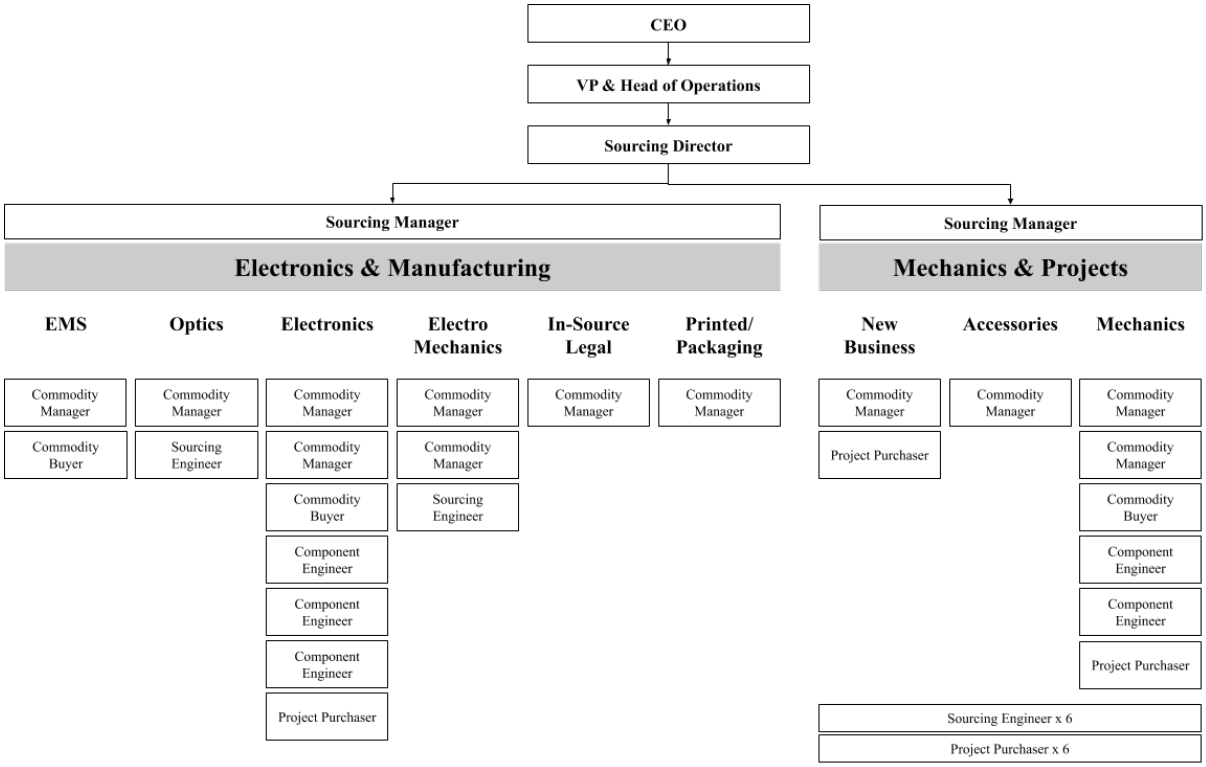


Figure 4.4. The organizational structure for the Sourcing department with a focus on the commodity roles and areas.

There are six different roles at the sourcing department that have different areas of responsibility and are active in the three phases of a product life cycle, see Table 4.1. The three phases can be described as:

i. **Road map**: concepts and discussions regarding which products may be brought to market. Certain tollgates need to be fulfilled for it to move into the next phase, e.g. suppliers need to be in place. Has a time horizon of one to three years into the future.

ii. **Project**: Approved and initiated projects to bring a product from concept to market. It has a time horizon of up to one year.

iii. **High volume**: Product is on the market and is being produced. Is performed continuously until product is phased out.

Table 4.1. Description of the different roles at the Sourcing Department.

Role	**Description**	**Phase involvement** *(primarily)*
Sourcing Manager (SM)	Responsible for managing the sourcing department. Divided into Electronics & Manufacturing and Mechanics & Projects.	
Commodity Manager (CM)	Responsible for the development of an optimal supplier base with capability to support Axis goals on supply, cost, quality, technology and growth.	*Road map*
Commodity Buyer (CB)	Ensures that Axis suppliers have production capacity to meet current and future part production volumes. In close cooperation with internal and external stakeholders, the commodity buyer maintains a supplier capacity evaluation process to secure that supplier capacity information is defined, registered and maintained in a standardized way.	*Road map* *Project* *High Volume*
Project Purchase (PP)	Responsible for supporting new product development projects regarding sourcing related tasks, from concept phase until hand over for volume production.	*Project*
Component Engineer (CE)	Represents the technical competence within Sourcing and covers the whole mechanical spectrum instead of focusing on a single or a few commodities.	*High volume*
Sourcing Engineer (SE)	Responsible for supplier chain management to develop a supply base that provides competitive advantage in quality, value/cost, delivery and technology. Following up new project development smoothly until MP. And as a Bridge of communication between HQ and Suppliers for smooth and timely communication.	*Project*

The nine different commodity areas are each governed as by its own team, which is called a Commodity Team (CT) and is led by a CM. To be noted is that the commodity management initiative was introduced around 2013. A CT is a cross-functional team with members that could be from other departments such as R&D, Quality, and Supply. How common it is that a department is represented in a CT can be seen in Figure 4.5. Even though a CT is by design a cross-functional team, the level of cross-functionality depends on the maturity of the commodity, i.e. how well developed the commodity's work is and how many departments that they commodity interact with. Nevertheless, all CTs have a core team and four of the CTs also have what is called a "extended team". The core team performs day-to-day tasks that concerns the commodity and generally meets once every month (45.5% of the CTs does this according to the survey, some more some less. See Appendix 5 for total breakdown). However, this can happen more frequently it the workload requires it. The extended team are consulted for expertise by the core team when necessary**,** which happens roughly two to three times per year. Which departments that are represented in the four extended CT can be seen in Figure 4.6.

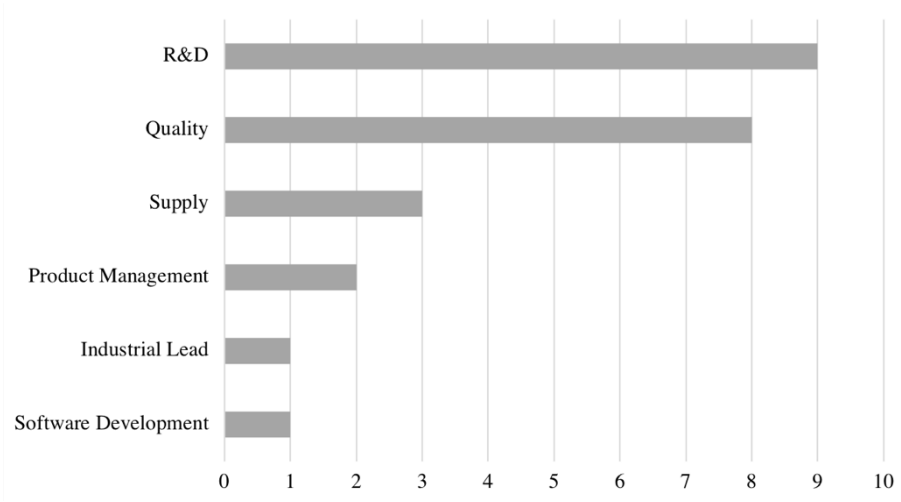


Figure 4.5. The number of CTs in which a department is represented.

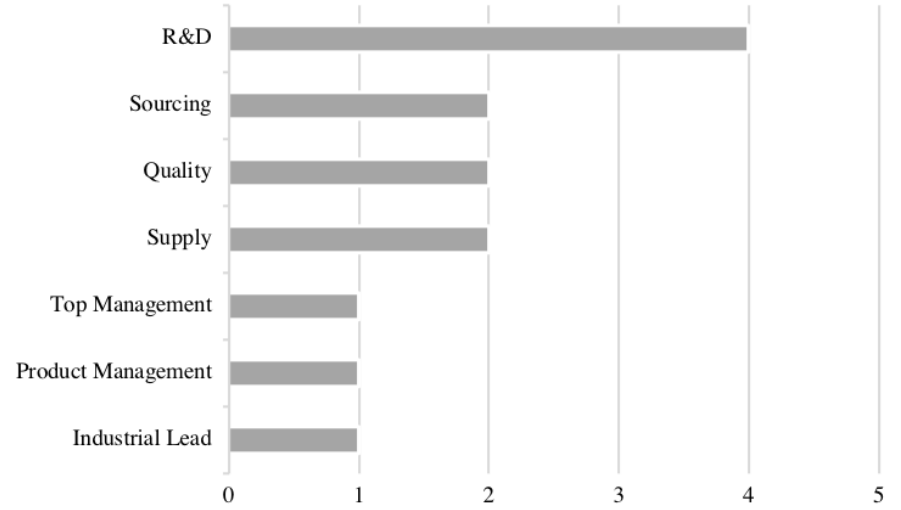


Figure 4.6. The number of CTs extended teams in which a department is represented.

Each CT has a governing team that consists of more senior members, relative to the CT's members, which is called a Steering Group (SG). The SG allocates resources and agrees on goals as well as the commodity strategy of the CT. Twice every year the CT presents the strategy for their commodity to the SG, which they then review and, if it is fitting, approves. The different roles and frequency of which they are represented in the different SGs can be seen in Figure 4.7.

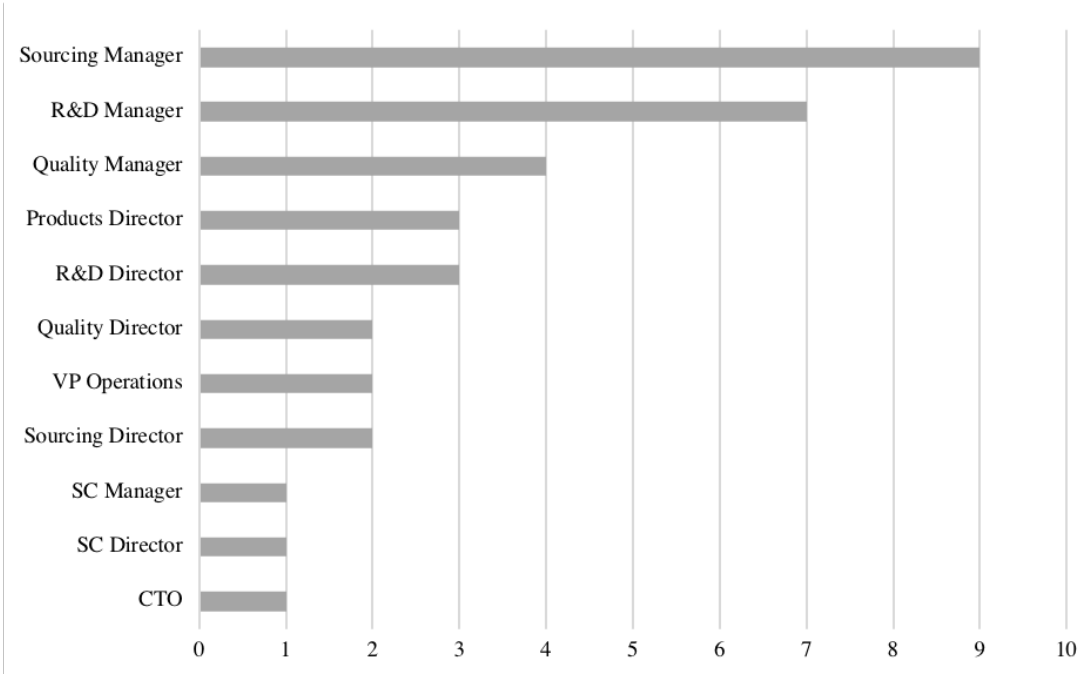


Figure 4.7. The number of CTs SGs in which a role and department is represented.

4.1.3 The Commodity Management Process

The high-level commodity management process is divided into seven main steps where each step, except RM, has sub-processes, see Figure 4.8. This process description can be found in the commodity manager process document at Axis intranet[6] and is accessible for everyone. Each step has a detailed description of expected outcomes based on e.g. inputs and "questions to ask". Even if this process exists, the CMs performs the activities in different ways, and has their own way of doing things.

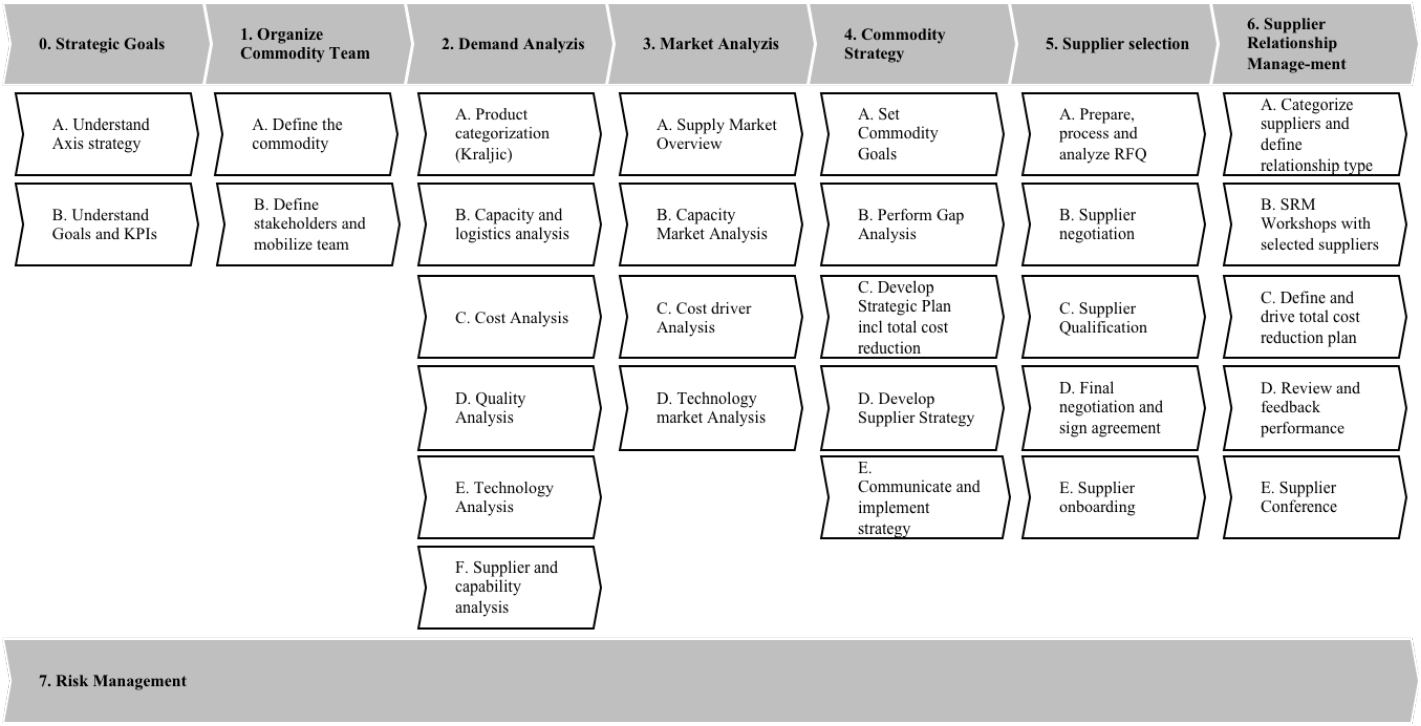


Figure 4.8. The High-Level Commodity Management Process and sub-process.

[6] See description in chapter 4.1.7 The Intranet "Galaxis".

4.1.4 The Escalation Hierarchy for the Sourcing Department

The escalation hierarchy is not directly equivalent to the organizational hierarchy due to the substantial use of the cross-functional teams at Axis. The Commodity Teams, if necessary, escalate their issues to their Steering Group. The seniority level of the individuals in the Steering Group depends on the commodity and its relative importance to Axis. For example, the individuals in the EMS commodity Steering Group are overall more senior than the corresponding individuals for the Accessories commodity. Nevertheless, if the issue that has been escalated to the Steering Group is too significant for them it will be escalated to the Operation's Management team and then, if necessary, to the Executive Management Team. This escalation hierarchy and possible corresponding members at the sourcing department is illustrated in Figure 4.9. Naturally, there are fewer and fewer issues being escalated up the hierarchy for each step.

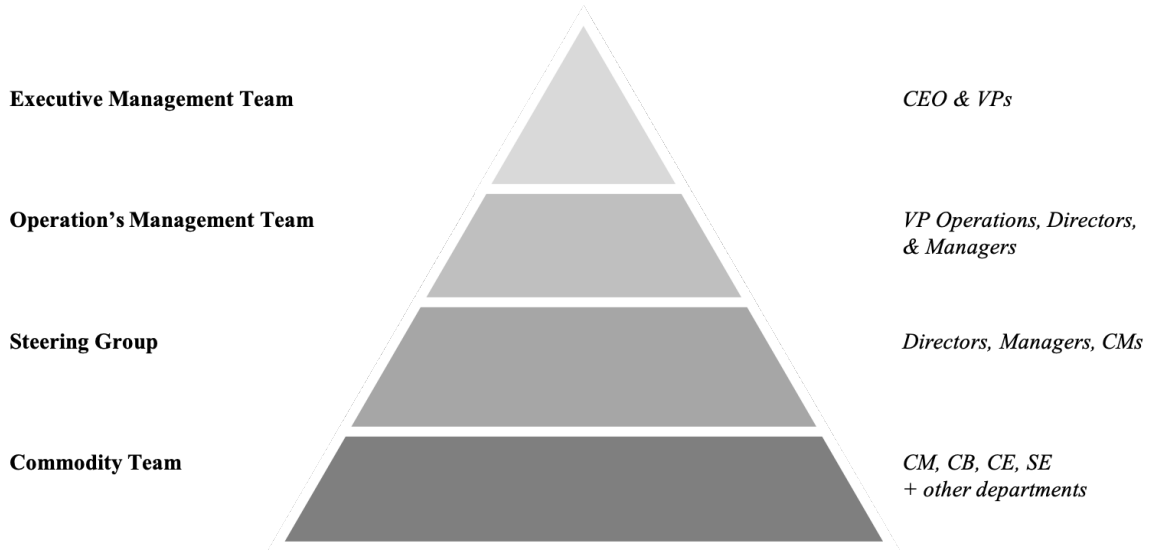


Figure 4.9. Escalation hierarchy at Axis and general seniority level of members for each group.

4.1.5 Company Culture at Axis

The culture at Axis is a relevant topic to discuss as it influences the way business is conducted at Axis. The culture is formed by a high level of decentralization where much responsibility and mandate are moved down in the organization. According to employees there is a strong will to help and support each other even if it is outside of the ordinary work routines. Management is very accessible, and Axis does not want to become a large slow-moving bureaucratic company as it does not facilitate innovation. As described by one top level manager: "*If I had to choose between being one step ahead so that you have a little more structure than needed, or being one step behind so that you have a little less structure than needed, I would go with little less structure than needed and one step behind. This is because we are quite concerned of becoming a slow-moving company and as a company, we are very dependent on being able to develop quickly. However, we believe as we get larger and more complex, we must introduce more structure, so we are moving in that direction. But not becoming bureaucratic and being too many steps ahead*". There are currently not many directives or strict guidelines for how to conduct activities or processes, instead there is a trust in the employees' experience and knowledge. This also results in employees performing the same activities but with different approaches, which sometimes results in decreased alignment within e.g. sourcing. However, activities related to e.g. legal or other regulatory tasks do have structured guidelines.

4.1.6 Learning and Training

The sourcing department has mainly four types of structured meetings or events which facilitates learning and sharing of knowledge as well as information: (i) weekly sourcing meetings; (ii) commodity forum; (iii) strategy days; and (iv) global supplier conference. The weekly sourcing meetings gather all available employees from the sourcing department where the SGs brings a topic which is to be discussed e.g. information regarding covid-19 or functional goals. Additionally, once every month the weekly meeting is replaced by a more extensive meeting where other departments at Axis can be invited or request a timeslot in order to present e.g. how they work or share information regarding something that affects sourcing.

The commodity forum is an event where all the CM gather and discuss learnings and topics such as supplier evaluation, component availability or risk management, see general explanation in Table 4.2.

Table 4.2. Governance description of the commodity forum.

Forum Governance	Description
Meeting frequency	Once/month
Duration	1 hour
Agenda	• Decide topic for next meeting, add other suggestion to the Galaxis List • Round the table for problems on the topic, add to whiteboard • Brainstorming on whiteboard problems in smaller groups (3-4 people) or entire group depending on attendance • Summary round the table for best ideas or conclusions
Responsible	CMs on rotating list to call to meeting and update this Galaxies List
Other	No further documentation, focus on free discussion and up to each to implement good ideas in own work

The strategy days incorporates the whole of Axis' global sourcing and takes place once per year for two days. The main goal is to develop sourcing's functional goals for the coming year, teambuilding and alignment.

The global supplier conference takes place once every second year, often on a remote location, during three full days. The event mainly consists of seminars, workshops and networking. The attending suppliers are primarily from the strategic partnership level but also some suppliers from the other levels. During the conference Axis also hands out awards e.g. "Supplier of the year".

4.1.7 The Intranet "Galaxis"

All employees at Axis have access to the intranet called "Galaxis" where every business area has their own homepage with e.g. important documentation, processes and goals. The intranet is based in the software solution "SharePoint"[7]. At the sourcing page, all commodity areas have their own folders with documentation and templates such as supplier rating, spend analysis, strategy presentations etc. that can be accessed. There are rarely any restrictions on documents, i.e. all Axis employees can see and edit most files. However, files such as contracts with suppliers have restricted access. Further, there is a lot of information and documents available at Galaxis since all employees can upload whatever they see fit. Regarding RM, there also lies documentation available and in a detailed document called

[7] See c*hapter 4.3.1.1 IS Support* for more details about SharePoint

"Commodity Manager Process" which includes a few basic RM steps that will be described in throughout Chapter 4.3.

4.2 Sources of Risk at Axis

Several different risk sources have been highlighted during the interviews and the survey. The risks which the CMs view as their commodities biggest risks, according to the survey, can be seen Figure 4.10. Single source suppliers are the risk, which 91 % of the CMs view as the largest risk. Another risk source that several interviewees mentioned during the interviews was external risks, such as trade wars between nations. This opinion was also supported by the survey, where it was the second most common risk with 45% of the CMs rating it as a big risk. Interviewees have also expressed that factors within their supply chain, e.g. critical failure with key suppliers (e.g. fire) could be a major risk for them. The flexibility and lead time with and from the suppliers, if not functioning on an adequate level, are also sources of risk. Lastly, some components that are used in several products and are complex, and therefore difficult to find suppliers for, was described as a risk source by several interviewees.

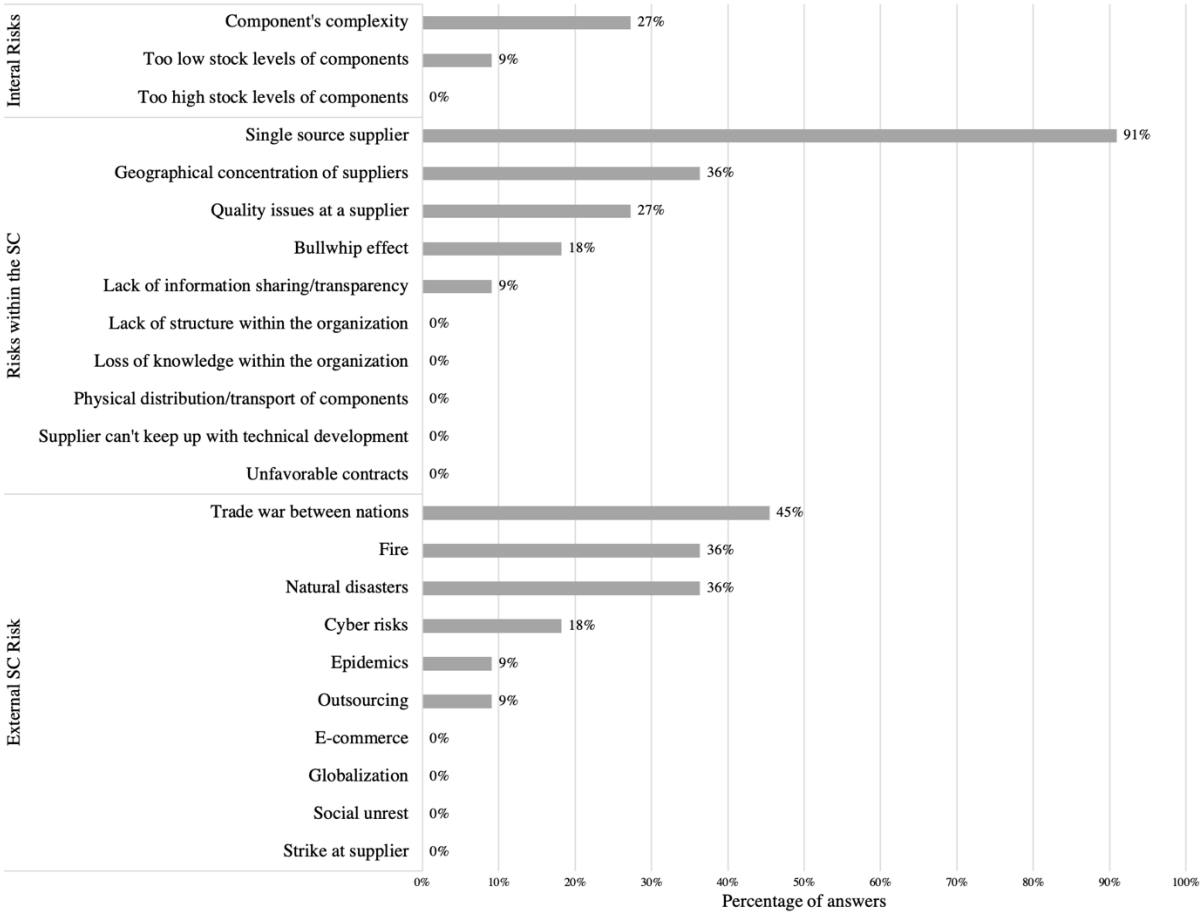


Figure 4.10. Answers to "What are your commodity's biggest risks?" by CMs, categorized according to risk source.

4.3 Axis' Informal Proactive SRM Process

The SRM at Axis' sourcing department are conducted in an informal and individual manner where the primary owner of risk is the CM and CT. There are no direct guidelines, which is followed, of how or

when the SRM process should be conducted such as identifying, assessing, mitigating or monitoring risk. The only directive is that SRM should be conducted. There is a trust in the employees that they will identify and manage the risks which they face or potentially will face. An aspect of this way of conducting risk management is that the employees do not work with or measure risk in a unified way, which was highlighted by all interviewees. This can further be exemplified through a quote from one interviewee: "*We all very actively work with risk, but that structured way of working does not exist. You need a common approach in order to compare and analyze. But currently, I work in one way and others in other ways*".

In terms of proactive SRM, all interviewees unanimously pointed out that Axis' current level of proactive SRM, and overall RM, needs to be increased by introducing a more systematic and structured approach. As stated by one CM: *"My impression is that risk management easily can be put aside if there is a lot to do. Risk management is not acute until something happens"*. However, it was also pointed out that Axis' reactive RM is well-functioning and something that creates a sense of safety even if the proactive RM is lagging. Further, some reluctance to spend resources at proactive RM was also communicated during an interview, as described by one manager: "*We have been able to lean against the fact that we are good at reactive RM. Sure, we try to make certain that we work with the proactive aspect but at the same time we do not want to spend too much resources, time and money on proactive RM for risks which may never occur*".

Even if the proactive SRM lack structured processes, proactive measures are performed by employees at Axis e.g. multiple sourcing, multiple sites of the same supplier, and the turnover policy. However, these proactive SRM activities are often not seen as risk management, even if they are, but rather actions to increase flexibility, increasing competition between suppliers or lowering costs. To be noted is that there does exist documentation of processes where risk management is included, such as the process document "Commodity Manager Process". However, the process is not followed by any of the CMs that were interviewed as they perceived the document as too extensive, detailed, and mostly suitable when starting as a CM. A visualization of the surveyed CMs reasoning behind not using the commodity management process document can be seen in Figure 4.11. One manager also described it during an interview: "*There is a lot of templates and such, but due to that the commodity manager process document is rather extensive and large, where risk management is incorporated, we see a tendency that it is experienced as rather though and hard to digest, so instead people find their own way of doing things*". Furthermore, all interviewees with an operational position mentioned that individuals conduct quantitative analysis using Excel when they do not have appropriate tools available. They then develop their own spreadsheets to suit the challenges of the situation and their own commodity.

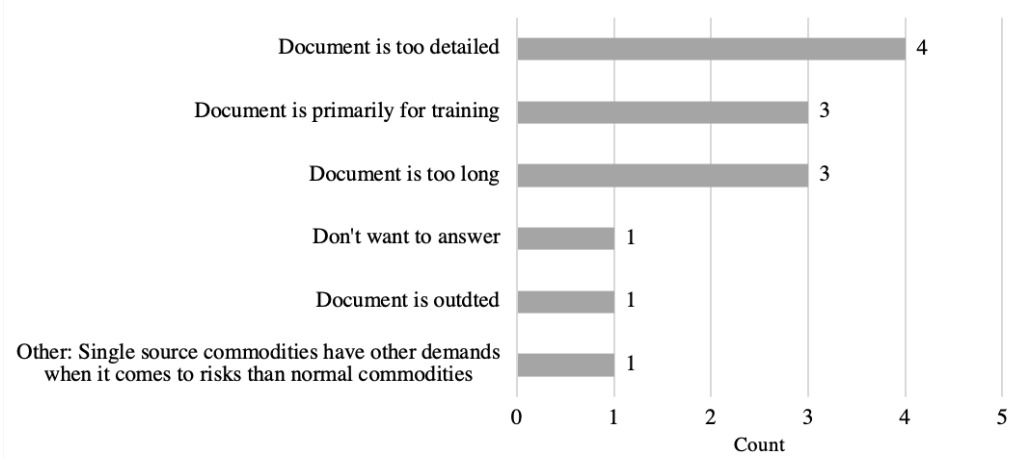


Figure 4.11. Reasons for not using the Commodity Management Process according to survey.

4.3.1 Risk Governance and Organization

At the corporate level there exists a department, Governance and Internal control, which is responsible for corporate risk together with the top management. They mainly address financial and legal aspects e.g. compliance with the American Sarbanes-Oxley Act[8] (SOX). However, during the last few years there has been increased activities related to overall risk management at Axis. An example is the annual report[9], which for the first time this year included a separate chapter for RM. Furthermore, the Governance and Internal control department now has a governance specialist which is responsible for updating and keeping a risk register. The governance specialist gathers and filters out the largest risks from all departments within Axis. These risks are then summarized into Axis's 20 largest risks in the risk register which is presented to top management. When it comes to risks that are more directly connected to the departments e.g. sourcing, and not one of the top 20 risks, it is the their responsibility to manage those risk. The reason for this, as described by two top level managers, is that the competences and knowledge related to those risks is concentrated within the respective departments. This results in that the executive team are responsible for large strategic corporate risks and the departments, and their members, are responsible for operational risks. However, no interviewee stated that there are clear objectives from management about risk or RM, except for the fact that it should be performed. Moreover, no interviewee said that there is a communicated risk appetite level from management, e.g. that a certain level of negative impact on revenue is not accepted. When asked if the interviewees could describe Axis' risk appetite or level of acceptance, the answers differed, see Table 4.3.

Table 4.3. The interviewees view of Axis' risk appetite.

Risk appetite according to interviewees	**Number of answers (% out of 11)**
High	33,3 %
Middle	16,7 %
Low	16,7 %
Don't know	33,3 %

In terms of governance and organizational structure related to RM on an operations-level, none of the interviewees with an operational position believed it to be clearly defined. The risk-governance at sourcing consists of the SM which has a responsibility for making sure that RM is addressed. The responsibility to perform RM for each commodity is delegated to the corresponding CT. The RM is then reported up the chain of command, from the CTs to their SG, through a bi-annual strategy presentation where risk is one of several discussed topics. However, there are no guidelines for how RM activities should be presented during this presentation. Moreover, the SG rarely dives into the details of how e.g. a substantial risk has been determined to be a substantial risk. Instead the SG trusts that the CT, with their combined experience, can determine what risks are appropriate to present, through their likelihood and severity. Moreover, action plans to deal with the risks are also presented. But if a risk or action plan stands out among it will be discussed in more depth. The SG then allocates resources to mitigate the risk if they deem it necessary and the presented action plan to deal with the risk is appropriate. This is determined through discussions within the SG.

[8] The legislation came into force in 2002 and introduced major changes to the regulation of financial practice and corporate governance. The Sarbanes-Oxley Act of 2002 is mandatory. All organizations, large and small, must comply. Source: *http://www.soxlaw.com/*

[9] Not a public document

4.3.1.1 IS Support

Axis have several IS systems that the employees at the sourcing department have at their disposal. A summarization of the systems and a short description of what they are used for can be seen in Table 4.4. How the tools are used in relation to RM will be discussed in the following chapters.

Table 4.4. IS systems used by the sourcing department with description of usage.

IS System	Usage
Galaxis	Axis intranet. Described in Chapter 4.1.7.
ERP-system[10] provided by IFS[11]	Axis' ERP system that among other things are used to gather financial results of suppliers.
Qlik Sense[12]	In Qlik Sense sourcing employees have created a dashboard that they call "Spend Tool". "Spend Tool" is used to keep track of spend and volume for different supplier and components. To be noted is that the data needs to be cleaned after extraction, but this will hopefully be resolved in the next update according to interviewed CMs.
PipeChain[13]	Axis uploads sales forecasts to this platform that are then accessible for internal use and for suppliers.
SharePoint[14]	SharePoint is used to share information mainly internally but, in some cases, externally. The reason for external sharing is that some of Axis' suppliers have their own pages on SharePoint where they can upload data, e.g. regarding their production capacity.

4.3.2 Risk Identification

The risk identification responsibility is located at the operational level of the organization and there are no explicit guidelines or rules for how it should be conducted. It is expected that each individual will take responsibility for their task, in this case by identifying possible risks, and find creative and suitable ways to do it. Consequently, risks are identified in many ways at the sourcing department but one thing that they all have in common is that it resides in the cross functional CTs. In the CTs, each individual has a responsibility to bring up issues that they find relevant to be discussed during their meetings. But according to one interviewee these discussions are performed in an ad-hoc manor. Further, most of the risk identification is done in an unstructured and qualitative way, based on individual experience and their general knowledge about what is going on in the world. An Axis employee argued that the general knowledge could be influenced by how much an individual watches the news and reads the paper. However, some tools are although used, but with varying frequency, as illustrated in Figure 4.12.

[10] Enterprise resource planning (ERP) is an business management software that an organization can use to store, manage, and interpret data from many different business units)
[11] Industrial and Financial Software (IFS) is a Swedish enterprise software company) (therefore only called "IFS")
[12] Qlik Sense is a self-service data discovery and analysis software tool. It has interactive user interface where data can be among other things be managed and visualized
[13] Pipechain is a cloud-based service system that provides visibility and connectivity in a supply chain through e.g. informing about delivery problems
[14] SharePoint is a document management and storage system provided by Microsoft. It is also the foundation of Axis' intranet Galaxis

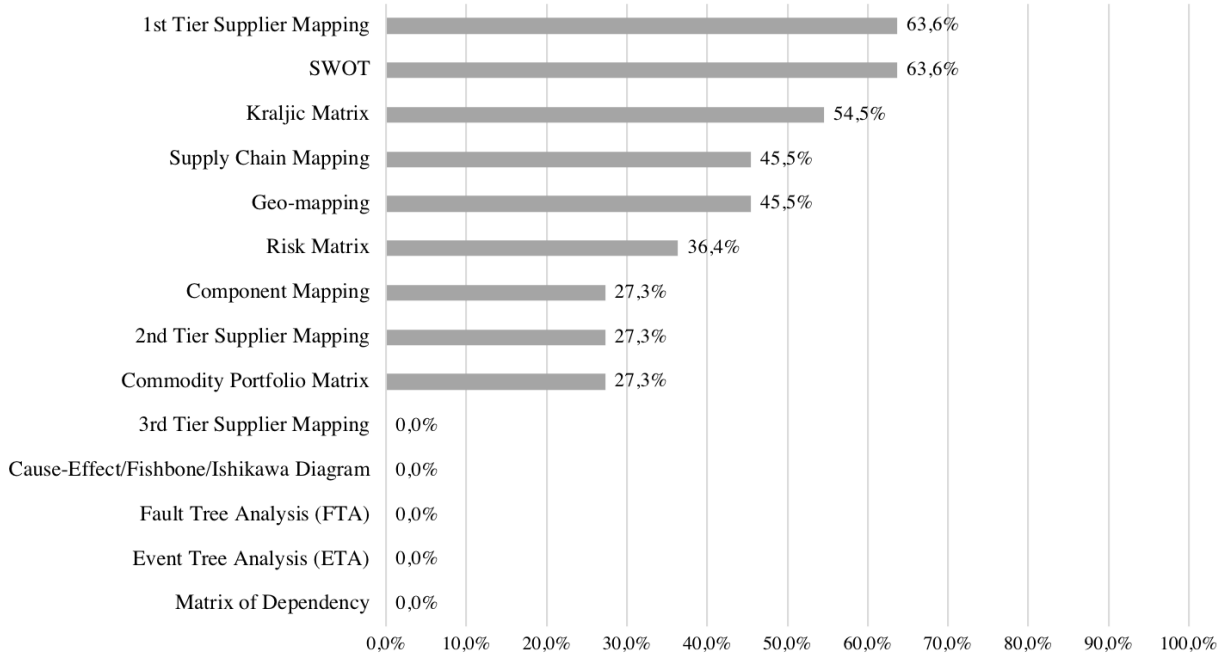


Figure 4.12. Usage frequency of tools by CMs.

Some data for components, e.g. capacity, quality, lead time, spend, and volume, are although quantitatively determined. Capacity is collected either through communication with the supplier or through SharePoint. Quality is measured by EMSs, and reported to Axis, or by Axis themselves as number of defects in a million. For spend and volume it is given by the ERP-system IFS and is visualized in "Spend Tool". This is important to the CMs since they do not want to become too dependent on one supplier, or that vice versa would happen, as according to the turnover policy. If other data in connection to a risk needs to be collected and cannot be found within the sourcing department, other departments such as R&D, Finance, and Sales are contacted.

4.3.2.1 Mapping of Suppliers and Components

The approved vendor list (AVL) is where the sourcing department gathers information about all approved suppliers for the rest of Axis, which is accessible at the intranet Galaxis, see Appendix 5 for a detailed description. According to one CM, this is the main approach of mapping that is performed at the sourcing department and there is no more detailed or in-depth mapping being done. Seven out of eleven (64%) of the CMs stated that they do first tier mapping, three (27.3%) stated that they do second tier mapping, none stated that they do third tier mapping. Further, three (27.3%) stated that they perform mapping of components.

Five out of eleven, 45.5% see Figure 4.13, CMs stated in the survey that they utilize geographical mapping of their suppliers by logging which city the manufacturing site is located. The locations are logged on a city-level, i.e. with the name of the city. An example of this mapping, which was taken from a strategy presentation, can be seen in Figure 4.13.

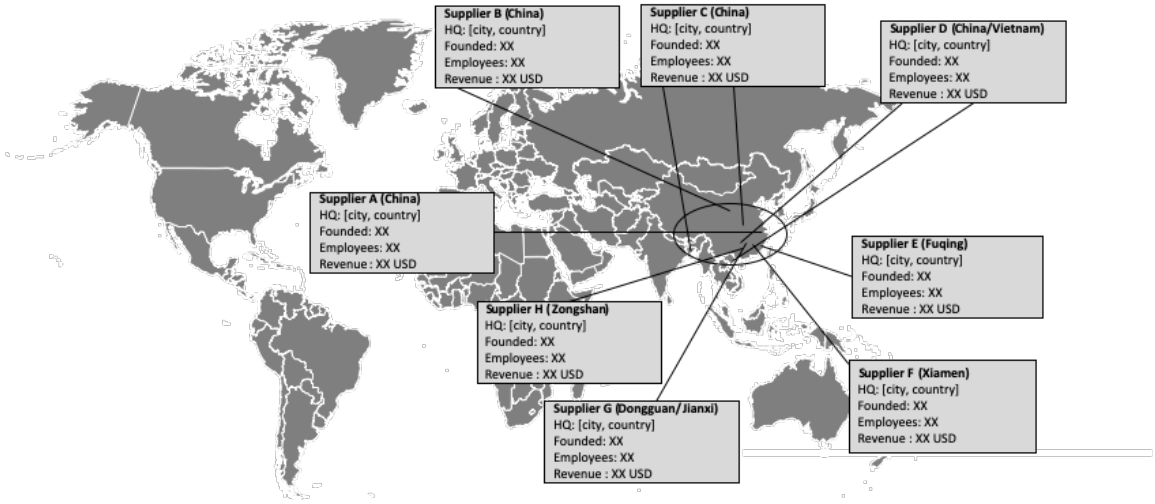


Figure 4.13. Example of a geographical mapping of suppliers for one commodity.

4.3.2.2 Supplier Rating

The CMs performs what is called a supplier rating which is an evaluation of supplier's performance during different phases. The average of all three phases results in a total score. See Appendix 5 for the scoring judging criteria. Each evaluation score is given subjectively by different entities which is shown in parenthesis. The three phases, a short explanation, and with their sub-categories are:

i. **Pre-project**: Prior to any project start up. (CT)
   a. Technology experience
   b. Service level

ii. **Project**: During project development phase. (Individual project members[15])
   a. Service level Product Quality
   b. Commercial

iii. **Volume**: After hand-over from R&D-project to Operations at Axis, i.e. during full production of a product.
   a. Service level (EMSs)
   b. Product Quality (EMSs)
   c. Commercial (CT)

An example of a supplier rating is illustrated in Figure 4.14. These supplier ratings are described by CMs as a way for the Sourcing department to identify performance trends for e.g. quality, price development, delivery precision, and service level. The different KPIs which the CMs stated that they evaluate can be seen in Appendix 5. They use this data to identify factors with each supplier that could be a risk in the future.

[15] Which could for instance be Project purchasers, Mechanical Engineers, Imaging engineers, or Quality engineers

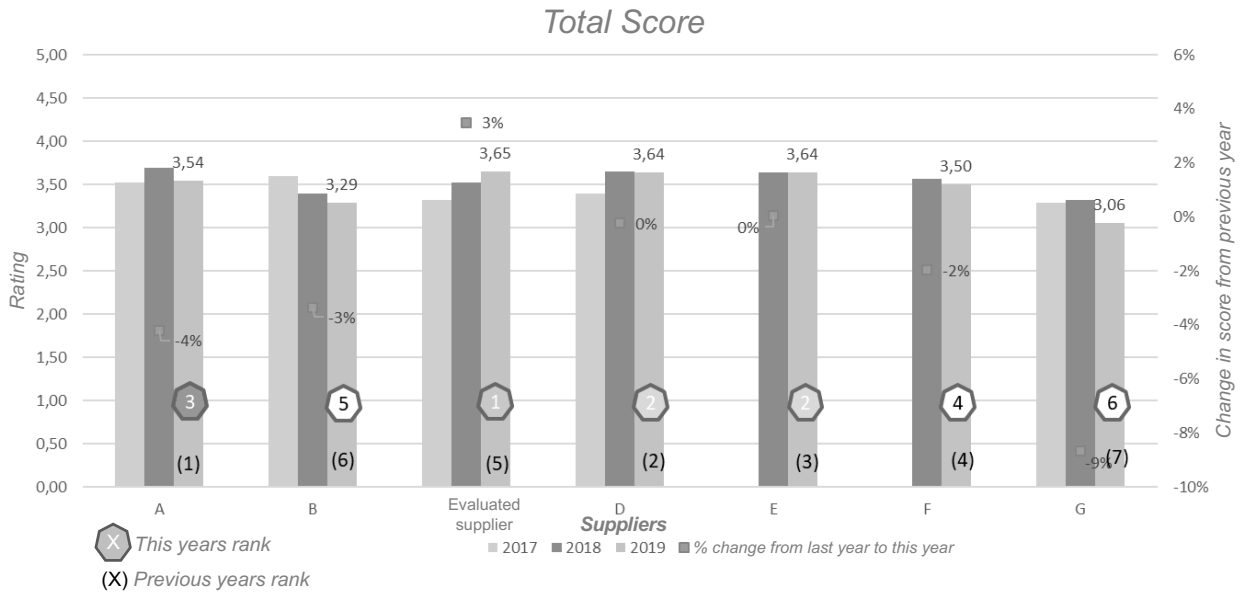


Figure 4.14. Example of supplier rating evaluation from Galaxis.

4.3.2.3 Kraljic Matrix

The Kraljic Matrix was brought up as a tool to classify the different components and identify where potential risks could arise. In the survey, which was sent out to all CMs, five of eleven answered that they used the Kralijc Matrix. However, it was also made clear during the interviews that the CMs used the tool differently as the classifications is based on subjective estimations and the outcome as a result also differ, see Figure 4.15 and Figure 4.16.

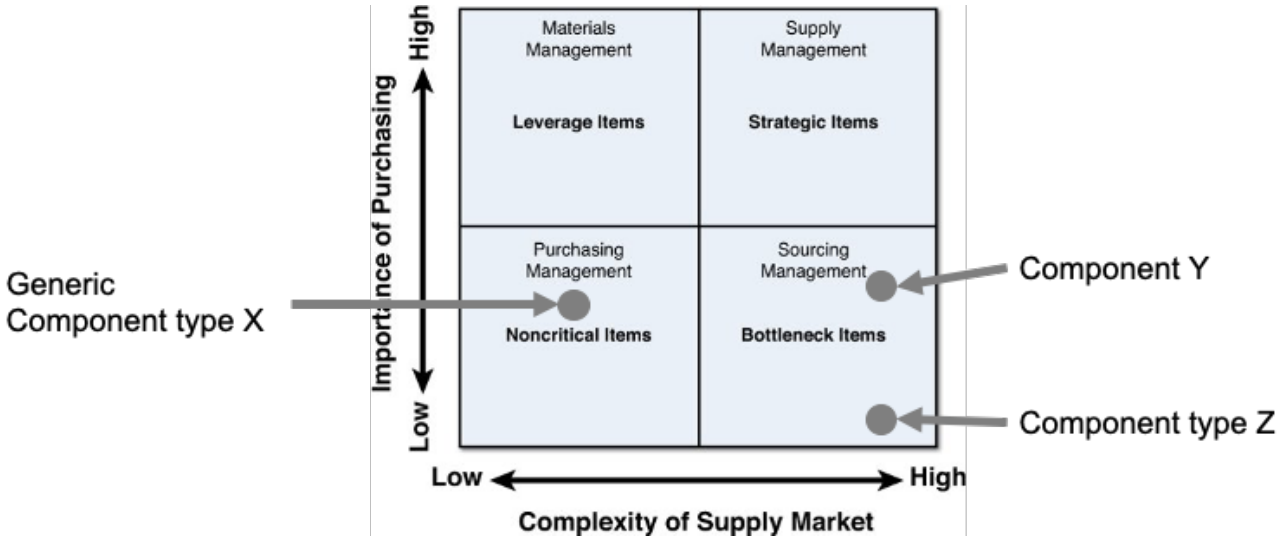


Figure 4.15. One CM's Kraljic Matrix from the strategy presentation

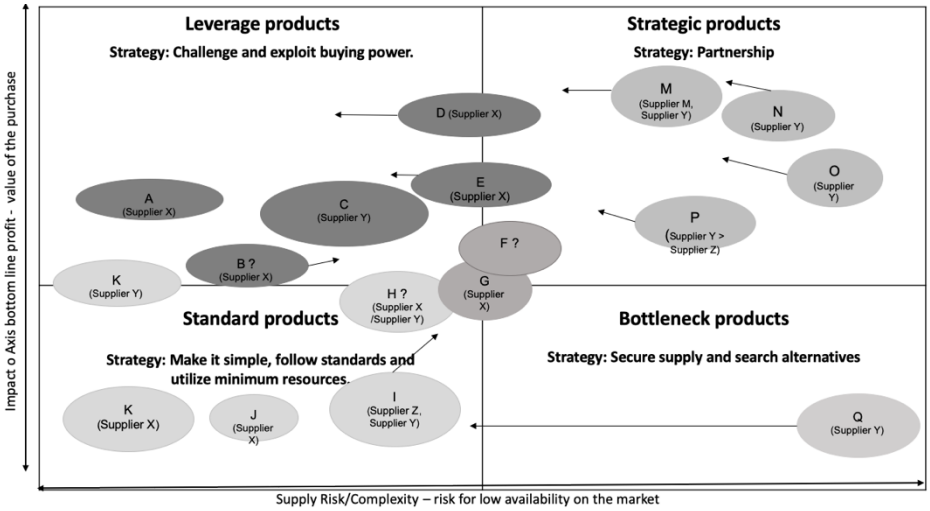


Figure 4.16. Another CM's Kraljic Matrix from the strategy presentation

To be noted is that the Kraljic Matrix is included in the commodity management process document with an excel file called "Axis' Kraljic Mapping Tool", see Table 4.5. The tool, based on the rating input, then calculates the average impact on bottom line and supplier risk. The averages are then compiled into a matrix where the components are automatically mapped. The Kraljic Matrix, together with a spend analysis of the commodity, is then used to prioritize commodities and define sub commodities and scope as well as define the scope for the commodity strategy. However, the use of the "Axis' Kraljic Mapping Tool" was not mentioned by any interviewees.

Table 4.5. Description of Axis' Kraljic Mapping Tool

Impact on Axis' bottom line profit *[Rating (1=Very Low, 5 = Very High)]*	**Supply risk of the component** *[Rating (1=Very Low, 5 = Very High)]*
How much of the total BOM cost is represented by this component?	How capacity constrained is the market for this component?
How big impact does the component have on the perceived value from the end customer?	How high is the switching costs for switching this component or supplier of this component?
How big impact does the component have on the end product's differentiation towards competitive products?	How patent protected is the current supplier of this component?
How big impact does the component have on the end products quality?	How difficult is it to find alternative suppliers of this component?
How big is the purchasing volume value (spend) of this component yearly compared to other products?	How customized is the design so only a few suppliers can manufacture the component?

4.3.2.4 SWOT

Through the survey is was determined that seven out of eleven (63.6%) CMs use SWOT[16]. Worth noting is that a SWOT analysis is only in four out of eleven (36.4%) strategy presentations on "Galaxis". Moreover, the SWOT analysis in those presentations are also only performed on individual suppliers and not on the community as suggested by step 4.B, "Perform Gap Analysis", in the "Commodity Management Process". How the activity should be performed can be seen in Table 4.6. The "SWOT analysis tool" which is referred to in the description is a SWOT-template, there is no guidance or instructions for using it.

[16] Analysis of strengths, weaknesses, opportunities and threats regarding e.g. a supplier

Table 4.6. SWOT analysis activity according to the "Commodity Management Process"

Activity	Questions to answer	Input	Output	Tool/Template
Summarize the As-Is analysis and perform a SWOT analysis	● What is our current position? ● What Weaknesses and Strengths do we have? ● What are our Opportunities and Threats?	The findings from the analysis in process steps 2-3	● Summary of current position ● SWOT analysis	SWOT analysis

4.3.2.5 Market Analysis Tools

Further, Axis has access to market analyses by login into online accounts at companies that provide these services. However, it is up to each employee if, when, and how they want to use the information available there. To be noted is that no interviewed CMs mentioned this possibility. Other resources connected to market analysis is available at the intranet at the sourcing's document-page where documents on market trends performed by e.g. analytics companies or the EMSs are uploaded, mainly by the SMs, and are available for all.

4.3.2.6 "Escalation Tool"

Axis have developed a tool called "escalation tool", for detailed description see Appendix 5, which was created in order to earlier identify issues that supplier experience, and as stated in the document: "*A collaboration between Axis and suppliers to minimize potential disturbances in the supply chain*". If a supplier experiences an issue, they can report it in the escalation tool in a standardized template so that Axis can be informed and aware of potential risks. However, as for now this tool is only used in one commodity and has not been applied for all suppliers but the goal is to incorporate all the commodity's suppliers.

4.3.2.7 Risk Identification in the Commodity Management Process

In the six first steps of the "Commodity Management Process" risks should be identified and logged, to be used in step seven, as seen in Figure 4.17. However, in the chapter for the seventh step, there is only two bullet points[17] to guide the risk identification process in the document and, as stated, this document is rarely used**.**

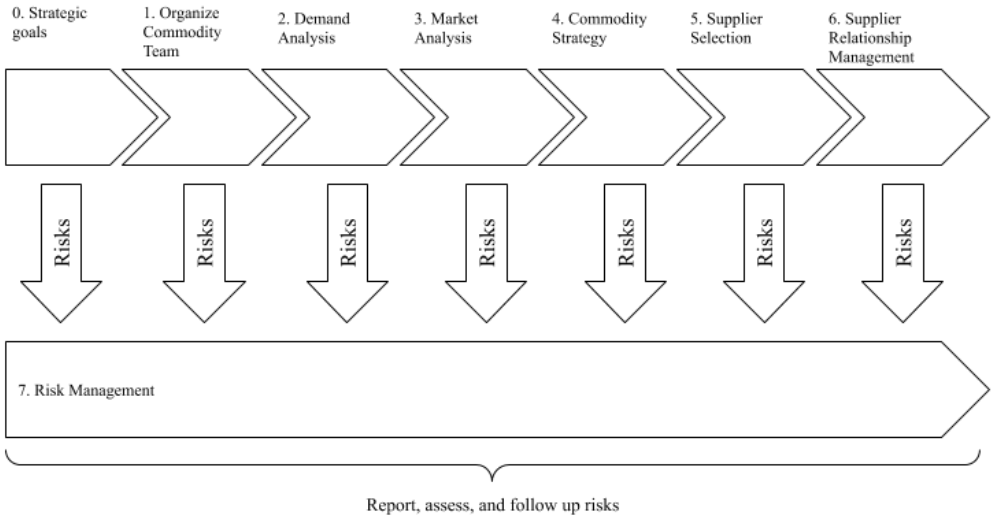


Figure 4.17. Risk Identification in all Commodity Management Process steps.

[17] Bullet points: What risks do we see? What risks do we actively take?

4.3.2 Risk Assessment

Risk assessment is generally performed in connection to the CTs strategy presentation to their SG. The assessment of risk within the CTs is based on qualitative discussions which result in a rank or prioritization of the different risks, according to all interviewees connected to operational risk. The prioritizing is mainly based on how the risk affects availability of components, but it is not quantitatively determined. One CM measured some of the risks in terms of impact on revenue, in case a part of the manufacturing at an EMS would be stopped. Therefore, there is no unified approach or e.g. variables that are used, which is why the risk assessment is not comparable between the commodities. In two out of ten strategy presentations the term "sales value exposure" was used. This term is defined as: "*If sudden event at respective supplier prevents supply, affected sales value at product level over 3-month period*".

In six out of the eleven strategy presentations that are uploaded to "Galaxis" the CT make use of what they call "traffic lights". The "traffic-lights" are a grading system to visualize something about suppliers using the colors green, yellow, and red. Five of the CTs that use it, visualizes supplier's performances, see Figure 4.18, while one CT use it to visualize which suppliers are preferred to use when initiating new projects.

Supplier	Category	Type	Sustainability	Quality	Cost	Capacity/ Delivery	Financial	Comments for R
Supplier X	Strategic	High end	R	G	G	G	G	*Comment for red grade*
Supplier Y	Strategic	High end	R	Y	G	G	G	*Comment for red grade*
Supplier Z	Approved	High end	Y	G	Y	G	G	

Color Code

Significant problem R

Some issues Y

Good G

Figure 4.18. Example of color-coded supplier performance.

4.3.2.1 Risk Matrix

Four out of the eleven CMs stated that they use the risk matrix. From the interviews, the risk matrix was described as a way to visualize the risks in terms of impact and probability. But the process of determining impact and probability is not structured, i.e. there are no guidelines, and is based on the CT's experiences, knowledge and subjective "gut feeling".

4.3.2.2 R&D Classification of Components' Design-Risk

One commodity has introduced a cross-functional risk assessment activity together with R&D where R&D performs a classification on components based on design-risk, i.e. the level of complexity which makes the component difficult to re-design or source from other suppliers. The commodity team then performs an assessment of the suppliers which are connected to the components with a high design-risk. One CM described it as following: "*We have established a work method together with R&D regarding the X components. When they create a new component, either in our reference design or product design, they must determine a design-risk prioritization. If it is classified as high, it will trigger certain activities within sourcing that results in an increased focus on that supplier relationship in comparison with a low design-risk classification of a component".*

4.3.2.3 Risk Assessment in the Commodity Management Process

The process document "Commodity Management Process" at Axis' intranet does include a risk assessment description, see Table 4.7 and suggests an excel template called "Axis risk assessment tool", see Figure 4.19. In this tool, the probability is on a 1 (very low) to 5 (very high) scale and business impact on a 1 (very low) to 16 (very high). Consequently, the business impact has a higher impact on the risk value than the probability variable. How the variables should be decided or calculated is not stated in the tool or in the risk assessment description. Furthermore, this process is not followed and none of the interviewed mentioned or used the tool "Axis risk assessment tool".

Table 4.7. Axis' risk assessment description for the CMs.

Activity	Questions to answer	Input	Output	Tool/Template
Risk assessment	• What risks do we see from each process step? • What is the impact if the risk occurs? • What is the probability that the risk would occur?	Risks from each process	Assessed risks	Axis risk assessment tool

ID	Description	Probability to occur	Business impact	Risk value	Proactive actions	Reactive actions	Owner	Status
1	[redacted]	2	16	32	Have alternative suppliers	Secure alternatives	[redacted]	Open

Figure 4.19. Axis risk assessment tool

4.3.3 Risk Treatment

Axis approaches risk treatment by utilizing several different risk mitigation actions. In the CTs, an action plan is developed for an issue or risk that guides the mitigation work going forward. A common action is to increase the safety stock, either at CLCs or at the EMSs. How much the stock should increase is determined by the CT or the CM and is based on experience and knowledge. Axis' personnel have expressed that they are reluctant to increase the stock levels at the CLCs since it ties up capital, and at the EMSs since it often leads to increased end-of-life costs[18] and Axis being required to purchase unused material. Another alternative for some components, if the volume is significant enough, is dual sourcing. But many of Axis components are described in interviews as low volume or customized, making this alternative difficult. One Axis employee described this as a constant balance between economies of scale and risk. As a counteract to this, Axis often improves their current suppliers through mutual collaboration. This is an explicit goal for Axis, to have long relationships with their suppliers and mutually grow and develop together. However, if a supplier underperforms for more than a year or two Axis will investigate phasing it out and finding a new or existing supplier to take its place. Moreover, if a supplier breaches Axis code of conduct they are blacklisted, and no future business will be conducted with that supplier until the issues are resolved in a satisfactory way. Furthermore, Axis does not, on principle, use insurances as a specific risk mitigation strategy towards known risks. The reason for this, according to a manager, is that it is very risky for a growing company like Axis and that receiving compensation for indirect losses such as revenue loss is very difficult. However, they do have some insurances if something would happen to their suppliers and the sourcing department therefore provides the insurance brokers with data on volume and spend for specific suppliers.

[18] Costs associated with terminating a product, e.g. components that now cannot be used for anything

4.3.3.1 Selecting Risk Mitigation Strategies

The risk mitigation strategy is selected based on the experience and knowledge of the individuals in the CT. Each person in the CT analyzes the problem from their unique point of view and area of expertise. They then, jointly, come up with an action plan that they can agree upon is suitable and is in line with the overall commodity strategy which is presented to the SG. The criteria that the personnel use for selecting mitigation strategies for risks connected to suppliers are: (i) they must follow Axis' code of conduct; (ii) the component quality must be adequate; (iii) the supplier should be flexible enough in their production capacity to satisfy Axis growth target; and (iv) price, but the prior criteria are more important. Other factors such as how easy suppliers are to work with and that not too much or too little of Axis business is with one supplier are also taken into consideration more often than not. No special tools are used in deciding the risk mitigation strategy, instead, as described above, unstructured brainstorming is used without it being explicitly said to be a tool. Another aspect which determines which mitigation strategy that is selected is if the CT suggest a strategy that demands a large amount of resources, but not a set amount. If that is the case, the SG needs to approve the use of resources or even escalate it one level up if the composition of the SG lacks mandate for that level of resource requirement. The different mitigations strategies that the CTs utilizes can be seen in Figure 4.20, which is based in data from the CM survey.

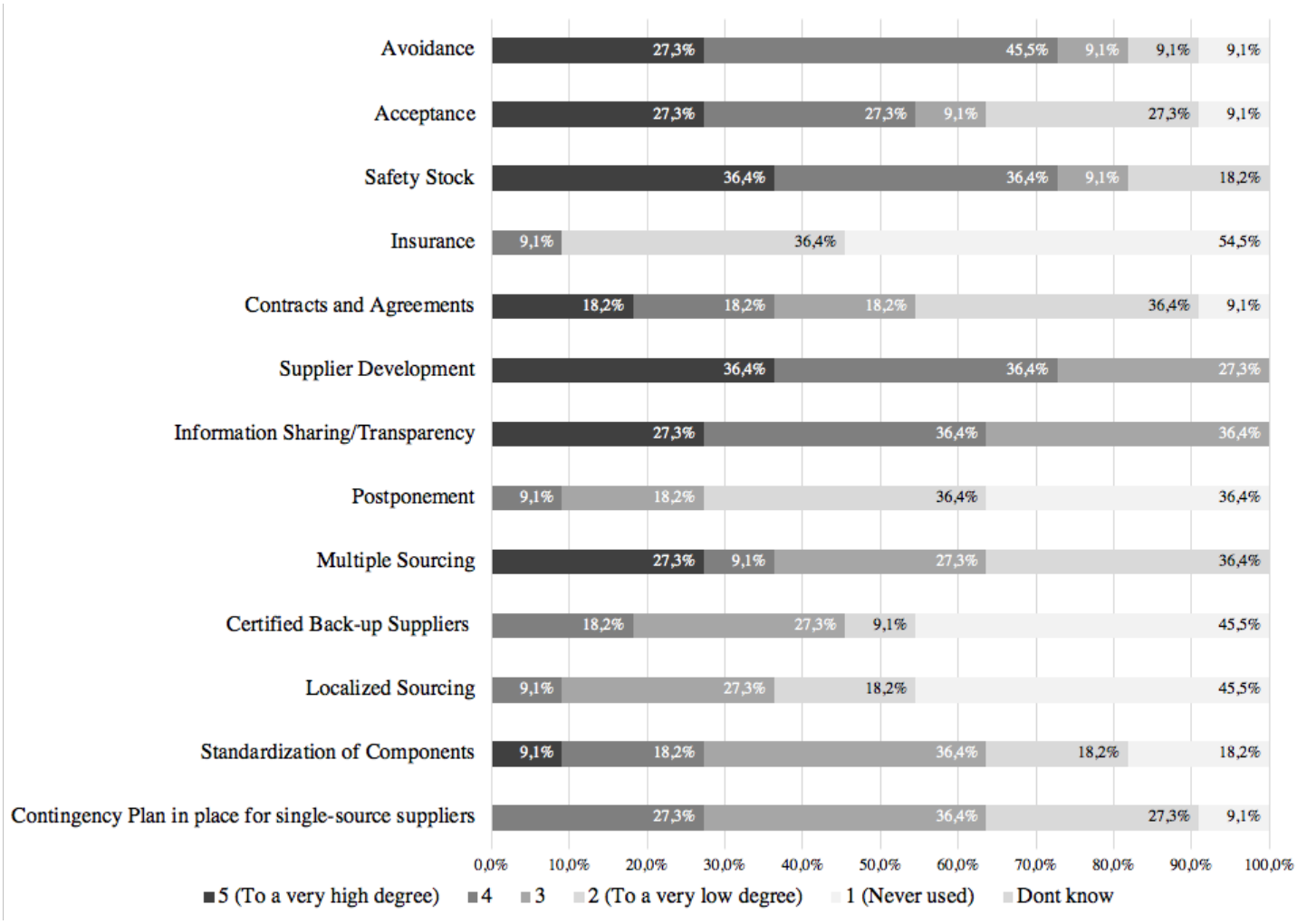


Figure 4.20. To what degree the CMs make use of mitigations strategy (To be noted: The option "Do not know" was never selected).

4.3.3.2 Business Review

Business reviews is a way for Axis to develop their suppliers through sharing information about what works and does not work, e.g. financial or operational factors. Financial data used comes from IFS. These business reviews are conducted by all the CTs and mainly for the strategic and preferred suppliers. The reviews are generally a physical meeting, either at Axis or at the supplier's facilities. The second alternative is preferred according to one interviewee since then Axis representatives can meet with higher executives and thus have a larger influence on the supplier. During the business review the supplier rating, and rival supplier's (with their names masked) ratings is shown. One interviewed CM exemplified the business reviews effectiveness by stating that a during a three-year period one supplier had gone from being the worst ranked one to the best. It was described that the supplier ratings were a key factor in motivating the exemplified supplier to become better. Depending on the supplier's strategic importance to Axis information regarding Axis' future and Axis' plans for the supplier is shared. Furthermore, during the business reviews the strategic level supplier's RM documents are also reviewed.

4.3.3.3 Risk Treatment in the Commodity Management Process

In the document "Commodity Management Process" located on Axis' intranet there are guidelines for how the risk mitigation activity should be conducted, see Table 4.8. But, as has previously mentioned, the document is rarely used according to the interviewees.

Table 4.8. Axis' risk mitigation description for the CMs.

Activity	*Questions to answer*	*Input*	*Output*	*Tool/Template*
Define Action Plan	● What proactive actions can we take to minimize the risk? ● What reactive actions can we take if the risk occurs? ● Who is responsible for the action plan?	Assessed risks	Proactive and reactive actions	Axis risk assessment tool

4.3.4 Risk Monitoring

The sourcing department mainly monitors risks using three methods: (i) bi-annual strategy presentations; (ii) supplier audits; and (iii) capacity monitoring. However, the above discussed supplier ratings, is also used to monitor trends of performance e.g. delivery performance and quality. The monitoring aspects of the strategy presentation is that: (i) the SG checks that the CT has performed their action plan connected to the previous meetings presented risks: and (ii) that the risk itself has not changed.

Risks which have been identified and plans developed to mitigate are reviewed in the yearly strategy presentations to the SG. However, one interviewee stated that last year's risks could be brought up again without being dealt with. One of the interviewed CMs creates action lists together with their team which is monitored on a yearly basis to keep track of the risks and if the mitigation strategies are successful. However, as one employee mentioned there are risks that have been present for several years but nothing is done. Not due to actively accepting the risk, but rather a level of neglect as it is not seen as important as other, mainly daily, activities. As described by a manager, *"Axis has grown rapidly in recent years and the focus is forward, what can be done next and what more can we provide to our customers.*

Perhaps not as much looking in the back mirror for learnings and reflection". But as Axis has grown, an interest in risk management has also risen which can be seen in corporate goals. For example, the goal of 2021 is to incorporate risk monitoring at C-suite level.

4.3.4.1 Supplier Audits

In terms of more actual monitoring activities, the sourcing department does perform supplier audits where e.g. financial status, capacity and working conditions are analyzed and reported. Further, physical visits to suppliers are also conducted where risks can be identified and agreed upon improvements can be followed up. These visits are mainly performed by the SE in Asia as well as e.g. the CM in combination with the business review. During the interview, one CM always described it as they always try to have at the supplier's location. The frequency of visits to the different partnership levels can be seen in Figure 4.21.

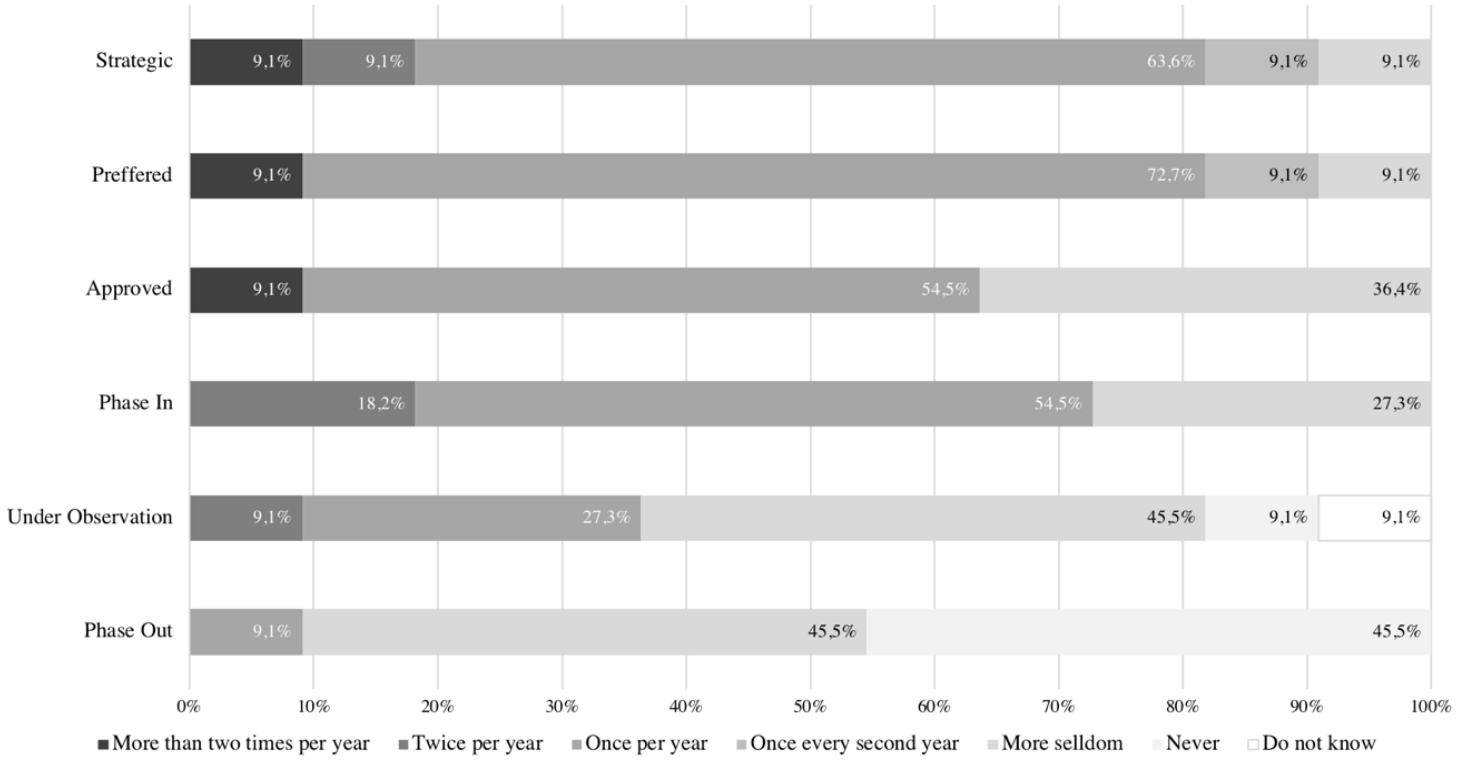


Figure 4.21. Frequency of physical visits to suppliers at different partnership levels, from CM survey (To be noted: The option "Do not know" was only selected once for "Under Observation").

4.3.4.2 Capacity Monitoring

One CB at the sourcing department has developed a tool to monitor the capacity at suppliers and compare it towards sales forecasts. Currently it is only implemented for five suppliers, but the plan is to have it implemented for all the other mechanical suppliers eventually. It works by having the maximum capacity data, which the supplier has shared on SharePoint, which becomes the "ceiling" for a component. Then by combining product sales forecasts from PipeChain and component per product data from Spend Tool the number of needed components can be calculated. The needed number of components can then be compared with available capacity at the supplier to monitor if there will be a capacity risk in the future. Moreover, all input variables can be tweaked to investigate e.g. worst-case scenarios.

4.3.4.3 Risk Monitoring in the Commodity Management Process

Even if there is a lack of structured risk monitoring and evaluation at the sourcing department according to the employees, there does exist documentation that includes risk monitoring. In the document "Commodity Manager Process" the risk management chapter includes some type of risk monitoring description, see Table 4.9. However, it is not followed according to the interviewed employees at the sourcing department.

Table 4.9. Axis' risk monitoring description for the CMs.

Activity	Questions to answer	Input	Output	Tool/Template
Follow up the risks and actions	● Which risks can we close? ● What is the progress of the action plan? ● Do we need to escalate?	Assessed risks and action plan	Updated risk list	-

5 Case Analysis

The case analysis is done using explanation building. The chapter is divided into eight parts. Firstly, an interpretation guide is presented. Secondly, the SRM practices at Axis will be compared to theory in six parts: (i) governance and organization; (ii) risk identification; (iii) risk assessment; (iv) risk treatment; (v) risk monitoring; and (vi) risk mitigation strategies. The analyses first describing Axis, followed by theory and a potential benchmark, then a mark is given and aspects to consider in the construct. Lastly, a summarizing chapter of the analysis is presented.

5.1 Interpretation Guide

The comparison between the empirical data and the presented theory is done through tables with an explanation in a sub-chapter. What each mark in the following comparison-tables represents can be seen in Table 5.1. The mark '++' means that Axis does beyond what the theory suggests achieving best practice, while the mark '+' means that Axis is in line with the theory. When the mark '0' is given it means that Axis is partly in line with theory, e.g. some CTs are in line with theory and other CTs are not. The '–' mark means that Axis only has a few aspects in line with theory. Lastly, the "– –" mark indicates that Axis is not in line with the theory.

Table 5.1. Explanation of grading system.

Explanation	Mark
Best practice/World Class	+ +
Being in line with theory	+
Partly in line with theory	0
Only a few aspects in line with theory	–
Not in line with theory	– –

5.2 Comparing Axis' Governance and Organization vs Theory

A comparison between the theoretical aspects of governance and organizational structure against Axis activities can be seen in Table 5.2 and, as can be seen, Axis overall is not in line with theory. Further, discussions for each aspect can be seen in the following sub-chapters.

Table 5.2. Comparison of the theoretical governance and organization aspects against Axis.

Theoretical Aspect	Mark
Top management support for proactive SRM	–
Incentives for employees to commit to proactive risk management	–
Risk culture	–
Learning and Training connected to SRM	– –
Risk management team/council	– –
IT/IS support for SRM	–

5.2.1 Top Management Support for Proactive SRM

Axis has started to become more interested in proactive RM which can be shown through three factors: (i) RM has for the first time its own section in the annual report; (ii) the new corporate governance specialist that updates a risk register that is shown to top management annually; and (iii) the explicit statement of the fact from a top manager during an interview. However, during interviews with operational staff the perception is that the support for proactive RM has not been communicated clearly. This can be exemplified by that there is no specific goals for RM besides "we need to become better at it", a risk acceptance level has not been communicated, and that there is a lack of organization and governance for proactive RM, e.g. no processes to facilitate decision-making. The fact that top management would rather have too little structure than too much, through strict processes or bureaucracy, could also become a barrier for implementing proactive SRM. The reason for this is that an argument could be made that without guidance and a clear process the SRM work is difficult to implement. Furthermore, if each individual can conduct their SRM process in their own fashion the result would be difficult to compare, and learnings would be difficult to implement. Based on the above, the given mark is an "–" since Axis only have a few aspects that are in line with theory.

In order to reach a higher level of proactive SRM which is in line with theory, Axis should increase the learning and training aspects related to SRM. Ericsson's investment in learning and training was proven crucial to the development but also not the loose the momentum of RM during times with less risk events. Another aspect of increasing the top management support is also by displaying the support by making investments and putting resources directly linked to SRM, e.g. The Ericsson's top management introducing ISO-standards connected to RM, investments in IS, and creating specific RM roles are all examples of clear RM investments.

5.2.2 Incentives for Employees to Commit to Proactive Risk Management

During all interviews the employees communicated that they all felt a motivation to do a good job and overall praised their employer for giving them freedom with little directives as well as opportunities to be creative. However, when discussing the more specific incentive for conducting proactive SRM, the lack of directives and guidelines was experienced as an issue. As described by an employee, the lack of guidelines and structure results in a feeling of lack of commitment by management and therefore a lagging proactive SRM. Or as another employee explained it: "*My impression is that RM activities easily can be forgotten if there is a lot of other things to do. RM is never pressing before something actually happens. It can always be dealt with next week, if you know what I mean. There, I believe tools incorporated in a process in a different way could make a difference. I agree that we need to increase the structural aspect and to perform RM activities, for example one time per quarter, no matter what happens*.". This is exemplified in the variety of and misalignment in the proactive SRM activities which are performed. Different commodities perform different activities and the same activities in different ways. Some commodities seem to have a higher commitment to proactive SRM while other commodities do not find the time or choose not to prioritize the proactive activities and these CM's did not express the same interest in SRM during the interviews. For example, one commodity is quite strongly committed to being proactive by analyzing the road map, looking into the future of what issues might arise and what can be done to prevent these risks to occur. This engagement in proactive SRM seems to originate in the individual CM's own interest in SRM. But also due to that this commodity is smaller and less complex which makes it easier. The incentives for proactive SRM are hence more concentrated in the individual's own driving forces and interest to perform SRM, which is exemplified when observing what the different commodities do.

An interesting aspect is that when the CMs was asked in the survey "Do you believe that there is an incentive to perform proactive SRM?", they experienced incentives for proactive SRM, see Figure 5.1. However, compared with the empirical data gathered from interviews and internal presentations, there is evidence for that defined proactive SRM activities are limited. It may be incentives for individually based proactive SRM to possibly be performed but that it lacks alignment and compliance. In regards of compliance, the commodity management process document[19] contains proactive SRM activities but almost no CM make use of it because they do not need to, as it is up to each individual to decide, which implicates low incentives to use the developed process.

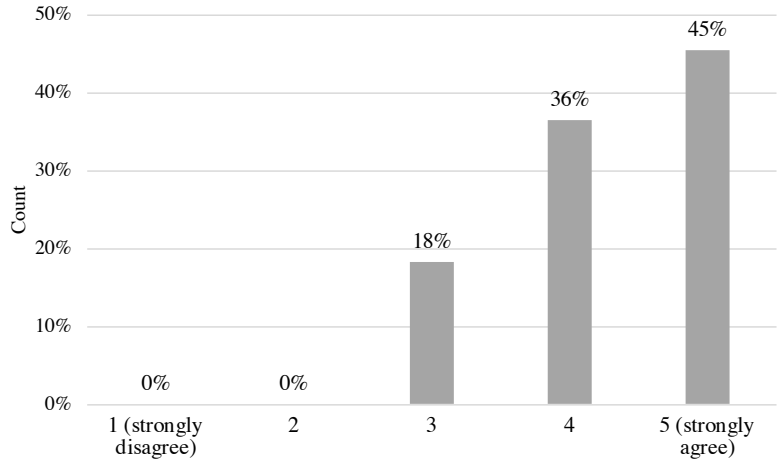


Figure 5.1. Answers to: "Do you believe that there is an incentive to perform proactive SRM?".

According to theory, see chapter 3.3.1, there must be incentives for employees in terms of resources and time to engage in proactive RM as it is one of the most important enablers. The work that needs to be done is performed in order to create future resilience and hence not as operational as other day-to-day activities may be and the result may never be visible. Therefore, being in line with theory is to have incentives that results in proactive SRM. Due to the discrepancy between the suggested theory and Axis activities, the incentives for employees to perform proactive SRM is marked as "–", only a few aspects in line with theory.

In order to improve the incentives to reach world class, the management should not only provide incentives for SRM but for structured and aligned proactive SRM. If, as the empirical data implies, the current incentives does not result in aligned proactive SRM, the management at Axis should consider introducing compliance to ensure that the activities of the different commodities are comparable and measurable. Furthermore, there should be governance and organizational structure in place to make sure that the proactive SRM activities are performed.

5.2.3 Risk Culture

Axis have a strong corporate culture based in e.g. individuality, freedom and innovation, and the culture were spoken highly of during all conducted interviews. But when it comes to risk as being part of the corporate culture the empirical data implies a vague presence. This implication is based in the lack of communication, guidelines and alignment in relation to proactive SRM. The risk culture at Axis is partly influenced by that they have had successful, in their own view, reactive RM and therefore they trust that this will be the case in the future as well. This has resulted in a sense of safety that is present in the

[19] See Chapter 4 Empirical data

minds of the employees. As exemplified by one interviewee's statement that Axis would probably handle future events in the same manner as before, which they also believed could be a reason for the lower commitment to structured proactive SRM. However, a positive aspect of Axis' culture is that since there is so much individual freedom no one is going to stop proactive SRM initiatives. The downside of the individual freedom as described by one manager is that they rather start new initiatives than evaluate and maintain old ones. This could make it more challenging to implement and conduct proactive risk management as it requires continuity, recurrence, and that it is conducted in the same fashion everywhere, i.e. a standardized process. But due to the described company culture at Axis processes are generally avoided and therefore proactive RM could be difficult to implement.

The theory suggests that a risk culture should be spread across the whole organization, acknowledged as well as represented at the board level and allocate sufficient resources to risk. This in order to enable a strong proactive risk culture. Further, comparing Axis to Ericsson which could be classed as "best practice" with a risk culture that is a part of the corporate brand and present at all levels within the company with an aligned organization surrounding risk, Axis is not there. Each employee at Axis can conduct their risk management in any fashion they deem appropriate, thus relying on the competencies of their employees. Additional examples of a lacking risk culture are that there are no clear directives regarding e.g. risk appetite or which products/components are the most important ones to secure availability for.

Axis does not want to become bureaucratic and hierarchical, as stated by all interviewed top-level managers, which Ericsson perhaps could be argued to lean more towards due to being e.g. process and compliance oriented. Therefore, Axis needs to find their own way of incorporating risk culture as a part of the corporate culture while keeping the cultural aspects in mind of which they deem as critical success factors. The majority of all CMs is positive towards clearer proactive SRM guidelines from management, see Figure 5.2. This positive mindset could be used to balance proactive SRM prerequisites with Axis corporate culture. The inclusion of RM in functional goals and the RM activities at the board level indicates a shift towards increased risk culture. But Axis, as described above, currently lack a risk culture overall. Therefore, the mark when comparing to theory is "–", only a few aspects in line with theory. Lastly, as displayed in the Ericsson case the risk culture needs continuous efforts and improvements to stay enforced and relevant which should be kept in mind when developing the construct.

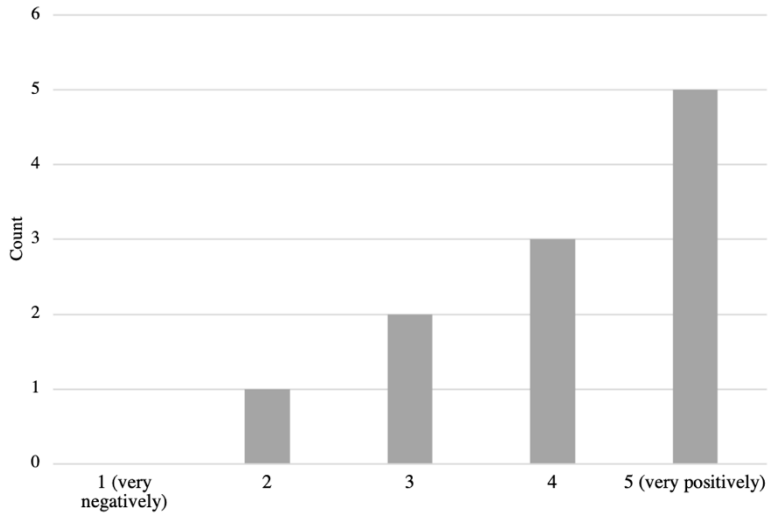


Figure 5.2. CMs attitude towards increased directives and guidelines from management.

5.2.4 Learning and Training

There exists different types of formal learning events or meetings at Axis[20]. When it comes to training and learning connected to proactive SRM it can occur during meetings or workshops e.g. a topic during a commodity forum. However, based in the empirical data, there is no evidence of defined proactive SRM learning or training events, but more on an ad-hoc basis based on if an individual brings it to a workshop, informal encounters between employees, or management sets it as a topic to discuss. For example, one manager during an interview described it as they probably would have a "lessons learned" after the covid-19 outbreak. In general, as described by a top-level manager, Axis has a lot to develop when it comes to learning from historical events and looking back. An interviewee also raised a concern regarding the dependency on specific individual's knowledge and experience, "*There is also a risk with only having a few persons understanding why we do what we do, if they would disappear, we would become very vulnerable*".

Theory suggests that learning and training is key in developing the work force into becoming e.g. more knowledgeable and risk aware. An example of "best practice" is Ericsson which has incorporated learning and training related to RM through the whole organization, from top management to operational level. The development of tools has also been based in the learnings gathered from the employees related to historical events as well as training scenarios. Another key aspect is that the learning and training helped Ericsson to maintain a high level of proactive RM awareness even in times with less disruptive events.

Based on the analysis, the mark "– –", not in line with theory, is given as Axis lacks any formal and defined proactive SRM learning activities or training. Axis should start to incorporate learning and training in order to increase the proactive SRM. It could be scenario training in order to identify new risks or explore new ways to mitigate potential risks. Learning from historical events are also critical and useful. This could perhaps not only be applied for SRM at Axis, but for the entire company. It could also potentially decrease the dependency on certain individual's specific knowledge.

5.2.5 Risk Management Team/Council

In terms of an established risk group or risk manager which are responsible for SRM at sourcing, or any other department, Axis does not have any group or role of this nature. However, one top manager at Axis believes the creation of such a group or role could be beneficial and send a message to the employees that they support proactive SRM. Then again, all interviewed managers or directors were careful in suggesting an actual implementation of a risk group or manager as a new role needs to be considered thoroughly and contribute with actual value to the company as well as employees. There was a fear of such a role becoming too administrative, which is the opposite of Axis culture, and as a manager put it "*You should create roles which perform work, not roles which create work*". Moreover, a consideration that one manager also had was that such a role would result in other employees abandoning their current proactive SRM activities since "now someone else will do it". But, the managers and directors where more positive to the idea of a risk manager position as a project position, i.e. a role that only exists for a year or two to implement proactive SRM, at least to start with. The negative aspect of a project position would be that it would not result in continuity and structure. Instead the creation of a permanent risk council or manager would increase the focus on risk and the ability to establish sufficient communication between different levels within the company.

[20] See Chapter 4.1.6 Learning and Training

Even if the CTs are cross-functional and there is some interest from management in introducing a risk council or risk manager, Axis does not follow the suggestion from theory. Therefore, the given mark is an "– –", not in line with theory. A practical business example at another company regarding this topic is the change in proactive RM at Ericsson, which introduced a risk council and saw benefits of such a group.

5.2.6 IT/IS Support

Axis has some IT and IS support that the sourcing department can use in their proactive SRM. However, all these tools require manual work, e.g. the data that is extracted from Spend Tool requires cleaning before it can be presented because it does not take dual sourcing and safety stock into account. This could be compared to Ericsson that utilized a high degree of automatization to improve their SCRM. Moreover, the comparison of Axis' geographical mapping of suppliers on city level is lacking compared to Ericsson's that has the suppliers' coordinates. However, Axis' internally developed capacity monitoring tool seems like a good tool to improve proactive SRM as suggested by theory. Consequently, the mark given is "–", only a few aspects in line with theory. The improvement and further implementation of IT and IS support, e.g. the capacity tool, should therefore be considered when developing the construct. This is also highlighted in Axis internal 202X goals which further strengthen the argument that it should be included in the construct.

5.3 Comparing Axis' Risk Identification vs Theory

A comparison between the theoretical aspects of risk identification and Axis activities can be seen in Table 5.3, overall, Axis only has a few aspects in line with theory, with two exceptions. Further, discussions for each aspect can be seen in the following sub-chapters.

Table 5.3. Axis' risk identification activities vs theory

Theoretical Aspect	Mark
Structured identification process	– –
Often and recurring risk identification	–
Mapping of suppliers and components	–
Knowledge about exposed areas of the upstream supply chain	0
Use of tools	–

5.3.1 Structured Identification Process

At Axis, the responsibility to identify risks within the sourcing department mainly lies on the CT. Consequently, each CT performs activities which results in risks being identified, e.g. supplier ratings, that are presented to the SG during the bi-annual strategy presentations. However, based on the empirical data, the risk identification activities are unstructured, ad hoc as well as different between the commodities and hence not a process. The CTs does not have a defined method, guidelines to follow or requirements from management regarding risk identification, other than that risks which affect the operation should be identified. However, there exist a risk identification step in the commodity management process document[21], but according to the interviewees this are not followed. Instead, the

[21] See Chapter 4.3.2.7 Risk Identification in the Commodity Management Process

risk identification is based on the individuals, from which the CTs are composed of and their knowledge. One top-level manager underlined in the interview that "*Axis should only take known risks, not unknown risks*", which implies a discrepancy between the way they conduct their RM and what management aims for. Moreover, the top-manager were unsure if this message was clearly communicated down the hierarchy.

According to theory, the goal of the risk identification process is to identify as many potential risks as early as possible. The identification process should be continuous, structured and performed in a context in which the company has knowledge about e.g. exposure, critical components or suppliers. Moreover, the identification should be conducted so that assessment of the risks can be done properly. Further, there is a consensus in research that the identification step is a determiner of the whole SRM process as the only risks which can be assessed, mitigated and monitored are risks which have been identified.

Even if the sourcing department at Axis does conduct isolated risk identifying activities, this mark is based on if the risk identification activities are done in a structured process or not. This is concluded to not be the case and why the mark "– –", not in line with theory, is given. In order to align the managements goal of only taking known risks, Axis is in need for a more structured and established identification process which is followed by all CTs and results in a risk list which can be stored as well as continuously updated. The existing risk identification activities should be utilized and be a part of the construct.

5.3.2 Often and Recurring Risk Identification

There is no stated interval where Axis employees should at the minimum perform risk identification. Generally, it is conducted either in combination with the strategy presentations for the SGs, which is once every year. Other risk identification events that are recurring are the business review as well as the supplier rating where risks could be identified to some degree. Theory suggests that *"risk needs to be scanned for often so that early signs of risk in the SC or its environment can be identified"*. But by nature, the business reviews and supplier ratings are lagging and not done often since they are only conducted annually or bi-annually. Risk could also be identified by employees in the Commodity Teams. But during the interviews it was revealed that those risks more often than not are already developing. Therefore, those risk identifications are not a proactive SRM activity. Moreover, during interviews it has been mentioned that a formal and structured risk identification meeting has happened only a few times. Consequently, Axis has only a few aspects in line with theory and receives the mark "–". Therefore, when developing the construct how often risks should be identified needs to be included.

5.3.3 Mapping of Suppliers and Components

According to the commodity survey, 70% of the CMs conducts 1st tier supplier mapping, 30% 2nd tier supplier mapping and 0% 3rd tier supplier[22]. Hence, Axis sourcing department mainly have mapped their 1st tier suppliers and some the 2nd tier suppliers. According to the empirical data, the main approach to perform 1st tier mapping is by the AVL list[23], where the detailed level of data is quite general. One interviewee mentioned that mapping the supplier network is not prioritized as it takes too much time and needs consistent updates to stay relevant. However, there is a recognition of the advantages a better mapping of the suppliers and supply flow would contribute with. To be noted is that Axis, according to

[22] In this case, 1st tier is Axis direct suppliers, 2nd tier are Axis supplier's suppliers, and 3rd tier are those supplier's suppliers.
[23] See chapter 4.3.2.1 Mapping of Suppliers and Components.

interviewees, have a large supplier portfolio in relation to the amount of CM which could explain the lowered prioritization. The mapping of components varies widely between the commodities, as e.g. the electronics commodity has a detailed mapping of some components which are performed by the R&D department. Looking at the data from the survey, see Figure 4.12, five out of eleven CMs answered that they perform mapping of components. Axis explains this by emphasizing the difference of components between the commodities where some are very complex to map and others simpler.

Theory suggests that the mapping of the supply chain should take place ahead of the risk identification process in order to enable better identification, assessment as well as monitoring of risks. A "best practice" benchmark for mapping is Ericsson which developed a dynamic tool in order to improve SC mapping, hence improving risk identification and assessment, called site@risk[24]. The tool combines data on both suppliers and components. This enables Ericsson to quickly identify potential bottlenecks and issues as well as identify which suppliers or components which gets affected of a sudden disruption. Hence, the proactive investments improved the reactive RM as well. Comparing to theory, Axis does perform some level of mapping but not at a detailed level that would enable proactive SRM. Therefore, the mark "–", a few aspects in line with theory, is given. In order to improve their mapping activities, Axis should invest resources and time into making a thorough mapping of all suppliers and the connected components. It would be a time demanding effort at first, but then would only need annual updates such as in the example of Ericsson. Furthermore, the mapping should available to all departments at Axis to create better awareness and ultimately cross-functionality. Lastly, the effort would create an improved basis for the whole proactive SRM process.

5.3.4 Knowledge About Exposed Areas of the Upstream Supply Chain

During the interviews it was made clear that the employees have a high degree of knowledge about their respective commodity area. For instance, they could by heart mention which supplier they were having an issue with, why, which processes and products it affected, and what they were going to do about it. However, most of this knowledge resides with the individual and their respective experience or within the CT members, and not e.g. in a database. Ericsson, a "best practice" example, had a risk database of their 30 000 components to transfer the knowledge from the individual to the organization. Moreover, theory states that *"to utilize the resources in an efficient way, risk observations should be performed in the context of known sources of risks and exposed areas of the SC. Therefore, knowledge about the existing SC, important processes, and the critical components is necessary"*. It could be argued that employees at the sourcing department takes the above into consideration when thinking about risks, but regardless the knowledge is not located within Axis it is located with the individuals. Therefore, the grade "0" is given, partly in line with theory. An issue that Axis could have is that knowledge would be lost if an employee suddenly quits.

5.3.5 Use of Tools

The CMs at Axis utilizes different tools as seen in Figure 4.12. The tools that are used are the ones that is, individually, deemed appropriate so no risk identification tools are general for the entire department. The exception is meetings which could, if they were more structured and formalized, be classified as brainstorming sessions. A tool which is inhouse developed is the supplier rating template, which facilitates identification of risk regarding the areas of which the commodity collects and rate data. To be noted is that there is a discrepancy between the supplier rating KPIs which are measured in the commodities, see Appendix 5. Furthermore, several interviewees were not aware that activities such as

[24] See Chapter 3.3.3.1.1, Supply Chain Mapping, for explanation of tool.

supplier rating could be viewed as proactive SRM which highlights a level of unawareness. Another aspect is the accessibility to market analysis which are available for all, e.g. market trend reports from the EMSs or analytic companies forecasting the future for electronic components. However, this resource was not mentioned during the interviews which is in line with the very few numbers of views the reports has on the intranet Galaxis.

The theory suggests the use of several different tools, but the common aspects is that a structured and systematic approach is key. There should also be tools which are general for a department so that results can be comparable, and alignment achieved. Therefore, the use of tools related to risk identification at Axis' sourcing department is marked as "–", few aspects in line with theory. The few aspects are the use of e.g. Kraljic Matrix, SWOT and supplier mapping. However, they are not structured or aligned which is why the score is given. For Axis to move towards what the theory suggests, appropriate risk identification tools should be implemented at the whole department to facilitate a structured and aligned risk identification process. Suggestions for tools should hence be included in the construct.

5.4 Comparing Axis' Risk Assessment vs Theory

A comparison between the theoretical aspects of risk assessment and Axis activities can be seen in Table 5.4. As can be seen, Axis is mostly not in line with theory on the majority of the aspects presented by theory. Discussions for each aspect can be seen in the following sub-chapters.

Table 5.4. Axis' risk assessment activities vs theory.

Theoretical Aspect	Mark
Structured risk assessment process	– –
Obtaining sufficient information to make informed decisions	–
Identifying and establishing probability and impact	– –
Classification of assessed risk	– –
Prioritizing of assessed risks	0
Use of tools	–

5.4.1 Structured Risk Assessment Process

The theory argues for risk assessment to be done according to a process, which is not something that Axis have. However, sourcing employees conducts risk assessment, but it is s individually based and hence varies a lot between the commodities, from some non-data driven, i.e. subjective, use of the risk matrix to only assess risk based on gut feeling. This also results in that the assessed risks' value or labeling are not comparable or general within the sourcing department. An example is the use of "Sales Value Exposure"[25] in only two out of ten strategy presentations. Some commodities cooperate with R&D that assess the components based on two scales, as discussed in Chapter 4.3.2.2 *R&D Classification of Component's Design Risk*. However, this is not true for all commodities and a similar work method for e.g. supplier risks are not implemented. Since there is no structure or process for risk assessment the given mark is "– –", not at all in line with theory. To Axis defense the outcome of their risk assessment is a prioritization of the risks, which is one of two outcomes argued for by theory (the

[25] See chapter 4.3.2, Risk Identification, for definition

other one being classification). But the outcomes need to be separated from the process which is analyzed in this section. The outcomes will instead be analyzed in Chapter 5.4.4 and 5.4.5. Furthermore, when developing the construct how a structured risk assessment process should look, which parameters should be included, and what the outcome should be needs to be taken into consideration.

5.4.2 Obtaining Information to Make Informed Decisions

During the interviews it became clear that a lot of knowledge and experience reside within each CM and that it is something which Axis is reliant on. When it comes to risk assessment this is also true as all assessment activities, according to the interviewees which was connected to this activity, are mainly based in qualitative discussions and hence the CTs knowledge as well as experience. Further, the scarcity of impact variables e.g. BIV or impact on revenue, also indicates a lack of data-driven analysis. This is also supported by the interviews were all described the assessment of a risk as more of a "is this bad or not". One CM described it as they did not know which components to prioritize which makes collection of correct data for assessment difficult. Another aspect is the high level of decentralization at Axis, which results in that the commodities and their CMs determines if sufficient information has been obtained.

To be noted is that the informed decisions in this chapter is related to decisions regarding assessment of identified risks. According to theory the importance to gather enough data to understand the risk so that an informed evaluation can be performed is important. The data should also facilitate a comprehensive but efficient assessment. Additionally, it is regarded as important to further understand the impact a risk would have on the entire SC, analyzing the inter-relationships and domino-effect. A benchmark regarding this aspect is Ericsson which, by e.g. the use of their site@risk tool, could make data-based decision when assessing risk as all suppliers as well as components and the links between them are mapped. Further, Ericsson also make use of a frequently updated risk database which is available for withdrawing information when needed.

There is no existing risk assessment process, and consequently data gathering, or analysis connected to assessing identified risks. Therefore, a case could be made that Axis does not follow the suggested theory. However, when the CTs assesses the risks in their discussions the outcome is based on knowledge and the information within the individuals. As theory does mention that assessment can be made in an informal and qualitative way, the mark "–", few aspects in line is given. In order to improve their data-driven and informed decisions related to risk assessment, Axis should consider operations-wide mapping of suppliers, components and related information. Further, there could be discussions or workshops with the employees to establish what data that should be the basis of risk assessment for different types of risk.

5.4.3 Identifying and Establishing Probability and Impact

At the sourcing department there is some activities connected to probability and impact identification, but it differs between the CTs. Furthermore, it is generally only done through qualitative discussions in an unstructured way since there are no defined parameters, processes, or methodology. But one CM stated that it is implicitly stated that it is the monetary impact that determines if it is a high impact or not. But there are no predetermined parameters for e.g. what is a low risk and what is a severe risk, unlike Ericsson that had five categories based on monetary impact. However, some of the CM's try to incorporate impact parameters such as potential percentage of revenue lost but it is only on a supplier level, e.g. what would the impact be if this supplier went bankrupt.

45.5% of CMs although uses the risk matrix to guide their impact-probability estimation. But there are no uniform criteria for what is e.g. a one or a five on the impact scale. Thus, it is difficult to measure one risk against another. Moreover, the employees experience the assignment of establishing probability as a game of guessing. Ericsson had the same issue and therefore move away from probability and focused only on impact, specifically through what they called BIV. Moreover, they also had predetermined categories that determined how severe a risk was depending on its BIV. Worth mentioning is that in later years Ericsson has further developed this value through adding additional parameters and developed the tool Ericsson Blue. Therefore, based on theory and best practice Ericsson arguing for structure and formal tools, which Axis does not use, the mark "– –" not in line with theory, is given.

5.4.4 Classification of Identified Risks

According to the interviews, the majority of the CMs does not classify their risks. There is no overall template or guidelines of which classifications that should be used and how. However, one CM did describe it as the risks in their commodity was classified according to: (i) financial; (ii) price; (iii) quality; and (iv) communication. In terms of sub-classification, e.g. investment as a sub-classification to financial, it has not been mentioned. Another commodity cooperates with the R&D department in order to classify design-risk for some components[26]. Nevertheless, it was clear from the interviews when discussing the subject that there exists knowledge to classify and that it perhaps is performed internally but a lack of directives and compliance.

According to theory the outcome of a risk assessment process always should be a prioritization and classification list. In order to create alignment and comparability, the classifications should be unanimous for all assessments. In terms of benchmark, Ericsson's ERMET tool[27] the main classifications of risk have several detailed sub-classifications. It is also integrated across the organization and available to all.

Despite that some CMs seems to perform classifications, the mark "– –", not in line with theory, is given due to the lack of structured and aligned classification, which the theory suggests. To create alignment and comparability, the commodities should have systematically established classification parameters ahead of entering the risk assessment activities.

5.4.5 Prioritization of Assessed Risks

Risks at Axis are prioritized, and it is explicitly stated by the SGs that the five biggest risks of their corresponding CT should be presented during the strategy presentation. But there are no guidelines for what to determines if something is a high risk or not and therefore the CTs uses different variables that they think are important, e.g. availability or monetary impact. In other words, the commodity does not prioritize the risks based on a methodology, parameters or in a generalizable manner. Moreover, the prioritization activity itself is done through discussions and is dependent on the participants experience, knowledge, and subjective opinion. This results in that one commodity may view one risk as most important, but another commodity would view it as less important due to the basis in the individual's perception. But since Axis personnel does prioritize assessed risks, even if it is not done in a structured or uniform way, the mark "0", partly in line with theory, is given.

[26] See chapter 4.3.2.2 R&D Classification of Component's Design Risk.
[27] See chapter 3.3.3.1.2 Ericsson Risk Assessment.

5.4.6 Use of tools

At Axis there is a lack of using formal tools or frameworks, i.e. a theoretical model, to assess the identified risks. The only formal assessment tool that is utilized is the risk matrix which 36.4% of the CMs use. However, the basis of which the risk matrix is used is subjectively and there is no description or guideline on how to apply the tool which is why it differs between the CMs which uses it. One CT uses an inhouse built excel spreadsheet where risk is assessed for some electronic components. Instead of using tools or frameworks the CTs assess the risks based in informal discussions during meetings. Another aspect is compliance to the use of tools that does exist, e.g. the "Axis risk assessment tool", which is low. A summary of the usage of tools, as understood by the authors, can be seen in Table 5.5.

Table 5.5. Use of tools by interviewed CMs and benchmark (+: uses; –: does not use).

Interviewee	**1**	**2**	**3**	**4**	**5**	**Benchmark** *(Ericsson)*
Discussion	+	+	+	+	+	+
Formal Tool	+	–	+	–	–	+
Formal Tool (systematically applied)	–	–	–	–	–	+
Computer tool (spreadsheet)	–	+	-–	–	–	+
Computer tool (advanced)	–	–	–	–	–	+

According to theory, "companies should implement and make use of formal risk assessment tools, which all individuals that are responsible for upstream supply flows should apply, in order to facilitate early discovery of risk and dissemination of supply risk knowledge". Beyond making use of formal assessment tools companies can take inspiration from theory and develop an inhouse, and potentially with support from external resources, tool which is adapted for companies' specific needs. Moving from spreadsheets to systems or spreadsheets which provides input for more advanced tools. Examples of this can be found in the theoretical framework of this thesis, e.g. Ericsson Blue, ERMET or site@risk.

As the theory suggests that companies should use formal risk assessment tools and Axis does not, the mark "– –", not in line with theory, is given. An effort in implementing formal tools should be done, perhaps seeking assistance from external resources, and investments in training as well as educating the employees in how and when to use the tools. Suitable and systematically applied tools with compliance will increase the proactive SRM.

5.5 Comparing Axis' Risk Treatment vs Theory

A comparison between the theoretical aspects of risk treatment and Axis activities can be seen in Table 5.6 and discussions for each aspect can be seen in the following sub-chapters. In general, Axis only has a few aspects of their activities which are in line with theory.

Table 5.6. Axis' risk treatment activities vs theory.

Theoretical Aspect	**Mark**
A structured approach to choosing strategies	–
Aligning SRM strategies with functional, corporate, and global SC goals	– –
Three antecedents: temporal focus, supply chain flexibility, and supply chain environment	–
Considering high impact-low probability risks	–

5.5.1 A Structured Strategy Selection Process

When a risk has been, in some way, identified and assessed, an action plan is developed in the CT. Then the risk and the action plan to treat the risk is presented to the steering group that then approves and allocates resources. The action plan should be in line with the developed strategy for the commodity and if suppliers are involved should adhere to five criteria (i) they must follow Axis' code of conduct; (ii) the component quality must be adequate; (iii) the supplier should be flexible enough in their production capacity to satisfy Axis growth target; the sourcing departments turnover policy for suppliers; and (v) price of components. However, a risk treatment strategy is not selected according to a structured process instead it is done through discussions within the CT. Therefore, the strategy that is selected depends on the individuals in the CT (and SG that approves or not approves the presented strategy) as argued for by Manuj and Mentzer (2008), seen in Figure 3.15. From the interviews with the CMs, a tendency has been identified that they only see few strategies as feasible and does not investigate other options, i.e. they tend to stick with strategies that they have used before and are comfortable with, e.g. buffering stock or finding a new supplier. This can be compared to Ericsson's process: *"templates start with describing the risk source and its probability and consequence, and continue with a summary of different mitigations strategies, their costs and how they affect the risk situation. To compare the cost of different preventive actions with the business interruption value is regarded as very important. Finally, responsible persons are appointed"* (Norrman and Jansson, 2004, p.449). One employee described how they sometimes experience a bullwhip effect due to overreacting on a risk, which has left them with overstocking warehouses and a need to carry unnecessary tied up capital. This could be an argument for having a process more like Ericsson's.

In conclusion, Axis uses treatment strategies, predetermined criteria to steer the selecting is present, but there is no process or structure for how the selection should be done, e.g. presenting at least three different strategies and their cost-benefit, besides that the SG checks and approves the selected strategy. Thus, Axis only has a few aspects that are in line with theory and the mark "–" is given. When developing the construct how a structured selection process could look like should be considered as well as the usefulness of having the SG check the CTs work.

5.5.2 Aligning SRM Strategies with functional, corporate, and global SC goals

At the sourcing department there is not a clearly defined SRM strategy. However, goals for the coming years include some risk aspects such as the sourcing department's functional goals for 2020 where there are two sub-goals of achieving WCCM which are related to risk:

- Implement risk management process/governance based on input from student thesis by end 2020.
- Add risk management in Commodity strategies for steering group presentations Q1 2021

A goal from 2019, which also exists in the 2020 functional goals, is also related to increasing proactive risk management and mapping, without specifically being connected to risk in Axis strategy: "Identify critical raw materials that are driving increased lead times and limiting flexibility at component suppliers and find appropriate way of increasing flexibility (buffer stock of components or unique materials etc.). There has also been an outspoken strategy of minimizing the number of single sourced products if possible. In terms of corporate strategies related to RM, there has been increased activity and interest where, e.g. risk monitoring is an aspect which is to be incorporated at top management level according to a top-level manager.

An important aspect highlighted by theory is the fact that the development of SRM strategies should be closely linked to the corporate, functional and SC goals of the company. Despite there being initiatives and increased interest in proactive SRM, there is no defined SRM strategy developed other than that it should be implemented. Therefore, the mark "– –", not in line with theory, is given.

5.5.3 Three Antecedents

The CMs and the sourcing department have a stated long-term focus in their work. An example being their high focus on e.g. supplier development and wanting to dual source. However, during the interviews a tendency to e.g. build stock as a solution to risks, which is not a long-term solution to a risk was noticed. A few of the commodities also work more with the road map, i.e. what products will be launched in the coming years, and those commodities naturally have a longer-term focus. Overall, Axis' long-term focus is mostly taken into consideration when selecting strategies, but sometimes they differ from it.

Axis SC is, overall, not so flexible since it often takes a long time to get new suppliers up to speed and the process to find and integrate new EMSs takes years according to interviewees. This is taken into consideration by the CTs through their occasional use of the above-mentioned short-term solutions and their use of existing supplier development since it takes so long to implement new suppliers. To be noted is that parts of the SC, related to more standard, "of the shelf", components are more flexible as it is easier to change suppliers if needed.

The risk level in Axis' SC environment is not something that has been highlighted by any of the interviewees. It is something that they have reconciled with and thus, in their opinion, cannot take into consideration. However, since experience and knowledge is often the foundation of the process of selecting a risk mitigation strategy, it could be argued that the environmental risks are taken into consideration subconsciously or when the individual thinks about risks that are a consequence of the environment.

All things considered, Axis is in line with theory when it comes to flexibility and partly when it comes to the temporal focus. But does not take the SC environmental into consideration and sometimes differ from their temporal focus. Therefore, based on the above discussion, the mark "–", only a few aspects in line with theory, is given. During the construct's development these three antecedents needs to be taken into consideration so that the finished construct helps to select strategies that are appropriate for Axis based on these antecedents.

5.5.4 Considering High Impact-Low Probability Risks

According to an interviewed manager there is a larger focus on "pressing issues" and "what needs to be done at the present?" which is why the proactive SRM activities perhaps is not as prioritized. Interviewed employees also highlighted the focus on internal risks and a lack of analysis regarding external risks e.g. natural disasters. There also seems to be a reluctance to spend resources on proactive measures for low-probability risks, as described by a manager "*Sure, we work with risks. But it is very rare that we feel like taking a cost for a risk that has pretty low probability of occurring*". On the other hand, one top-level manager described high-impact, low-probability risks as the most important risks to address. However, in some commodities these high-impact and low-probability risks do get attention.

According to theory, a lot of mitigation activities focus on the low-impact, high-probability risks and seem to neglect the high-impact, low-probability risks which often are important to address. This also

seems to be true, in general, for Axis sourcing department. As few commodities does incorporate these high-impact, low-probability the mark "–", a few aspects in line, is given. As there is no directive or agreed upon level of risks impact-level as well as a lagging probability assessment it is also difficult to address so called high-risk, low-probability risks.

5.6 Comparing Axis' Risk Monitoring vs Theory

A comparison between the theory and the risk monitoring activities at Axis will be presented in this chapter. The result can be seen in Table 5.7 and Axis does, for the most part, not follow theory. A discussion regarding the theoretical aspects can be seen in the following sub-chapters. Even if Axis does not follow theory and is lacking monitoring activities, not only in relation to risk, there is an awareness of that fact. This awareness seems to be spread across all different levels at the company, and as put by a director "*We seem to always jump into and create new initiatives, and are really good at it, but we lack the monitoring and follow-up activities which is why some initiatives never get evaluated*".

Table 5.7. Axis' risk monitoring activities vs theory.

Theoretical Aspect	**Mark**
Continual monitoring of identified risks, i.e. follow up	– –
Continual monitoring of selected strategies	0
Continual monitoring of the company's risk performance	– –
Guidelines for which risks that should be monitored	– –
Guidelines for what and when to monitor	– –
Responsible entity for monitoring tasks	0
Use of tools	– –

5.6.1 Continual monitoring of identified risks, i.e. follow up

There are several different monitoring activities for identified risks performed at Axis, e.g. the business reviews, the supplier rating, supplier audits, and capacity monitoring. However, all these activities, besides the capacity monitoring, is only done annually or bi-annually. Moreover, risks are also discussed in the, on average, monthly meetings if necessary. As described by one CM, "*During the monthly meetings, it is natural to discuss what should have been done prior to the meeting and what should be performed until the next. But it is rather a focus on walking through the contingency plan for identified risks and if the activities have been performed, not monitoring the actual identified risks*". Often, risks which have been allocated mitigation strategies are considered as "done" in terms of identification or potential monitoring and especially when the mitigation activity has been performed. In other words, there are no structured way that identified risks are monitored.

Other risk monitoring activities besides the above mentioned are up to the individual and is only done ad hoc and unstructured. Worth discussing is the capacity monitoring tool, which is currently only implemented for five suppliers and are therefore, at this moment of time, excluded in this evaluation. To be noted is that if it were implemented more extensively it would make Axis more in line with theory. Theory argues that identified risks should be monitored continually since they may change in nature over time and then the assessment or selected strategy may no longer be correct. Moreover, continual risk monitoring, if done properly, alerts companies of the risks change earlier. Therefore, Axis is not in line with theory, since the activities are not conducted continually, and receives the mark "– – ".

5.6.2 Continual monitoring of selected strategies

The annual strategy presentations, which the CT presents to the SGs, act as a checkpoint for the action plans which was approved at the previous presentation. Beyond those presentations there is little of structural monitoring activities of the performance their selected strategies. As described by more than one CM, if a strategy worked sufficiently well you move forward and do not dwell on why it worked for long. If a mitigation strategy were not to solve a risk as planned it will be further investigated and included in the new action plan. One manager described the monitoring as: "*It is performed in a decent way, but not with a structured approach. It highly depends on the individual, if they reflect on why things went good or bad"*. From the interviews it was apparent that the monitoring of strategies that took place was quite informal and ad-hoc, supporting the quote from the manager.

Theory suggests that companies continuously should monitor the selected mitigation strategies. An example of "best practice" is Ericsson's implementation of their risk review template[28] which both monitored the implementation and development of SRM at the sourcing department on a quarterly and then bi-annual basis. Due to Axis performing a reoccurring monitoring activity during the annual strategy presentations the mark "–", a few aspects in line with theory, is given as it should be more continuous and structured to be more in line with theory.

5.6.3 Continual monitoring of the company's risk performance

There has been an increased interest in overall RM and specifically at board level where RM activities have gained interest. But in terms of monitoring the performance of SRM, there are no activities, but an interest to implement it. Hence there is no monitoring of Axis' SRM performance, which is why the mark "– –", not in line with theory, is given. The continual monitoring of a company's SRM is seen as very important since increased RM can lead to increased business value (Proença et al., 2017). To evaluate their SRM Axis could use the RM maturity model developed by Proença et al. (2017). This maturity model and other ways that Axis can monitor their risk performance should be taken into consideration when developing the construct.

5.6.4 Guidelines for which risks that should be monitored

There are no guidelines at the sourcing department for what risk should be monitored. It is up to each individual to evaluate themselves what should be monitored in their specific commodity. However, in each commodity a risk prioritization list is often developed and the risks on that list should successively be dealt with. But they are not monitored in a structured way while they are on that list, besides during the annual strategy presentations. One CM described the lack of monitoring of risks and guidelines could be dangerous since, unknowingly, you could be working with the wrong things. Theory suggests that a company should have a set level of risk acceptance and everything which is higher than the accepted level should be monitored. This is difficult to perform if there is no clear directive regarding the acceptance level or what to monitor. Therefore, the mark "– –", not in line with theory, is given. Axis should agree on a level of acceptance and define which risk that should continuously be monitored, how often, and when they are no longer in need of continuous monitoring.

5.6.5 Guidelines for what and when to monitor

There are no guidelines for what or when to monitor at the sourcing department at Axis, besides the task to, in a broad sense, work with risk and what that may incorporate. This could once again be traced

[28] See Chapter 3.3.5 Risk Monitoring

back to the reluctance to implement processes and guidelines from management. Therefore, in comparison to theory, Axis is not in line with in and the given mark is "– –". However, there is a request from employees for more guidelines e.g. what and when to monitor which implies deviations between management's perception and the employees wish. This should be included when developing the construct.

5.6.6 Responsible entity for monitoring tasks

According to all interviewees, on an overall level the SMs is responsible for SRM and the more operational aspect is delegated to the CTs. But when it comes to risk monitoring, there is no real clarity on where the responsibility lies. It could be argued that, in the manner which the risk monitoring is conducted presently, that the SGs carries the responsibility as it is the SGs which follows up on the CTs action plans. Beyond that, the SRM lies within the CTs, but overall, there is no defined or structured monitoring activities within sourcing of risk or mitigation strategies. Consequently, there is no responsible entity. However, as mentioned, risk monitoring is to be implemented at the top management level in the coming year which then would create an overall owner of risk monitoring. As for now, Axis is not in line with theory and thus the mark "– –" is given.

5.6.7 Use of Tools

The only tool that Axis uses are the capacity monitoring tool that is only implemented for five suppliers and therefore is not taken into consideration when evaluating Axis. Ericsson uses documentation, see Figure 3.16, and a risk review template, see Figure 3.17, to help them in their monitoring activities. Consequently, Axis is not in line with theory and the mark "– –" is given.

5.7 Comparing Axis' SRM Mitigation Strategies vs Theory

Axis uses several of the SRM strategies that were proposed in the theory. But not all and some to a lesser extent than others. The comparison can be seen in Table 5.8 and discussions of all strategies and their mark can be seen in the following sub-chapters. To be noted, some strategies may be deemed as unsuitable or suitable for some companies and it is not necessarily a goal to include all of the mitigation strategies listed below. The theory suggests that the correct and suitable mitigation strategy should be selected, not a certain number of strategies as the suitability is context and company based. Furthermore, for a mitigation strategy to be considered a chosen strategy, it must be actively selected. In the survey the CMs rated to which degree they utilized different mitigations strategies, see Figure 4.20 in Chapter 4.3.3.1 *Selecting Risk Mitigation Strategies,* where supplier development, safety stock and information sharing are mostly used.

Table 5.8. Comparison of the SRM strategies against Axis' used strategies.

SRM Mitigation Strategies	Mark
Avoidance	+
Acceptance	– –
Buffering/Safety Stock	–
Insurance	–
Contract and Agreement	– –
Supplier Development	+
Information Sharing/Transparency	+
Postponement	–
Multiple Sourcing	+
Localized Sourcing	0
Standardization of Components	0

5.7.1 Avoidance

The CMs use of avoidance as a mitigation strategy varies between them, but overall is one of the most selected strategies of the CM survey where only two (18.2%) CMs answered "to a low degree" or less, see Figure 4.20. An example of applying avoidance from the interviews is one CM which actively avoids conducting business with too large companies as it would increase the risk of losing important support and control. Another example was a CM which changed supplier in order to reduce potential issues since the supplier was located in a turbulent region of the world. Further, Axis also limits their business with suppliers if they are troublesome and ultimately will complete stop conducting business with the suppler if it does not improve.

According to theory, there are mainly two types of avoidance strategy: (i) "Type 1": completely avoiding risk events if possible; and (ii) "Type 2": when risk markets or partnerships cannot be excluded but is avoided as much as possible through proactive engagements (Manuj and Mentzer, 2008). Comparing this with Axis, they do perform this mitigation strategy, both "Type 1" and "Type 2", when avoiding suppliers or regions as well as limiting business with troublesome suppliers. Hence the mark "+", in line with theory, is selected.

5.7.2 Acceptance

The concept of risk acceptance has recently started to be discussed at the board level at Axis but has yet to reach the more operational parts of Axis, as showed by all interviewees stated that there is not a communicated level of risk acceptance. However, in the survey 55% of the CMs answered that they use acceptance as a strategy often or very often. Theory states that there needs to be an organizational level of risk acceptance so that the risk in question can be benchmarked against it (Fan and Stevenson, 2018). Therefore, when Axis' employees actively choice to accept a risk they do not do it according to theory since they cannot compare their risk acceptance to the organizational one. Based on this the mark "– – ", not at all in line with theory, is given. For Axis to become in line with theory they would need to have a company-wide risk acceptance level that are communicated clearly. Then the employees could make a more informed decision based on the acceptance level.

5.7.3 Buffering/Safety Stock

Buffering and safety stock is one of the most common risk management strategies used by the employees at the sourcing department, as it is described as simple and straightforward by the interviewees. According to the CM survey, eight (72.8%) CMs answered that they used the strategy "to a high degree" or more, see Figure 4.20. Furthermore, Axis always has some safety stock to ensure that demand can be satisfied but they also increase their stock levels momentarily, e.g. when Brexit happened, just as theory suggests. However, how much the stock levels should be increased is mainly not based on a quantitative analysis or robust information as suggested by theory. Instead it is based on the experience and knowledge of the employee, which estimates the amount which is needed.

According to theory, there is two variations of the strategy to increase safety stock: (i) momentarily; and (ii) continuously (Tomlin, 2006), where the latter is deemed as less desirable (Chopra and Sodhi, 2004; Giunipero and Aly Eltantawy, 2004; Tomlin 2006; Chopra and Sodhi, 2014). When increasing safety stock factors such as value of the product, obsolescence and uncertainty of demand and supply should also be considered. Furthermore, it is suggested that the amount of safety stock should be based on robust information and a thorough analysis. Axis does make use of this strategy, both continuous and momentary increased stock in order to mitigate risks. But, due to that Axis' strategy of increasing safety stock in order to mitigate risk is not based on a quantitative nor robust analysis including the factors above, the mark "–", a few aspects in line with theory, is given.

5.7.4 Insurance

Axis does not use insurances as a risk mitigation strategy in principle according to a manager. However, they use it for some suppliers if anything would happen to them. Therefore, the sourcing department provides data on spend and volume for specific suppliers. Moreover, 91% of the CMs answered that they never or to a very low degree use this strategy, see Figure 4.20. Theory argues that the entire SC should be mapped so that an appropriate insurance can be selected (Dorfman, 1998). Moreover, with a proper RM the insurance premium could even be lowered, which was the case for Ericsson (Norrman and Jansson, 2004). Based on this, Axis only has a few aspects in line with theory, i.e. insurance if something would happen to a supplier, and is given the mark "–".

5.7.5 Contract and Agreement

Contracts and agreements are something that has been incorporated more as Axis has grown, previously there was a high degree of "handshake-deals". However, as for now, new suppliers are signed using contracts. In the current contracts SRM is generally not incorporated. But half of the CMs answered that they used contract and agreements as a form of mitigation strategy to "some extent" or higher, see Figure 4.20. However, it is not clear in how it is being applied as a mitigation. Furthermore, in the interviews it was apparent that some level of production flexibility and guarantee was included in contracts which could be argued as a type of SRM strategy. There are some SRM collaborations with the EMSs, but it is based on good will between the parties rather than forced through contract. Throughout the interviews there has been an overall skepticism towards contracts which perhaps could be that some of the old ways of working are still lingering around or that employees feel that a contract negatively affects the relationship that Axis wants to have with its partners. Another aspect to consider is that Axis in several instances is much smaller, in an economic sense, than their suppliers and thus have difficulties in making them conform to Axis demands or requirements.

The theory suggests that RM can be incorporated in contracts as a way of transferring and mitigating risk for the focal firm. As Axis uses this mitigation strategy but to a small degree, the mark "–", only a few aspects in line with theory, is given. Inspiration could be taken from Ericsson which specifically incorporated proactive RM into their contracts. However, Axis would need to consider their relationship and potential negative impacts on them before changing contractual demands. It could however be a start to incorporate more proactive risk sharing into new contracts.

5.7.6 Supplier development

At Axis there is a stated desire to work long-term with their suppliers, this is exemplified by that over 90% of a CMs answered in the survey that they use supplier development. Axis improves their suppliers through business reviews, supplier audits, and indirectly through gamification[29] of the supplier evaluation as described by one CM. During the interviews it has also been stated that Axis puts in extra effort to help a supplier when they see negative trends in e.g. quality or capacity. When asked if their supplier development minimizes issues with their suppliers, they all answered yes. Therefore, Axis supplier development is an action that leads to proactive SRM. Further, Axis has recently started to insource activities that they previously outsourced due to having issues with among other things quality. Bringing in activities is in line with theory (Handfield et al., 2006) since supplier development is not always the correct solution (Zsidisin, 2003b). Axis focuses their supplier development to their strategic and preferred suppliers and is in that aspect also in line with theory. Based on the above reasoning it can be concluded that Axis is in line with theory when it comes to supplier development. Therefore, the mark "+" is given. For Axis to become even better at supplier development a more structured and uniform way to develop their suppliers is suggested as well as having pure SRM activities in mind. This would perhaps also include documenting and mapping what tasks they have done and what the results were for easier evaluation and internal learning regarding what works and does not work.

5.7.7 Information Sharing/Transparency

Since Axis has a strong desire to have close collaboration with their suppliers there is rather high degree of information sharing, in both directions. To what extent this mitigation strategy is used by the CMs can be seen in Figure 4.20, where no CM answered below "to some extent" and eight (72.8%) "to a high degree" or higher. Despite there being a high degree of information sharing in both directions, there were some interviewees that believed that suppliers still withheld some information from Axis. Especially if they were ashamed of something, as exemplified by one interviewee. Another aspect is the suppliers which are much larger than Axis, where it was described during the interviews as they only share limited amount of information as Axis only is a small part of their sales. But then again Axis also, naturally, withholds some information from their suppliers, especially when it comes to factors that could influence possible contract negotiations according to interviews. Since Axis has divided their suppliers into a hierarchy depending on how important they are to Axis, suppliers further up in the hierarchy are provided with more information than those further down, see Figure 5.3. An example of this is that Axis lets them know what products will be produced in the near future, while the strategic level partners share with Axis their risk management plan. It is at the business reviews that Axis can discuss thoughts about risks and risk management with suppliers and EMSs.

[29] Definition: "The process of adding games or gamelike elements to something (such as a task) so as to encourage participation" Source: Merriam-Webster. Available at: https://www.merriam-webster.com/dictionary/gamification

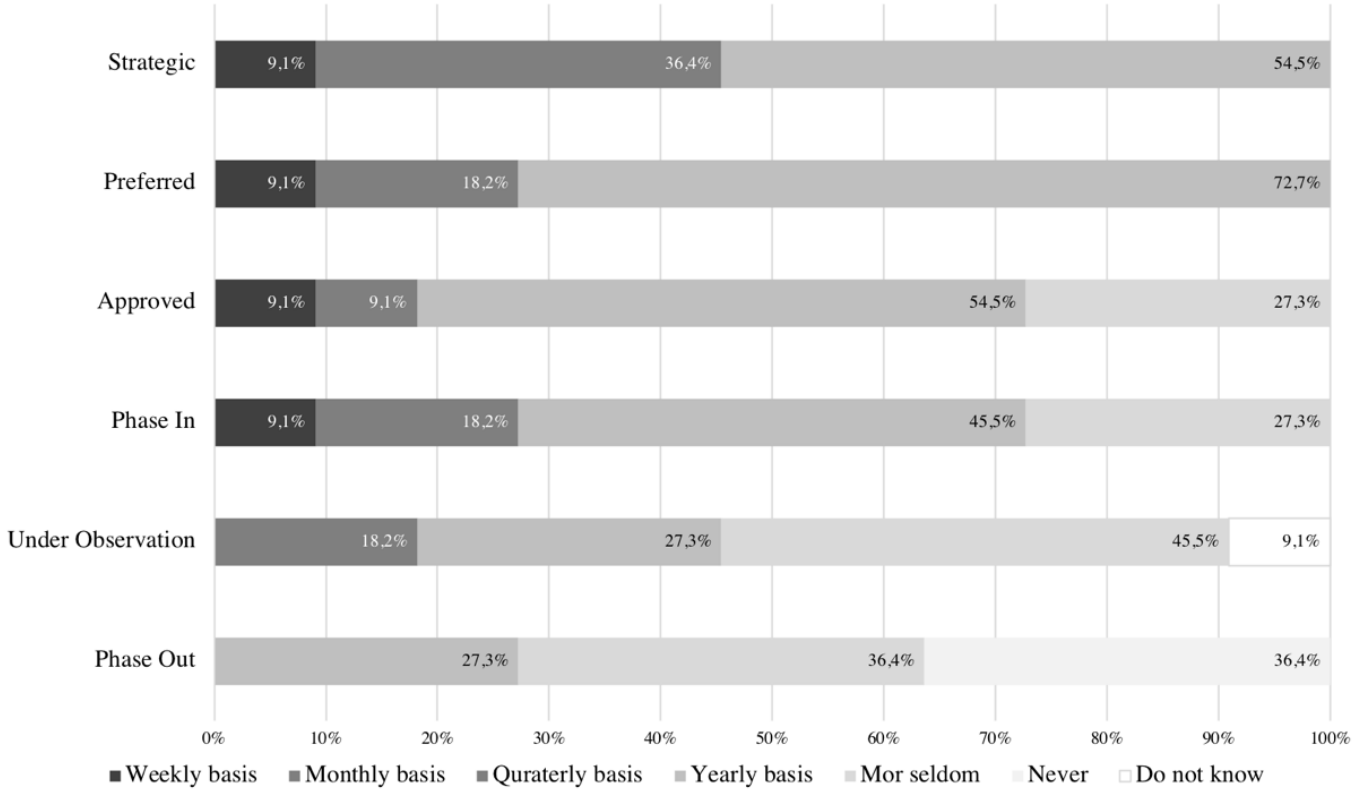


Figure 5.3. How often information regarding RM is shared with the different partnership levels.

According to theory seamless information sharing and transparency are enablers for proactive SRM. To withhold information in the SC is also viewed as undesirable as it complicates the incorporation of risk in decision-making. As Axis views their supplier relationships as critical, the information sharing is also, in general, high. But as theory also points out as a common issue, there is occasions of withholding information from both Axis and their partners. In terms of conducting information sharing and transparency, the overall analysis points towards that Axis is in line with theory which is why the mark "+" is given. In order to reach "best practice", risks and SRM needs to be incorporated further in the information that is shared, i.e. which risks Axis and the supplier has as well as how they conduct their RM.

5.7.8 Postponement

The main level of postponement which Axis' perform is in the final assembly of packaging before shipping it to customers. There, manufactured components and off-the-shelf-products get packed together to create a complete product package. According to the CM survey, eight (72.8%) of the CMs used postponement of final assembly "to a very low degree" or less. Generally, this is not something the sourcing department performs in the context of proactive RM. Based on this, Axis, to the extend postponement is used, has a few aspects in line with theory, i.e. the logistical postponement, and is given the mark "–". However, to be noted is that Axis have a high level of complexity and low standardization regarding their own products which makes postponement less suitable. Furthermore, the difference of products, components and complexity vs more standard is quite big between the commodities, e.g. accessories and optics. Nevertheless, if a higher degree of modularization could be achieved for a commodity, postponement would increase as a viable option. However, as Axis does not manufacture their products the postponement of product assembly is more related to the EMSs choice of strategy.

5.7.9 Multiple Sourcing

Multiple sourcing is something that Axis utilizes and want to utilize even more since they believe single sourcing is a big risk[30] for them. Seven (63.7%) of CMs answered that they use multiple sourcing "to some degree" or higher in the CM survey, see Figure 4.20. It also was expressed by interviewees at all hierarchy levels that multiple sourcing is an effective way to mitigate risks. There are two prerequisites that influence if Axis can use multiple sourcing: (i) there needs to be enough volume to justify it; and (ii) that there is an additional supplier that meets the requirements for the component. The second factor was expressed by almost all interviewees to be quite challenging because some of Axis products require highly specialized components and therefore there are only a few suppliers world-wide that can manufacture these components. Further, Axis does not want to become irrelevant for a supplier and therefore has a turnover policy that Axis needs to represent a certain percentage of a supplier's revenue. Theory suggests that using multiple sourcing can mitigate the risk of becoming too dependent on one supplier (Miller, 1992; Jüttner et al., 2003; Manuj and Mentzer, 2008; Silbermayr and Minner, 2014). However, it also suggests that an effective solution could be to mix the use of single and multiple sourcing depending on the volume (Chopra and Sodhi, 2004). As can be seen, Axis does what is suggested by theory and therefore receives the mark "+", in line with theory.

5.7.10 Localized Sourcing

One CM did mention the risk aspect of geographical locations of the suppliers and mitigated some of these risks by relocating capacity or searching the market for new suppliers. Both in terms of not concentrating too much volume and critical components to one geographical location but also due to some locations being more prone to risk events. However, not all CMs can apply this type of risk mitigation since some of Axis' specific and complex products only can be produced by a small pool of suppliers. Only three CMs (27.3%) utilized localized sourcing "to some degree" or higher while five (45.5%) never used it, see Figure 4.20. Another initiative by Axis, which goes in line with theory, is spreading out the geographical concentration of their EMSs but also moving them closer to Axis' markets to reduce lead times and potential issues with distribution. However, when looking at the geographical location of Axis' suppliers they are concentrated in certain parts of the world. To be noted is that the theory surrounding localized sourcing are quite adapted for manufacturing companies which Axis is not as they outsource all manufacturing. But the approach of taking geographical location of suppliers in consideration is in line with the theory that is applicable for Axis. However, there is still quite high concentration of suppliers in a part of the world which implies that the geographical location in relation to RM could be further developed, hence the mark "0", party in line with theory, is given.

5.7.11 Standardization of Components

At Axis there is some level of standardization depending on the nature of the component. A reason that not all components are stndardized could be due to their desire to be innovative and have cutting edge products. One example that was described during the interviews was that R&D was limited in what they were allowed to develop since they implemented modifications that resulted in minimal improvement but aggravated the sourcing's work substantially. In the survey the answers from the CMs, regarding if their commodity use standardization of components as a RM strategy, differs, see Figure 4.20. This could be explained by how different the commodity's products are from each other and thus the opportunity for standardization they have. An example of this would be the comparison of the commodity "Accessories", that buy of the standard shelf products, with the commodity "Optics", that

[30] The biggest risk in the survey, see *Chapter 4.2 Sources of Risk at Axis*

buy custom components. Moreover, some components are used in many products and some platforms are used across product groups, but this is not a developed risk mitigation strategy by Axis. Moreover, some interviewees described this as a considerable risk. Consequently, Axis is partly in line with theory and receives the mark "0". To be noted is that due to Axis innovative and specialized products, standardization of all components might not be feasible or suitable.

5.8 Summary of Analysis

To summarize, the analysis performed on the empirical data in comparison with the theoretical framework indicates that Axis is lagging in their proactive SRM. However, it should be noted that this thesis was initiated since the sourcing department realized that their proactive SRM needs to be improved. This analysis indicates that this insight was true. Moreover, if the risk management maturity model, see Chapter 3.3.1.1, would be applied to Axis it could be seen that they are at level 1, Initial. This statement is based on five factors: (i) Axis know that there is a need for RM; (ii) Axis currently conducts some RM activities; (iii) however, these activities are done in an unstructured and ad hoc way; (iv) Axis tends to be reactive in their RM than proactive; and (v) the RM depends on the competencies of the individuals. These factors are the same criteria as Proença et al. (2017) have for level 1, Initial.

Many of the analyzed aspects which needs improvement are connected to a lack of structure, systematic approach and hence governance as well as organizational structure. As the empirical data indicates, Axis does perform activities which are related to a proactive SRM, e.g. supplier rating, supplier development and multiple sourcing, in their cross-functional CTs. But to reach best practice, or what the sourcing department refers to as "world class", these activities needs to be incorporated in an aligned process that is anchored to management. The CTs responsibility of SRM should continue since they are cross-functional teams which is preferable. However, as for now the CTs, in regards of SRM, almost acts as "cross-functional silos[31]" where the shared information and alignment between the CTs is low and the composition of the teams seems to dictate the level of proactiveness. This notion was also indicated during the interviews, that the CMs had little knowledge of the other CTs issues. So even if the CTs consists of individuals from different departments, there seems to be only cross functionality within the CT and not between the departments themselves. This was exemplified by one CM that had to have a meeting with the managers of the R&D department since the CT had been ineffective to influence R&D through their meetings. Therefore, the use of forums, workshops, common tools, parameters/variables as well as a process should be spread across the department and the CTs. If all the CTs would reach a high alignment and cooperation regarding SRM, commodities which has less risks but resources available could support other commodities in their SRM. In order to make sure that an implementation of a proactive SRM process is fulfilled and achieves compliance, it is also suggested that a risk manager or council could be introduced. This would not only improve alignment, development and a better overlook, but also display top management support by investing resources for proactive SRM.

[31] Silo: "an isolated grouping, department, etc., that functions apart from others especially in a way seen as hindering communication and cooperation". Source: Merriam Webster. Available at: https://www.merriam-webster.com/dictionary/silo

6 Developed Construct: Proactive SRM Process

This chapter presents the developed construct based on the case analysis which compared the theoretical framework with the empirical data. Five different constructs are presented, in the following order, according to the findings; (i) governance and organization; (ii) risk identification process; (iii) risk assessment process; (iv) risk treatment process; and (v) risk monitoring process. But firstly a summarized model of all constructs is presented to give an overview of the recommended SRM process.

The findings from the case analysis, together with the theoretical framework have provided the basis for developing the constructs which are recommended to Axis. The overall process, an overview of the five constructs, can be seen in Figure 6.1. As can be seen, the initiating step is the risk identification process which needs to be performed ahead of the other steps. Lastly, the risk monitoring step provides feedback to the risk identification step and the process can start over. It is recommended that the frequency of which these activities are performed should start at a high level, e.g. monthly or quarterly, and then, as learning has increased as well as alignment is reached, the frequency can be lowered to e.g. bi-annually or annually. Additionally, these constructs should be seen as recommendations and not the only way to conduct proactive SRM. Therefore, Axis is recommended to adapt these constructs in a way they deem as feasible. Furthermore, to implement all steps at the same time is not deemed as reasonable and Axis should hence start with some parts, e.g. supplier and component mapping as well as determining the enablers, first to create a solid foundation for their continued development of proactive SRM. By implementing the suggested constructs Axis could move from level one to level three in the maturity model which could lead to increased business value as suggested by Proença et al. (2017). Moreover, implementing the constructs would not necessarily lead to the identification of huge disruptions such as Covid-19. But instead would lead to an overall more resilient SC that would withstand all types of disruptions better and a more effective and efficient reactive responses to disruptions. The criteria which would be fulfilled by the constructs are e.g. a described and standardized RM process, consistency, and enablement to improve over time.

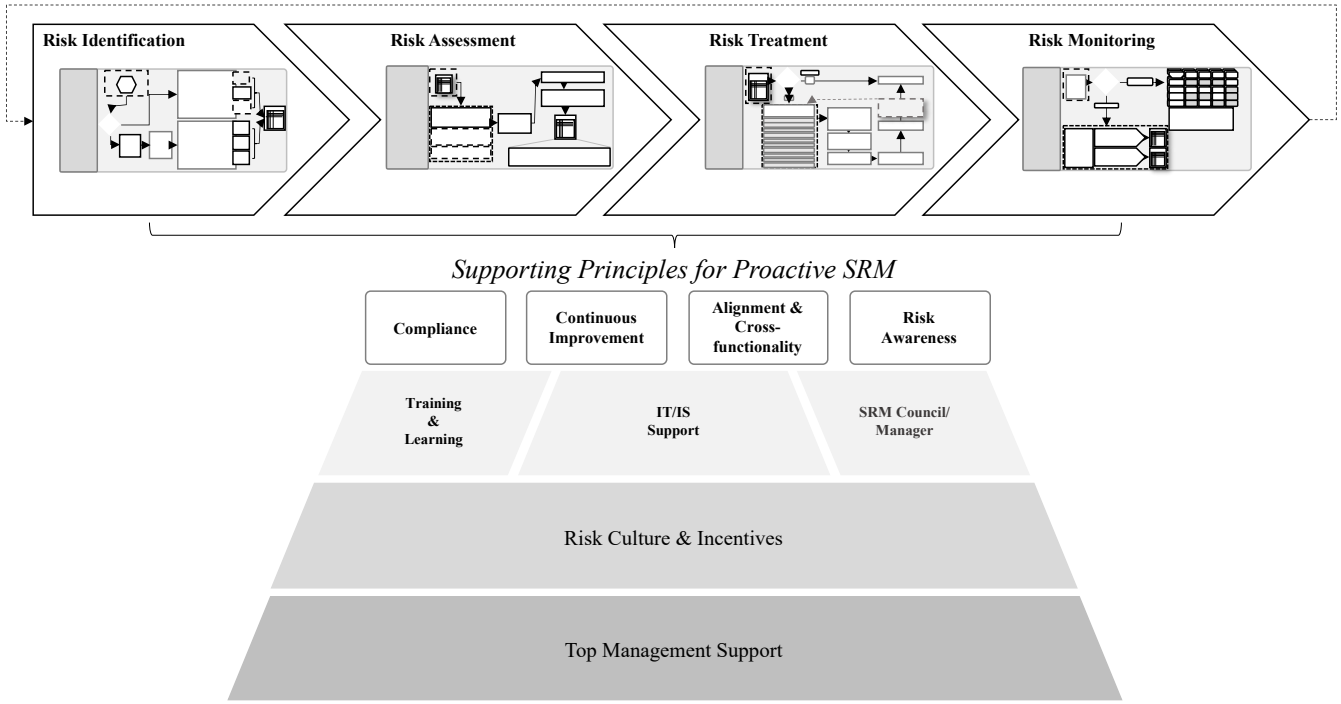
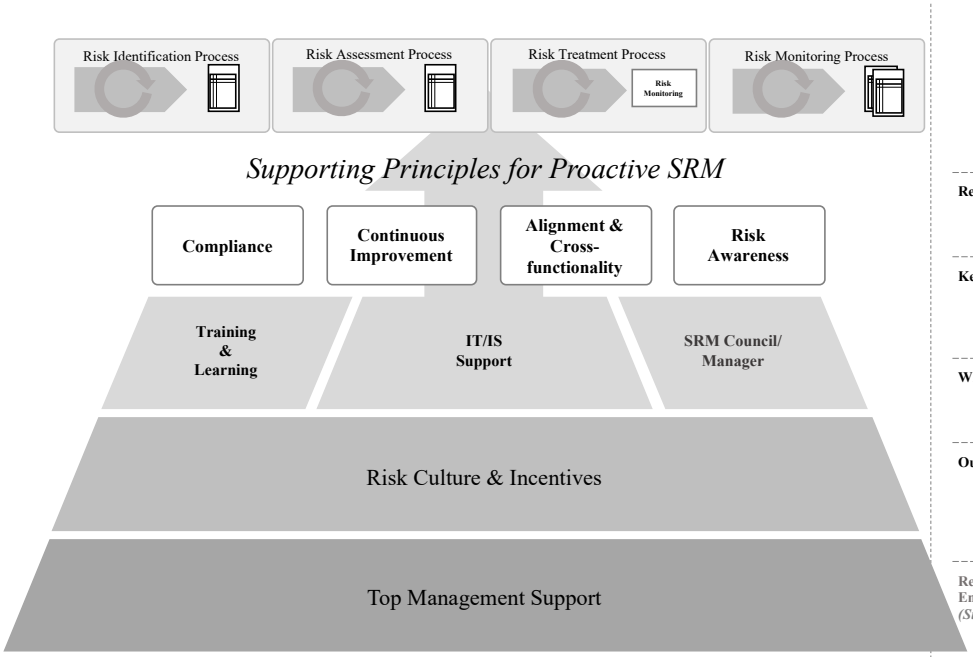


Figure 6.1. The constructs summarized into one model.

6.1 Governance and Organization Construct

The analysis indicated that even if Axis performs several SRM activities the lack of structure, governance and systematic approach hinders alignment and comparability[32]. Therefore, the developed construct regarding governance, and organization, see Figure 6.2, aims to enable, facilitate, and create a basis for the rest of the SRM process. From both the conceptual framework and the analysis four main concepts are concluded to be most critical for Axis moving forward to reaching SRM that is in line with the WCCM goal: (i) top management support; (ii) risk culture and incentives; (iii) training and learning; and (iv) IT/IS support. Furthermore, a risk council is also proposed to be formed in order to take ownership of the SRM implementation and development. The solution proposes that if these four and perhaps five cornerstones are achieved Axis would create "supporting proactive SRM principles": (i) continuous improvement; (ii) alignment and cross-functionality; (iii) compliance; and (iv) risk awareness. To be noted is that this construct differentiates itself from the other four as it is not a clear process with activities but is something that should be continuously present[33].



	Training & Learning	IT/IS Support	SRM Council/ Manager *(Suggestion)*
Resources	• Time • External expertise	• Money • Time to learn systems/tools	• Dedicated individuals • Time • Authority
Key Activities	• Workshop • Seminars • Scenario training	• Implement capacity tool • Supplier & Component database (*Mapping*)	• Aligning, driving, & combining RM activities • SRM Performance
When	• First quarterly… • … then bi-annually	• Continually • Develop as necessary	• Could be project-based for 1-2 years • *Preferably continually*
Output	• Keep interest in RM alive - Awareness • Develop internal capabilities • Quicker reactive response	• Data driven knowledge • A more analytical approach • Higher efficiency	• Aligning & sustaining RM throughout the company
Responsible Entity *(Suggestion)*	• Director • SM • CM	• VP • Director • SM	• VP • Director • SM • Process developer

Figure 6.2. The governance and organization construct.

6.2 The Risk Identification Construct

Axis has stated a wish for more structure and systematic work related to SRM, which also has been supported in the interviews with employees. Additionally, the theory also suggests a more structured and systematic approach[34]. Therefore, this construct, see Figure 6.3, introduces a systematic approach to create a common and aligned process of how and when risk identification should be conducted. The risk identification process is the step that initiates the whole SRM process, i.e. assessment, treatment,

[32] See *Chapter 5.2 Comparing Axis' Governance and Organization vs Theory*
[33] See *Chapter 3.3.1 Risk Process Governance and Organization*
[34] See *Chapter 3.3.2 Risk Identification*

and monitoring. Descriptions of the suggested tools, e.g. brainstorming or cause-effect diagram, can be found in the theoretical framework[35].

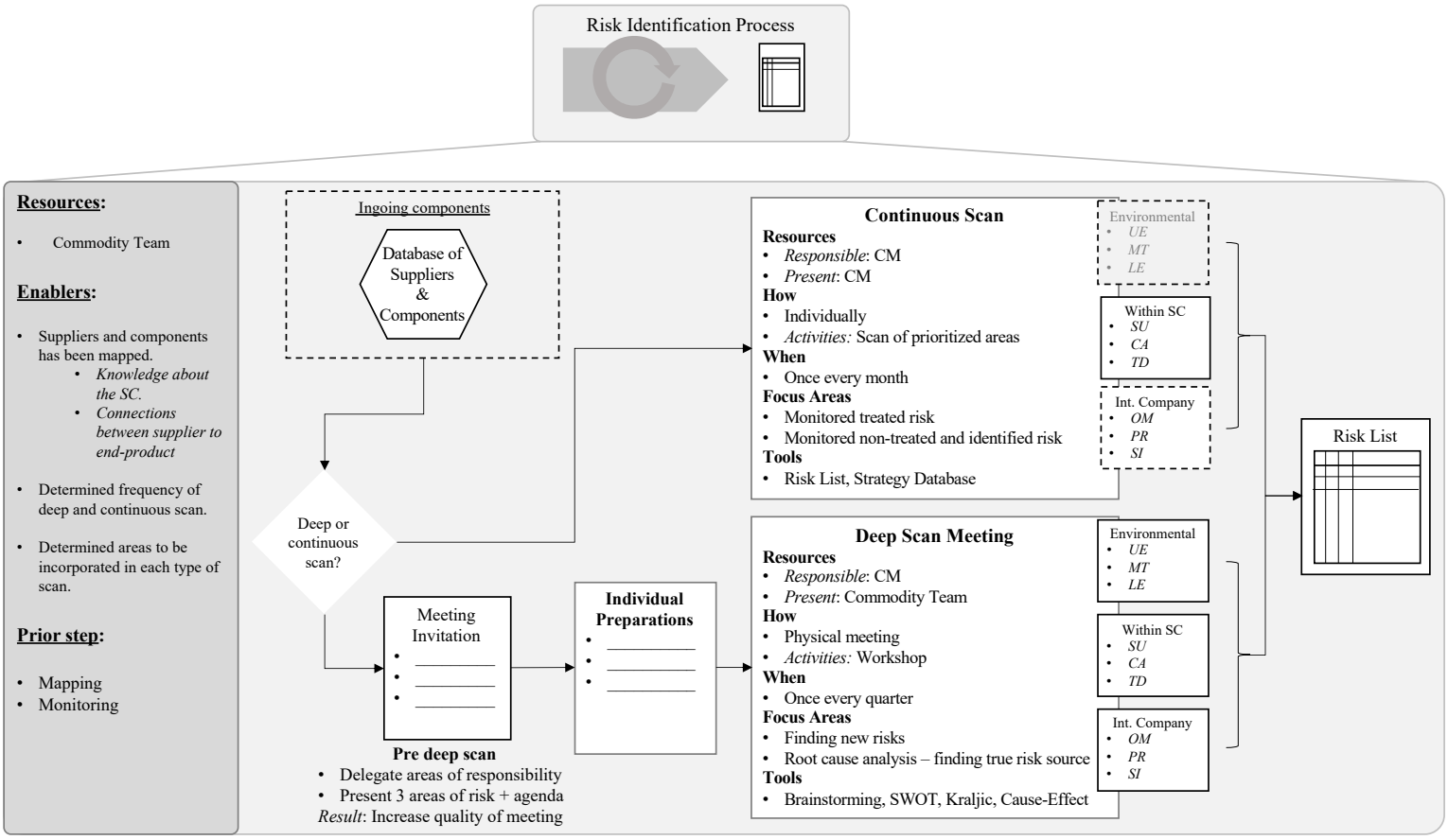


Figure 6.3. Risk identification process map.

One key enabler to the risk identification step is mapping of the supplier and components and thus the entire SC[36]. Having knowledge about the different areas of the SC makes the identification process more efficient and can help in knowing which areas are exposed and needs to be investigated more extensively. Creating a map of all components and their corresponding suppliers and end products could be a sizable task. Therefore, the authors propose that this activity is spread out and done according to a ABC-analysis[37] based on e.g. those components that are connected to high revenue products. Worth mentioning is that during the conversation with Axis employees it was mentioned that the components of a mapping is already present and it is the connection between them that are the only missing part. Nevertheless, the suggested process map for the mapping activity can be seen in Figure 6.4. The factors "Business Recovery Time" could include factors such as time for ramping up of production or time for qualifying a new supplier depending if it refers to suppliers or components respectively.

[35] See *Chapter 3.5 Conceptual Framework for SRM*
[36] See *Chapter 3.3.3.1.1 Supply Chain Mapping*
[37] ABC-analysis breaks down products into three categories based on revenue were the idea is that a few product represents a large part of the revenue. The three categories are A (20% of goods stands for 70-80% of revenue), B (30% of goods stands for 15-25% of revenue), and C (50% of goods stands for 5% of revenue).

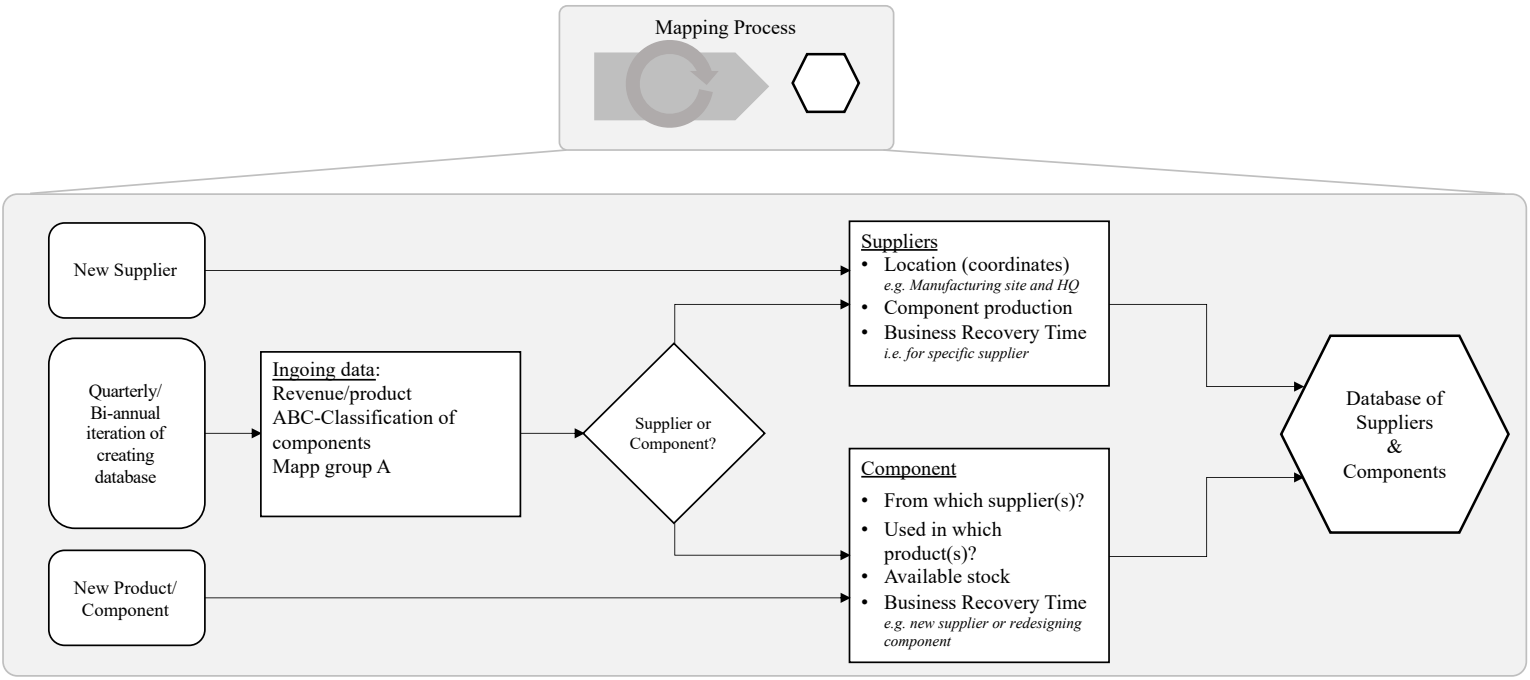


Figure 6.4. Process map of the mapping activity.

The risks that should be scanned for identification are divided into three main categories based on theory[38]; (i) risks in the environment; (ii) risks within the SC; and (iii) internal company risks. Each main category is then divided into sub-categories, see Table 6.1. The purpose of this categorization is to create a basis for statistics, traceability, and alignment in the identified risks between the CTs. In terms of the suggested categories and sub-categories, Axis should discuss if they want to add more, redefine, or use fewer categories.

Table 6.1. The suggested risk categories and sub-categories.

Risk Category	Risk Sub-category	Abbreviation
External (EX)	Unexpected events (UE)	EXUE
	Market Trend (MT)	EXMT
	Local Event (LE)	EXLE
Within the SC (SC)	Supplier (SU)	SCSU
	Contract & Agreements (CA)	SCCA
	Transport & Distribution (TD)	SCTD
Internal Company (IC)	Organization & Management (OM)	ICOM
	Product (PR)	ICPR
	Storage & Inventory (SI)	ICSI

It is proposed that the CTs conducts deeper scanning activities, i.e. "deep scan", each quarter where all three main categories and subsequent sub-categories are analyzed. This is recommended in order to create a comprehensive understanding of the different risks, both internal and external as well as unlikely or likely events. Further, it would increase alignment between top management's whish for Axis not taking any unknown risks[39] and Axis RM. The "deep scan" activity is recommended to take place in the CTs where the members have prepared with scanning their respective areas before attending the meeting. Which areas that each member should be responsible for should be determined ahead of the activity based on their knowledge and expertise. The goal with the deep scan is hence not to only try to identify risks but to put a larger emphasis on understanding the risks and the root-cause based on

[38] See *Chapter 3.2 Sources of Supply Risk*
[39] See *Chapter 5.3.1 Structured Identification Process*

the risks which each member has brought with them. The risks are then logged in a risk list which should be general and accessible for all commodities.

The continuous scan is recommended to act more as a monitoring activity or light-version of the risk identification process. For the continuous scan, it is proposed that CMs mainly focus on some sub-categories of the risks within the SC and internal company risks, e.g. suppliers, components, and inventory, and not all of the risk categories, as the workload then could be too high. Ahead of this activity, it is recommended what each commodity's CM should focus on for their continuous scan. The output should be an updated risk list.

6.3 The Risk Assessment Construct

The risk assessment step, see Figure 6.5, depends on the input from the previous risk identification step as the only risks which can be assessed are identified risks. Hence, the process relies on a robust risk list. If a risk is identified it should also always be assessed in order to take the correct action based on informed decisions[40]. It is also recommended that the supplier and component mapping is utilized in order to make the process more efficient and data-driven. For example, it would make it easier to assess the impact of a supplier issue as all the connected components and their sales value would be accessible to the CT.

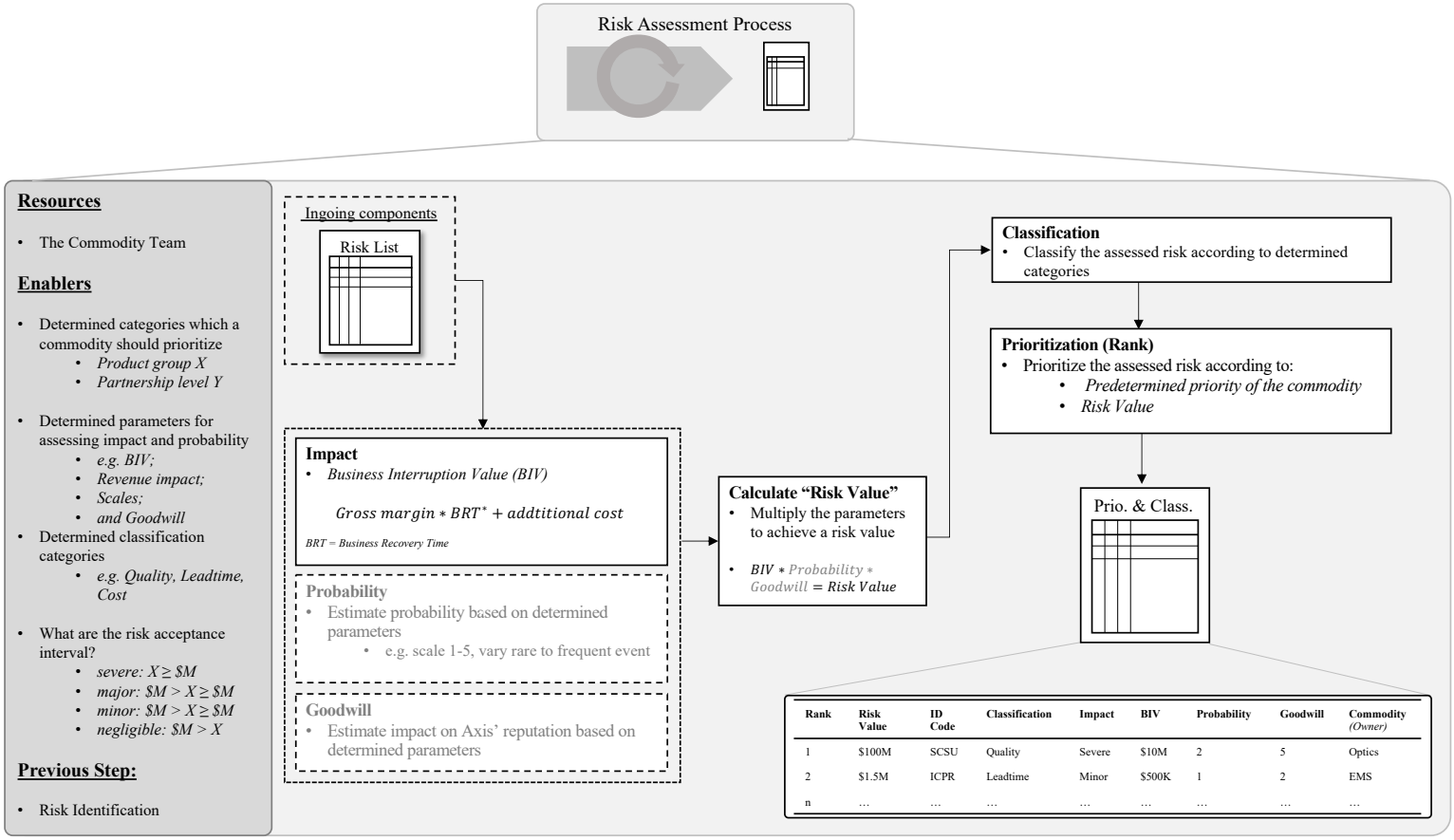


Figure 6.5. Risk assessment process map.

[40] See *Chapter 3.3.4 Risk Assessment*

Further enablers for this process step that should be determined for all commodities ahead of initiating the process are: (i) categories which a commodity should prioritize, e.g. product group A or supplier B-D; (ii) parameters to estimate the risk value, e.g. business interruption value, revenue impact, probability and/or goodwill; (iii) classification categories, e.g. quality, lead time and cost; and (iv) the risk acceptance level, i.e. what risk value is acceptable and what is not. The goal with the enablers is that each CT conducts the risk assessment in the same way with common parameters that have been collectively decided beforehand. This would create alignment, comparability, and make a total overview of the risk level more accessible.

According to theory, the output of the risk assessment step should be a classification and prioritization list[41]. The solution to Axis follows this suggestion and the list is recommended to contain, but not limited to, nine different columns, see Table 6.2. The risk value is a summarized variable of the determined parameters which should determine the severity of the identified risk. It is recommended that the BIV[42] or revenue impact has the largest effect on the risk value variable as they are objective as well as data-driven. Variables such as probability or goodwill are subjective parameters that are more difficult to make aligned between commodities. Therefore, it is recommended that if Axis is to use subjective variables that they are predetermined and that their definition is collectively agreed upon. Furthermore, it would be beneficial to include Axis related examples to the subjective variables' score.

Table 6.2. The recommended nine different columns in the classification and prioritization list with examples.

Rank	Risk Value	ID Code	Classification	Impact	BIV	Probability	Goodwill	Commodity *(Owner)*
1	$100M	SCSU	Quality	Severe	$10M	2	5	Optics
2	$1.5M	ICPR	Leadtime	Minor	$500K	1	2	EMS
n	…	…	…	…	…	…	…	…

6.4 The Risk Treatment Construct

The ingoing component to the risk treatment step, see Figure 6.6, is the classification and prioritization list from the assessment step. Each assessed risk should be compared to the predetermined risk acceptance level, which is a key enabler for this step and should be determined either by management or by the entire sourcing department together. If the assessed risk is below the predetermined risk acceptance level the risk treatment strategy "Acceptance", i.e. to not do anything about the risk, should be selected and the risk should be logged in the risk and action plan monitoring list.

If the risk, however, is above the risk acceptance level it should be treated with an appropriate strategy(s). The appropriate strategy(s) should be selected and evaluated through a business case. These parameters in the business case should also be predetermined again either by management or the entire sourcing department. Based on the business case the strongest alternative, if there are more than one, should be selected and an action plan for this strategy should be developed. To be noted is that the combination of a long-term and short-term strategy, e.g. buffering stock and supplier development, could be selected if appropriate. Nevertheless, if necessary, i.e. the plan is above the CT's budget, the action plan is to be presented to the SG for approval. If approved the strategy is to be executed according

[41] See *Chapter 3.3.4 Risk Assessment*
[42] Inspiration from Ericsson's BIV variable, see *Chapter 3.3.3.1.2 Ericsson Risk Assessment Tools*

to the developed action plan. The risk and the action plan is then to be logged in the risk and action plan monitoring list. Further, the authors propose that a strategy database should be developed were selected strategies based on risk and business cases are to be logged. This database would function as a guidance system for current and future employees. It could also be used in training and learning exercises as well as for statistics.

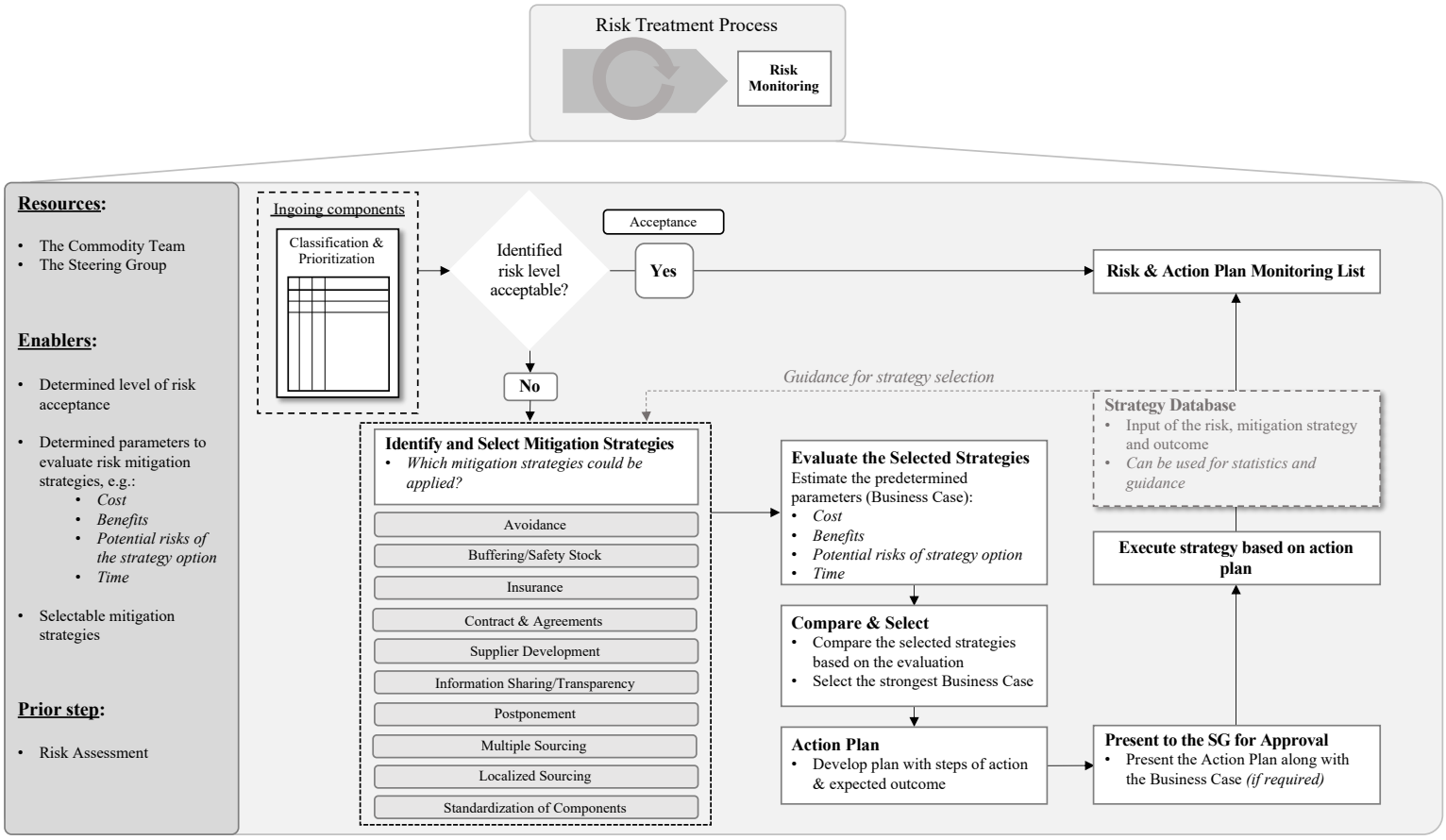


Figure 6.6. Risk treatment process map.

6.5 The Risk Monitoring Construct

In order to keep track of risks, chosen mitigation strategies, i.e. action plans, and the performance of proactive SRM, which due to risks uncertain nature can change, it is recommended that the sourcing department performs risk monitoring activities[43]. To reach consistency, alignment, and comparability the suggested approach is systematic and a structured process, see Figure 6.7. Enablers of this construct are: (i) determine which type of risks and mitigation strategies that should be monitored; (ii) determine how often and when risks, as well as mitigation strategies, should be monitored; and (iii) establish proactive SRM goals for the commodities which is to be monitored for SRM performance.

[43] See *Chapter 3.3.5 Risk Monitoring*

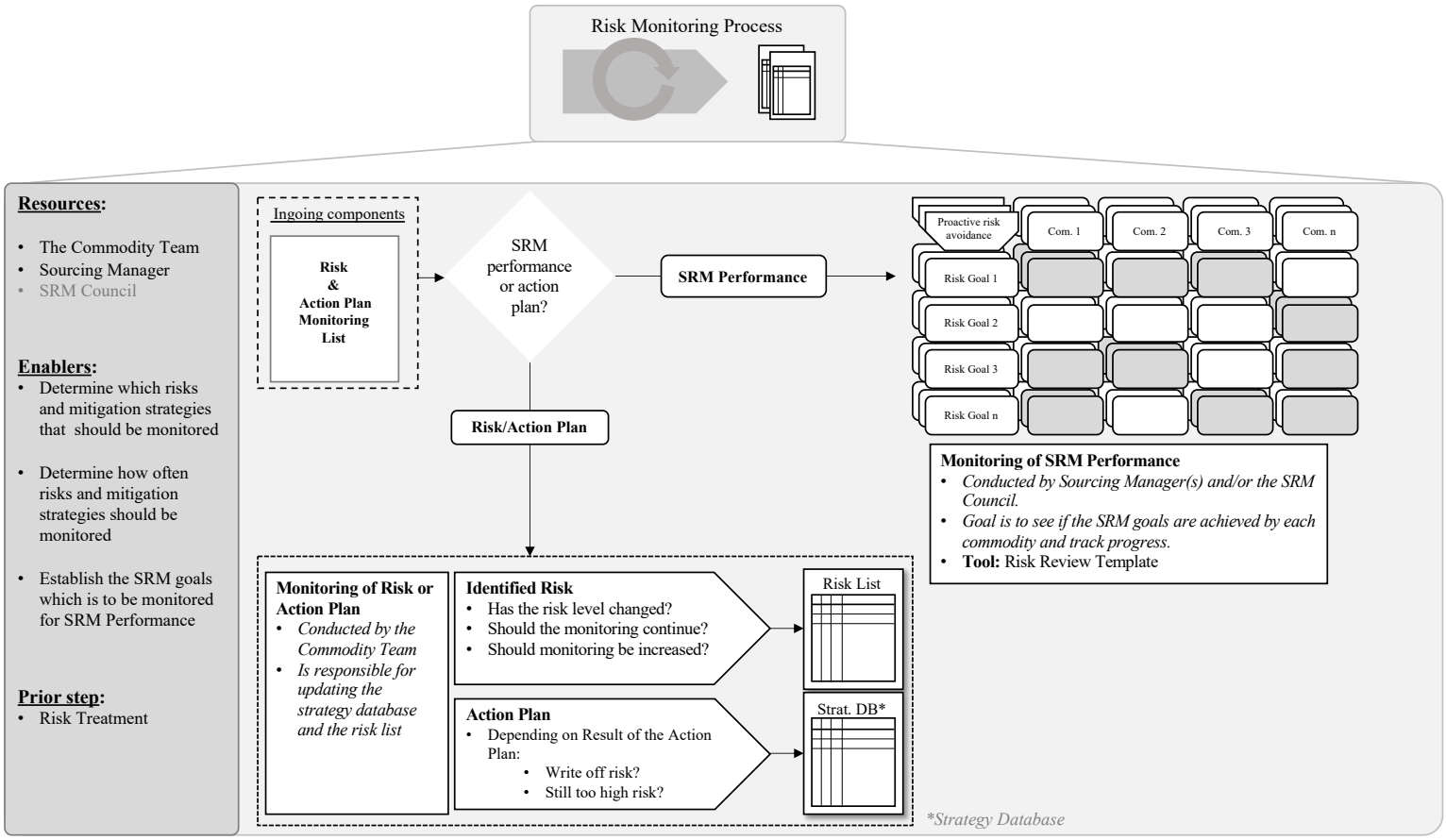


Figure 6.7. Risk monitoring process map.

The risk and action plan monitoring of the process is recommended to be performed by the CT with the action and risks list as input. The main purpose is to track changes in order to stay on top of the risks. The output is to update the risk list if the risk has changed, e.g. write-off the risk as it has been fully dealt with or increase the risk value as a risk has negatively changed. This monitoring activity can also be seen as a part of the continuous scan of the risk identification step. The chosen mitigation strategy which is a part of an action plan is also recommended to be monitored in order to identify if the strategy works and reduces risk or if a change in strategy perhaps is needed, the strategy database is then updated if needed.

The monitoring of SRM Performance step of the process is recommended to be performed by someone at sourcing with a holistic view on all commodities, hence the SM or a potential SRM risk council/manager. The purpose is to track the development and implementation of proactive SRM. Therefore, the determined proactive SRM goals are important as they act as a measure of how mature each commodity is in relation to proactive SRM. If certain commodities need more support it can be identified, but it also visualizes the whole sourcing department's progress. The SRM performance is suggested to be gathered in a risk review template, inspired by Ericsson's tool[44]. This activity is not in need of as high frequency as the other risk monitoring activity as development and progress takes more time. However, this activity, as the others, are still recommended to be of higher frequency, e.g. quarterly or bi-annually, in the beginning, to keep closer track of the development and then get lowered to e.g. annually.

[44] See *Chapter 3.3.5 Risk Monitoring, Figure 3.17*

7 Conclusion

The thesis is concluded in this final chapter were firstly the findings are summarized and the research questions are explicit. Secondly, additional findings that could be of interest to Axis are presented. Thirdly, the thesis' contribution to the theory is discussed. Fourthly the limitations of the thesis are described. Lastly, ideas for areas of future research are highlighted..

7.1 Summary of findings

The purpose of this research and master thesis can be seen from two perspectives; (i) as an effort to develop the research area within SCRM in connection to sourcing with a live-case; and (ii) to assist Axis in their journey towards World Class Commodity Management through proactive SRM. Constructs have been developed to provide a structured process to Axis to reach alignment, compliance, and ultimately support the journey towards WCCM. The theoretical framework, case analysis, and the constructs have developed the existing research on SRM. The four research questions were created in order to reach the purpose and answered below.

7.1.1 RQ1: How should Axis' proactive SRM be set up in order to achieve World Class Commodity Management?

The realization at Axis' sourcing department that a more proactive and systematic approach was needed initiated this thesis. Through interviews, survey, and other empirical data, e.g. internal presentations and documents, the sourcing department's activities related to risk has been thoroughly understood. It became apparent that the employees at sourcing did perform several, even proactive, risk activities such as committed supplier development and emphasis on information sharing. However, the missing link was concluded by the authors to be alignment, compliance, and structure. Hence, the way of which Axis should set up their proactive SRM to reach WCCM should be based in alignment, compliance and a systematic approach, see Figure 7.1. As Axis is a decentralized and innovative company with a high level of freedom and individuality, the introduction of a more compliance-based, structured SRM with a systematic approach could be challenging. Therefore, it is concluded that collaboration, cross-functionality, and adherence with the decided processes are key in order to achieve a higher level of proactive SRM.

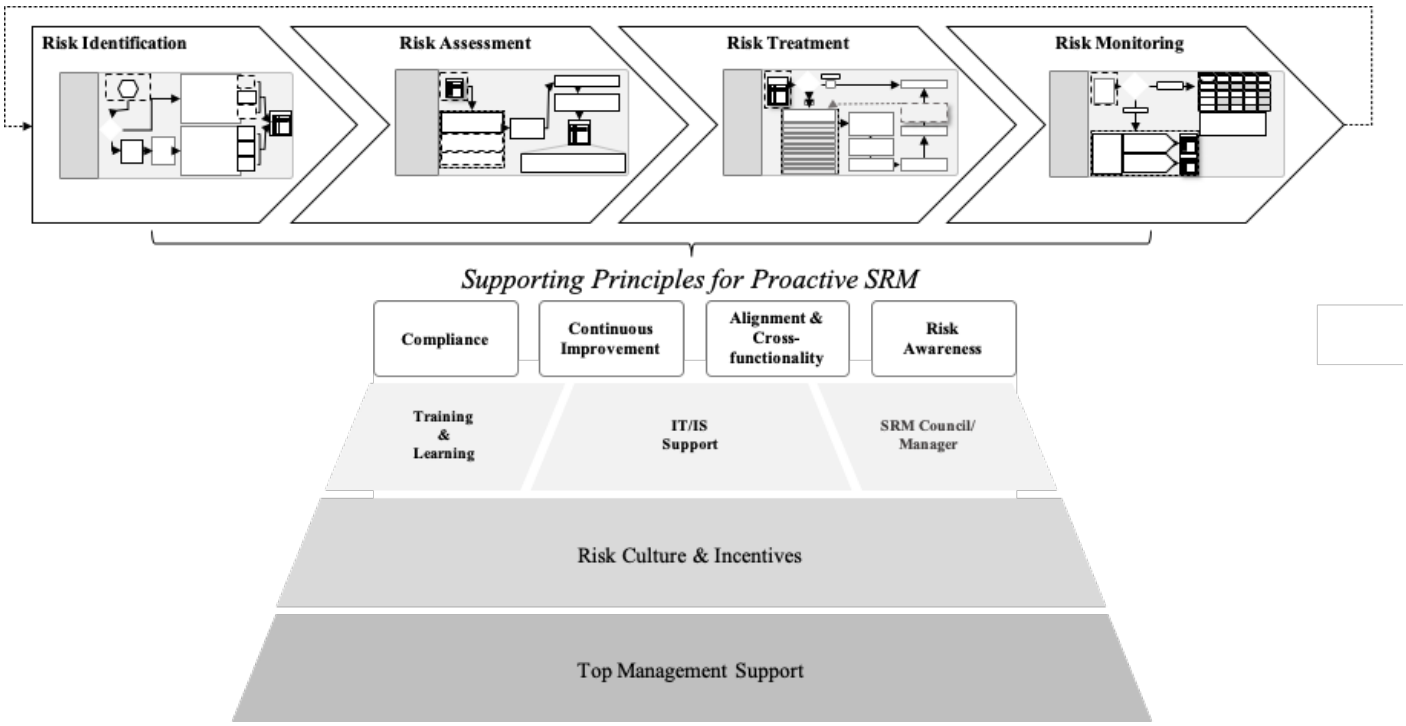


Figure 7.1. The constructs summarized into one model

7.1.2 RQ1a: How should Axis apply and choose proactive SRM-tools in order to reach WCCM?

The sourcing department at Axis already used several tools in their informal SRM work which was revealed through interviews and the survey. However, since there was a lack of structure and alignment between the commodities those that were used were used in an individual manner and different capacities. Therefore, Axis should still use formal tools in their proactive SRM process, strategies, and activities. However, exactly what tools should be used are peripheral. Instead, the most important factor is that the tools are used in the same way across the department and organization. This will enable comparison across commodities so that informed decisions can be made. Thus, the tools that Axis currently are using, e.g. the Kraljic matrix and SWOT, can still be utilized but the criteria should then be uniformed and aligned. Further, Axis could also utilize the tools described in the process maps in Chapter 6 such as structured brainstorming sessions, cause-effect diagrams, BIV (possibly with additional factors that are Axis specific), strategy database, Risk review template, and risk list. Moreover, the formal use of business cases for comparing treatment strategies is perhaps not a tool per se, but the authors still recommend its usage as it would provide structure and alignment in how strategies are selected.

7.1.3 RQ1b: How should proactive SRM processes be applied at Axis and which are suitable for the sourcing department in order to reach WCCM?

Currently Axis have little to no processes for their proactive SRM activities. Therefore, it is suggested that Axis implements processes that will make their proactive SRM work more structured and aligned. Moreover, due to Axis' unique company culture the processes must not be too bureaucratic or controlling. This could be achieved by including the employees at the sourcing department when different elements of the processes are decided. The process that the authors suggest and believe are suitable for Axis sourcing department follows four steps: (i) risk identification; (ii) risk assessment; (iii) risk treatment; and (iv) risk monitoring. These four steps are illustrated in Figure 6.4; 6.5, 6.6, and 6.7

respectively. Furthermore, to complement the process and to make it even more efficient it is suggested by the authors to map all components and suppliers. The process of how this should be done can be seen in Figure 6.4.

7.1.4 RQ1c: How and which proactive SRM strategies should Axis choose in order to reach WCCM?

The empirical data displayed that Axis already uses and applies mitigation strategies to deal with risks to their business, examples being the supplier development and information sharing. The analysis implies that these two strategies should continue to be used as mitigation strategies and as partnerships are crucial to Axis and are in line with the long-term focus. When it comes to other specific strategies that should be used by Axis the theory implies that it is the risk and the context of that risk which should drive the selection and not a limited list of strategies. However, due to the way Axis' business model is constructed, all mitigation strategies should consider the partnerships with suppliers and EMSs.

When it comes to how Axis should select proactive mitigation strategies, the selection process should become more structured and data-driven, see Figure 6.6, to create alignment, compliance, and continuity. Specific proactive mitigation strategies could be supplier development and multiple sourcing[45]. In order to create better understanding and transparency into the CTs decisions, the action plan, which is how the selected mitigation strategy will be applied, should be constructed as a business case when presented to the SG. The business case approach is suitable as it provides an overlook of the selected strategy with parameters such as cost, time, and expected result that management easily and quickly can assess and make an informed decision on. Furthermore, a business case approach will make all CTs selections comparable and aligned.

7.1.5 Additional findings

During the interviews with employees and the survey to commodity managers some feedback was given to the authors and some insights revealed. Some of the feedback and insights were not directly included in the developed construct but could be of interest for Axis. They are therefore listed below:

- A yearly Risk Conference was discussed to bring more focus to the topic and to facilitate training and learning for employees.
- Despite a decentralized organization the employees were overall more positive to more guidelines when it comes to proactive SRM.
- A desire for more standardized templates, e.g. premade PowerPoint slides for different occasions, was mentioned by interviewees since they believed it could facilitate their work.
- A decentralized structure can lead to many new initiatives but there is a large risk that these initiatives are not followed through and therefore becomes redundant. This could in the long run lead to fewer initiatives as they are seen as futile.

7.2 Contribution

The main contribution of this thesis is the developed construct that has been provided to Axis' sourcing department. The sourcing department at Axis had realized that their proactive SRM needed to be improved and become more structured. The construct provides a more structured and systematic

[45] See *Chapter 5.7 Comparing Axis' SRM Mitigation Strategies vs Theory*, for suitable proactive mitigation strategies.

approach to proactive SRM by being divided into four different processes with suggested enablers, activities, resources, and frequencies. The basis of the four processes is the governance and organization which also has been analyzed and provided as a construct. The thesis has also provided empirical data on how the sourcing department works with SRM today which could give insights into areas of improvement and increase cooperation between the commodities. With this thesis and its constructs, Axis have been given guidelines and suggestions into how they should proceed with their proactive SRM as a part of achieving WCCM.

The thesis' contribution to theory can be found in the analytical comparison between SRM theory and the empirical data of a large decentralized and innovative company. The construct could, therefore, shed new light, and with a different angle, on how proactive SRM, which theory suggests to be process and compliance-oriented, can be applied in an organization with a high level of decentralization and innovative culture. Even if companies of this type can be reluctant to implement structured processes and compliance, the thesis displays that it is needed, can be achieved, and is requested from employees. Moreover, Manuj (2013, p.101) suggested that future research should develop user-friendly tools connected to sourcing and risk management, "*Researchers may focus on further exploring the complex interrelation- ships between risks and developing theory and user-friendly tools to support decision-making related to identifying and assessing risks*". As this thesis has constructed clear processes with defined activities, based on theory and on cooperation with employees at Axis, user-friendly tools to support decision-making have been provided, see Figure 6.1 which is a summarizing visualization of Figure 6.2, 6.4, 6.5, 6.6 and 6.7. Furthermore, the thesis' theoretical framework on proactive SRM and the corresponding conceptual framework has not been identified by the authors in other research where a larger focus has been on SCRM. Therefore, the theoretical framework and the conceptual framework can be considered to add to the theoretical knowledge. More specifically, the detailed level of the framework displays connections between sub-areas as well as important aspects of the RM steps with each step respectively which has not been identified in current literature, see Figure 3.22. Lastly, the term of "cross-functional silos" in the concluding analysis has also been lifted and given a practical case example.

7.3 Limitations

There are some limitations to this thesis. One of those limitations is that the focus only was on the supply side of an SC and not the SC as a whole. With a broader focus area it could be possible that additional interesting factors would be found. However, due to the time restriction of the thesis is was deemed that such a large focus area would lead to difficulties. Further, since the focus of the thesis mainly was on the sourcing department at Axis, factors could have been missed. Nonetheless, it was the sourcing department that initiated this thesis and are the ones that are going to work with the suggested process, strategies, and tools. Another limitation was that the authors had no prior experience of working at Axis and therefore needed time to understand the organization, the roles, the intranet, and the company culture. Supervisors and other staff at Axis were therefore consulted to help the authors understand these aspects, the understanding also grew for each. Another limitation is the limited testing of the developed construct. The reason for this was mainly due to the ongoing Covid-19 pandemic that made it unreasonable to conduct a workshop with the entire or large part of the sourcing department. To counter this the authors instead had individual meetings or calls with employees to get feedback on the developed constructs.

7.4 Future Research

As the developed construct is based on Axis, and more specifically the sourcing department, the construct could be tested for other organizations to analyze its applicability and ultimately generalizability. It would also be of interest to study other companies that, similar to Axis, are in the starting phases of proactive SRM and how the theoretical framework of SRM should be applied. Further, similarities and discrepancies between this thesis and new case studies investigating proactive SRM in decentralized organizations could be studied. Another proposal for future research, which also is identified as a gap in the research, is the implementation of proactive SRM, that is structured and systematic in its nature, at a decentralized and innovative company. What are the potential barriers and enablers regarding the implementation and acceptance? Considering the limitations listed in Chapter 7.3, the study of Axis adaptation and implementation of proactive SRM could also be extended to incorporate more functions, and perhaps the whole operations department or even Axis as a whole. This could be performed as a longitudinal study to study Axis over a longer period, much as Norrman and Wieland (2020) was an extended longitudinal study of the initial research by Norrman and Jansson (2004). The existence of cross-functional silos, why, how, and where they exist could also be further researched as an extension on functional-silos. Lastly, four research questions for future research are suggested:

- Is the developed proactive SRM construct for Axis applicable for other organizations in a similar field?
- How can a structured and compliance driven proactive SRM process be implemented in a decentralized and innovative company, and what enablers as well as barriers exist?
- How does proactive SRM evolve in an organization as a whole when it initially was implemented within a single department?
- How and why do cross-functional silos exist within cross-functional organizations?

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A. Appendix 1: Survey Question

This appendix contains the survey questions which was sent out to all CMs at the sourcing department. To be noted is that the actual survey was created through Google Forms and digitally answered.

Question 1:
Which departments are represented in your Commodity Team? (*e.g. R&D, Quality, Product Specialist*)

Question 2:
If you have an extended Commodity Team: Which departments are represented in it? (*e.g. R&D, Quality, Product Specialist*)

Question 3:
If you have an extended Commodity Team: What purpose does it have?

Question 4 (single choice):
How often does your Core Commodity Team have structured meetings? (*neglect covid-19 circumstances*)

- Multiple times a week
- Once every week
- Once every second week
- Once every month
- Once every quarter
- More seldom

Question 5:
Which departments and roles are represented in your Steering Group? (*e.g. R&D Manager, Quality Engineer, Sourcing Manager*)

Question 6 (multiple choice):
Which are your Commodity's largest risks?

- Natural disasters
- Fires (*e.g. a fire in a factory*)
- Epidemics
- Social/Political turmoil (*e.g. terror attacks, coup d'état*)
- Strikes at the supplier
- Trade wars between nations
- Outsourcing
- Globalization
- E-commerce
- Cyber risk
- Single source suppliers
- Quality issues at supplier
- Supplier lagging in technological development
- Geographical concentration of suppliers
- Lack of information/transparency from suppliers
- Contracts

- Physical distribution/transport of goods
- The bullwhip effect
- Loss of knowledge within the organization
- Lack of structure within the organization
- The complexity of the components
- Too high stock levels of components
- Too low stock levels of components
- Other:_____

Question 7 (multiple choice):
Which tools/models do your Commodity utilize?

- Kraljic's Matrix (*categorization of products based on, bottleneck, strategical, non-critical and leverage*)
- SWOT (*Strengths, weaknesses, opportunities and threats*)
- Risk Matrix (*probability and impact of risks*)
- Matrix of Dependency (*level of dependency between supplier and customer*)
- Commodity Portfolio Matrix (*categorization of suppliers based on, bottleneck, strategical, non-critical and leverage. OBS this is not Kraljic's Matrix*)
- Event Tree Analysis
- Fault Tree Analysis
- Cause-effect/Fishbone/Ishikawa Diagram
- 1st Tier Supplier Mapping
- 2nd Tier Supplier Mapping
- 3rd Tier Supplier Mapping
- Geo-mapping (*geographical mapping of suppliers*)
- Component Mapping

Supply Chain Mapping (*mapping of the supply flow*

Question 8 (multiple choice, mark with X):
To what extend does your commodity team use the following risk treatment strategies?

	5 (to a very high degree	4	3	2	1 (never used)	Don't know
Avoidance						
Acceptance						
Safety stock						
Insurance						
Contracts						
Supplier development						
Information sharing						
Postponement						
Multiple sourcing						
Having certified back-up suppliers						
Localized sourcing						
Standardization of components						
Contingency plans						

Question 9 (multiple choice, mark with X):
For which suppliers and how often are supplier rating conducted?

	More than 2 times/year	2 times/year	1 time/year	1 times every other year	More seldom	Never	Don't know
Strategic							
Preferred							
Approved							
Phase in							
Phase out							
Under observation							

Question 10:
What KPIs do you measure during your supplier audits?
Answer: _____

Question 11 (multiple choice, mark with X):
At which suppliers and how often are physical audits conducted?

	More than 2 times/year	2 times/year	1 time/year	1 times every other year	More seldom	Never	Don't know
Strategic							
Preferred							
Approved							
Phase in							
Phase out							
Under observation							

Question 12 (multiple choice, mark with X):
To what degree is information regarding risk or risk management shared, regardless of direction, with suppliers?

	Weekly	Monthly	Quarterly	Yearly	More seldom	Never	Don't know
Strategic							
Preferred							
Approved							
Phase in							
Phase out							
Under observation							

Question 13 (single choice):
How often is the risk management work monitored?

- Weekly
- Monthly
- Quarterly
- Yearly
- More seldom
- Never
- Don't know

Question 14 (single choice):
Is there incentives for proactive risk management?

1. Is not true at all
2.
3.
4.
5. Is very true

Question 15 (single choice):
What is your attitude towards increased directives and guidelines from management when it comes to proactive risk management?

1. Very negative
2.
3.
4.
5. Very positive

Question 16 (single choice):
How often do you use the "Commodity Management Process"?

- Weekly
- Monthly
- Quarterly
- Yearly
- A few times since employment
- Never
- Don't know what this document is

Question 17 (multiple choice):
If you answered "Yearly" or more seldom, what is the reason for this?

- The document is too long
- The document is too detailed
- The document is outdated
- The document is primarily used for onboarding
- Other

Other: _____

B. Appendix 2: Conducted Interviews

Table B.1. When and with whom an interview was conducted.

Role	Part of organization	Date	Duration
Corporate Governance Specialist	Corporate & Governance Control	2020-03-23	90 min
CM	Sourcing	2020-03-24	90 min
CM	Sourcing	2020-03-24	90 min
Director	Corporate & Governance Control	2020-03-24	90 min
CM	Sourcing	2020-03-25	90 min
CM	Sourcing	2020-03-25	90 min
CM	Sourcing	2020-03-26	90 min
CB	Sourcing	2020-03-26	90 min
PP	Sourcing	2020-03-27	90 min
Manager	Sourcing	2020-03-27	90 min
Manager	Sourcing	2020-03-30	90 min
Process Developed	Sourcing	2020-04-01	90 min
VP	Operations	2020-04-03	60 min
Director	Sourcing & Product Preparation	2020-04-06 2020-04-09	90 min 60 min

C. Appendix 3: Interview Guide

Introduction

1. We tell shortly about ourselves and the purpose of the master thesis
2. Explanation about how the empirical data should be used and that they can see the thesis in its entirety when it is complete
3. Go through the suggested agenda of the interview and ask for permission to record the interview
4. Explanation of the terminology: identification, assessment, treatment, monitoring, and tools.
5. Explain that one author will mainly ask the questions while the other takes notes.

General introduction questions

1. Can you tell us about yourself and your role at Axis?
2. How does Axis work with sourcing
    a. Which areas of responsibility does the sourcing department have?
        i. How and with which department does the sourcing department interact with?
    b. What degree of outsourcing do you have at Axis?
    c. What is the strategy for outsourcing at Axis?
3. What does the organizational structure look like for risk? (e.g. a corporate risk department)
4. How do you work with risk acceptance in your organization?
    a. What are the directives from management when it comes to risk?

The risk management process at the Sourcing department

Governance when it comes to risk

5. Do you have a defined risk management process? If yes, how does it look?
    a. Could you share it with us if it is documented?
    b. Who knows about this process and works according to it?
    c. What type of risks is included in this process?
6. Whom developed and improves risk processes at sourcing and company-wide?
7. How does your proactive risk management look at compared to the reactive?
8. How is risk management coordinated cross-functionally?
    a. With which other departments do you cooperate with when it comes to risk?
9. How do you share information regarding risk management with your suppliers and vice versa?

Risk Identification

10. How do you identify risks?
    a. What are your starting points for risk identification? (e.g. products, components, suppliers)
    b. What are the advantages of this way?
    c. What are areas of improvement?
11. How is data collected for risk identification?
    a. How is this data structured?
        i. What type of data is focused upon? (e.g. volume, lead times)
12. How often do you identify risks?

13. How is the accountability for risk identification distributed?
    a. What are the advantages of this way?
    b. What are areas of improvement?
14. What are the biggest risks you have identified?

Tools

15. What tools do you mainly use when it comes to risk identification?
16. Can you describe these tools?
    a. Advantages?
    b. Disadvantages?
17. Whom uses these tool and how often are they used?
18. Which tools are supplied by external parties (e.g. consultancy firms and system providers)

Risk Assessment

19. How do you assess risks and how often do you do it? (e.g. qualitative/quantitative & formal/informal)
    a. What are the advantages of this way?
    b. What are areas of improvement?
20. How do you classify risks?
    a. What categories do you have?
21. How do you prioritize and rank risks?
22. Whom and how determines when a risk needs to be treated?

Tools

23. What tools do you mainly use when it comes to risk assessment?
24. Can you describe these tools?
    a. Advantages?
    b. Disadvantages?
25. Whom uses these tool and how often are they used?
26. Which tools are supplied by external parties (e.g. consultancy firms and system providers)

Risk Treatment

27. How do you treat risks that have been assessed and how often do you do it? (E.g. find new supplier, increase safety stock, accept the risk)
    a. What are the advantages of this way?
    b. What are areas of improvement?
28. How do you select a risk treatment strategy? (What factors affect your selection?)
29. What risk treatment strategies do you use most frequently and why?

Tools

30. What tools do you mainly use when it comes to risk treatment?
31. Can you describe these tools?
    a. Advantages?
    b. Disadvantages?
32. Whom uses these tool and how often are they used?
33. Which tools are supplied by external parties (e.g. consultancy firms and system providers)

Risk Monitoring and Risk Management Performance Monitoring

34. How do you work with risk monitoring and how often do you monitor a risk?
35. How do you follow up treated risks?
    a. How often do you follow up on treated risks? Are there rules/guidance for how often it should be done?
36. How do you monitor identified risks?
37. How do you monitor your selected strategies?
38. How do you monitor you risk management performance?

Tools

39. What tools do you mainly use when it comes to risk monitoring?
40. Can you describe these tools?
    a. Advantages?
    b. Disadvantages?
41. Whom uses these tool and how often are they used?
42. Which tools are supplied by external parties (e.g. consultancy firms and system providers)

Other

43. Is there anything regarding your organization and/or risk management that you want to add?

D. Appendix 4: Theoretical framework

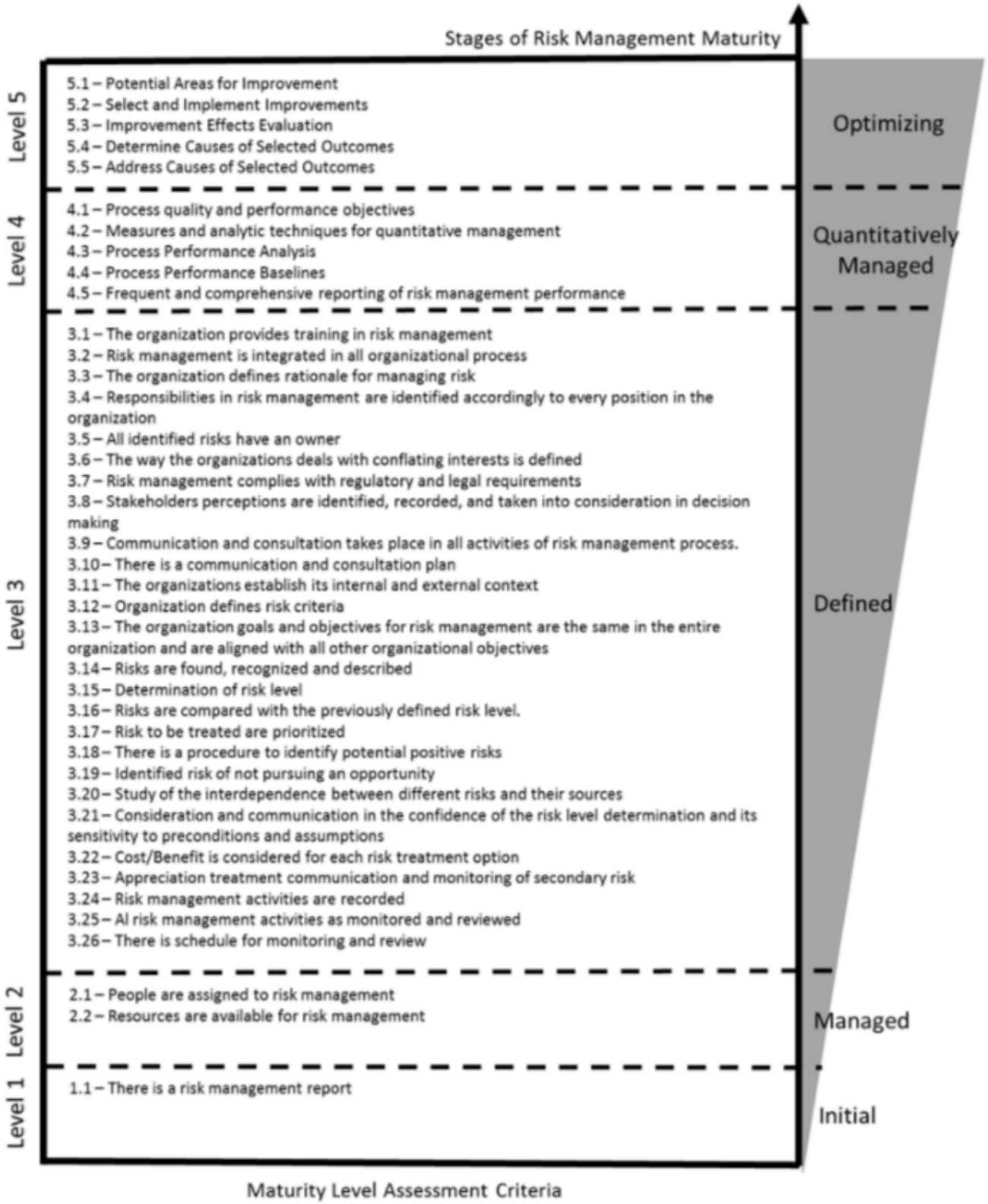

Figure D.1. Maturity Level Assessment Criteria (Proença et al., 2017, p.106)

E. Appendix 5: Empirical Data

Table E.1 Detailed description of Axis' partnership levels

Category / Aspect	Strategic	Preferred	Approved	Phase In	Under Observation	Phase Out
Category Purpose	Access to products / technology that strengthen competitive edge of Axis	Close collaboration for better cost and/ or service. Reward Category vs Approved where we exploit what suppliers value but does not cost Axis anything, an even business load for instance	To maintain competition and volume flexibillity in supplier base	New supplier being tested in smaller scale	Under performing suppliers in any aspect ; Quality, delivery, service level If a supplier simply is too expensive it may be phased out directly	Continuous under performance , breach ot Code of Conduct or severe financial problems
Category Management Structure	Management Involvement Regular business reviews with management	Commodity Team involvement. Business reviews at least twice per year	Commodity Team. Business reviews when needed, at least once a year	Commodity Team monitors performance closely. Business reviews if needed	Commodity Team monitors performance closely. Business reviews if needed	Commodity Team monitors performance closely when needed. Business reviews if needed
Supplier Performance (Quality, Delivery, Cost, and Service will be tracked)	Supplier performance is not the most important aspect of this category. Min level required.	Strong performance level required in return for priority towards even business load	At least decent performance level	To be evaluated, when we know supplier will be transfered to Approved, Under Obs or even Phase Out	Below requirements	Performance history has led to a decision to phase out.
Capabilities	Posesses the ability or potential to bring unique / valuable features to Axis products	Standard capabilities used in considerable share of Axis volumes	Standard capabilities used in considerable share of Axis volumes	Standard capabilities used in considerable share of Axis volumes	Standard capabilities used in considerable share of Axis volumes	Standard capabilities used in considerable share of Axis volumes
Financial requirements	Healthy	Healthy	Healthy	Healthy	Healthy, other status may be reason for this categorization	Healthy, other status may be reason for this categorization

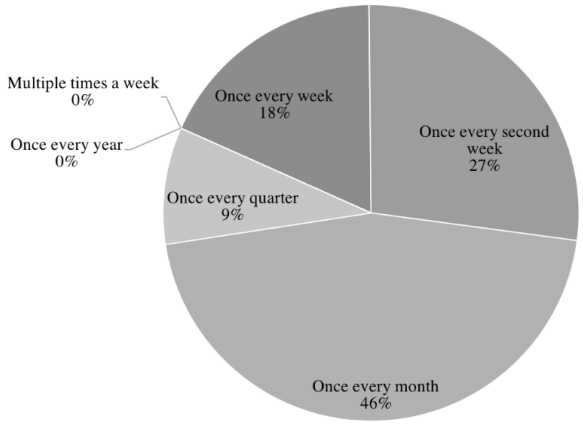

Figure E.1. Breakdown of how often the CTs meets from survey.

Table E.2. Description of what the AVL contains.

Columns for data	Description
SUPPLIER_ID	Supplier ID used in IFS system.
Supplier name	Use same supplier name as has been entered into IFS
Manuf Country	Indicate where supplier have manufacturing for Axis products. Just one country can be indicated per row
Manuf Site City	Indicate where supplier have manufacturing for Axis products. Just one city can be indicated per row
Manufacturer ID	Usually common for tool bounded parts, such as die-casting, plastic injection. Find more info at Axis #XXXXX in Camel database
Supplier Classification	Indicate what status supplier having
Supplier Approved Date	The date the supplier was formally approved.
Supply Responsible	Supply responsible person for this supplier.
Sourcing Responsible	Sourcing responsible person for this supplier.
Commodity 1	Indicate main product/service supplier offer.
Commodity 2	Indicate secondary product/service supplier offer.
Supplier contact information	Several columns; Name, Description, E-mail/Phone.
Quality Certification	Which quality standards the supplier is in compliance with
Environmental Certification	Which environmental standards the supplier is in compliance with
Quality Status	Coming
Last Quality Audit	Date of last Quality audit
Type of Audit	Coming
Sustainability Status	Coming
Last Sustainability Audit	Date of last Sustainability audit
Sustainability Critical	Coming
MD Trustworthiness	Coming
RoHS Material Assessment	Coming
RoHS Justification	Coming

Table E.3. Judging criteria for supplier evaluation rating.

Score	Judging criteria
5	Excellent performance, always offer solutions beyond expectations
4,5	Very good performance, always meet requirement and offer what Axis need.
4	Good performance, meet requirements with very few exemptions
3,5	A bit uneven performance, mostly meet, but occasionally fail.
3	Fair
2,5	Not quite reaching Fair performance
2	Below average performance, meet requirement sometimes, but relatively often fail to offer what Axis need.
1,5	Poor performance, fail to meet requirement more often than they succseed.
1	Poor performance, almost never meet requirement, often fail to offer what Axis need.
0,5	Very Poor performance, has never met requirement. Phase out over time

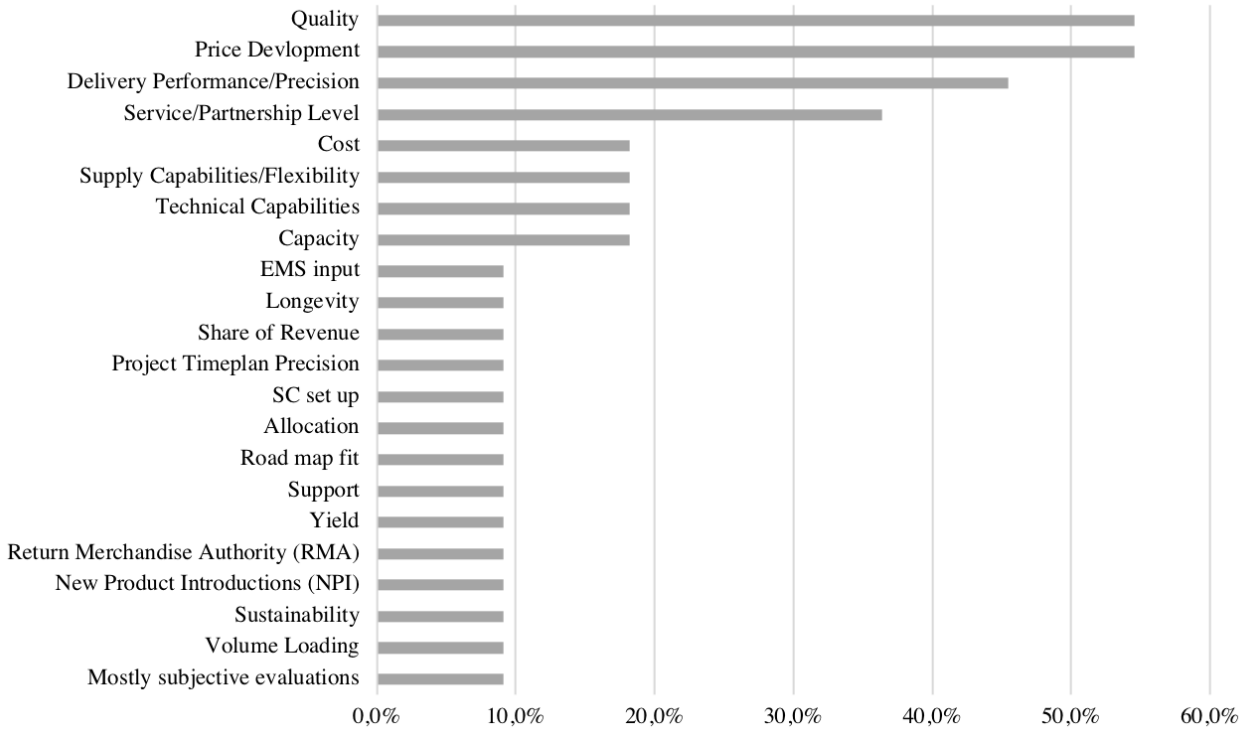

Figure E.2. The different KPIs which is measured at the supplier rating. (Source: CM survey)

Table E.4. The Escalation Tool.

General info	**Description**
Why	A collaboration between Axis and suppliers to minimize potential disturbances in the supply chain.
How	In a standardized way highlight parts to Axis in a pre-determined template.
When	When the supplier recognizes a potential risk that could affect deliveries and no solution is given after 1 weeks' time.
Examples when to escalate	• Escalate when there is no availability on market of raw materials/components • Sub-supplier is not delivering as expected • Potential bottlenecks in productions, Capacity issues • Highlight quality issues affecting deliveries (Solutions discussed in separate processes)
Template headlines	Example input
Created date	DD/MM/YYYY
Supplier	abc
Component(s) (Axis part number)	123
Part description	screw
Problem/Risk description	Sub-supplier has long lead times and an unstable supply
Potential affected orders/forecasts. State if it is for Axis or EMS	This will affect order nr; XXXXX and potentially delay upcoming orders to Axis
Suggestions for improvements/solutions	Buffer stock at sub-supplier or better exchange information/forecast
Status (open/closed)	open