**LAPPEENRANTA UNIVERSITY OF TECHNOLOGY LUT**

School of Business and Management

Master's Programme in Supply Management

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# Developing a Risk Evaluation Criteria for Indirect Procurement

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**TIIVISTELMÄ**


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Globaalit ja monimutkaiset hankintaketjut ovat arkipäivää nykyisessä liiketoimintaympäristössä, toimialasta riippumatta. Yritysten ollessa yhä riippuvaisempia hankintaketjujen toiminnasta, niihin kohdistuvat riskit ja niiden hallinta ovat nousseet yhä tärkeämmäksi osaksi hankinta-ammattilaisten toimenkuvaa. Huolimatta lukuisista aikaisemmista tutkimuksista hankintaketjujen riskien hallintaan ja arviointiin liittyen, epäsuoraan hankintaan keskittyvien tutkimusten määrä on edelleen melko pieni, huolimatta sen kasvavasta taloudellisesta vaikutuksesta, erityisesti suurissa yrityksissä.

Tämän pro gradu tutkimuksen tarkoituksena on selvittää, millä tavoin hankintaketjuihin kohdistuvia riskejä voidaan jaotella hallittaviksi osa-alueiksi ja määritellä, mitkä niistä ovat olennaisia epäsuoran hankinnan kannalta. Tutkimuksen tarkoituksena ei ole muodostaa tarkkaa kvantitatiivista riskimallia eikä määritellä tarkaan eri osa-alueiden arviointiin vaadittavia riskimittaristoja.

Tutkimusmeneltämänä toimii laadullinen toimintatutkimus, jossa tutkija on itse mukana ratkaisemassa käytännöllistä liiketoimintaongelmaa kohdeorganisaatiossa. Käytetty ainesto kerättiin kohdeyrityksessä järjestettyjen työryhmäpalavereiden, pienempien, vapaamuotoisten haastattelujen sekä tutkijan kehitysprosessin aikana tekemän tiedonkeruun avulla. Tutkimuksen tulokset esittävät viitekehyksen epäsuoran hankinnan ydinprosessien ja kategorioiden hallintaan liittyvien riskien kokonaisvaltaiseen arviointiin. Tulokset osoittavat myös, että yrityksen mahdollisuudet onnistuneeseen riskien arviointiin ovat selvästi kytköksissä käytettävissä olevan datan laatuun.

## ABSTRACT


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Global and complex supply chains have become common in the today's business life, across all industries. As businesses have become increasingly dependant on the performance of their supply chains, the related risks and managing them has become more relevant in the work of supply chain professionals. Despite the vast amount of studies focusing on supply chain risk management and evaluation, little attention has been paid to them in the context of indirect procurement, despite its growing financial impact, especially in large companies.

The study aims is to examine, how supply chain risks can be categorized into manageable dimensions and define, which are relevant for the purposes of indirect procurement. The purpose of the study is not to create a quantitative risk modelling tool or define the exact input variables for each dimension of the supply chain risks.

The study applies a qualitative action research, in which the researcher has actively participated in solving a practical business problem in the case organization. The data was collected from workshops, discussions and unstructured interviews in the case organization as well as first-hand observations made by the researcher during the project. The results of the study present a framework for supply chain risk evaluation from a broad perspective. The findings also point out the relevance of the quality of data in relation to the organization's capabilities in risk evaluation.

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# 1. INTRODUCTION

The study's purpose is to understand which risk elements are essential for a structured risk evaluation between different product categories. As business has become increasingly global, the longer and increasingly complex supply chains present many kinds of risks throughout the chain. During the 21st century, tackling these risks has become an increasingly important topic both in academia and business organizations.

The introduction consists of three subchapters: a background section and objectives, literature gaps and research question. The background section presents the overall background implications leading up to the research topic as well as the real-life business need originating from the case company. The second subchapter examines the gaps in existing literature and ways the study aims to contribute to academia. The third subchapter lays out the research questions determined based on the first two subsections.

## 1.1 Background and objectives

During the past 25 years the economic world has become more complex and unstable. (Christopher & Holweg 2011) With business management trends, such as emphasizing the best possible process efficiency, and the increasingly competitive and complex business environment, companies have started focusing on their core competencies, further increasing the level of outsourcing (Aqlan & Lam 2015). Supply chains have become more complex and increased in length, as a result of several parallel information and physical flows, whose purpose is to assure the delivery of products, in required amounts and to the correct location, as efficiently as possible (Jüttner 2005).

Traditionally the procurement function has been responsible for handling the communication between the company and its first-hand suppliers. Due to globalisation and increasing levels of outsourcing, it has evolved from routine-based and supportive part of the organization into a possible source of competitive advantage. (Schoenher, Modi, Benton, Carter, Choi, Larson, Leenders, Mabert, Narasimhan & Wagner 2011) This change in the role of procurement function, together with the occurrence of external and internal risks has surfaced the need for supply chain management activities (Aqlan & Lam 2015). While examining supply chains, Harland, Brenchley and Walker (2003), noted that the focal

companies could only detect less than 50 percent of the risks occurring in their supply chains. As an illustrative instance of this phenomenon, the initial demand for this research originates from real business cases in the procurement organization of the case company.

The case company has grown quite a lot during the last 10 years and entered new markets, making the supply chains increasingly complex and international, and thus harder to manage. Consequently, the company's indirect procurement unit has experienced an increased amount of realized supply chain risks in the recent past, such as supplier bankruptcy, service unavailability and price changes due to no monitoring and verification of supplier pricing. As the risks have often been detected quite late, the management has had to focus more on reducing the impact than preventing the risk occurrence all together, which has had an excessive amount of negative impact on the procurement unit's performance, compared to the desired state. Consequently, the procurement managers have identified an increasing need for data related to the category and supplier risk management. As a result, the procurement unit has set a goal of constructing a forum for category and risk management data and information during the current fiscal year, in order to provide a sufficient tool for the managers to utilize for successful category management. Therefore, the study aims to ultimately provide the category managers sufficient knowledge to better manage the general, category specific and supplier specific risks.

## 1.2 Research gaps in literature

While several studies regarding supply risk management exist in the academic literature and several risk evaluation and management models have been developed in business organizations (Zsidsin 2003; Song, Mascini & Zacharias 2006; Rao and Goldsby 2009; Ming & Liu 2017), the existing frameworks are still somewhat unpolished and no general guidance seems to exist. Most of the existing research tends to focus on direct procurement in manufacturing companies and therefore generally account for specific kinds of products or services, which share similar characteristics affecting different parts of the supply management core processes.

Indirect procurement is largely neglected in supply chain risk management literature and supply management research overall. According to Jayara and Curkovic (2018) this is largely due to "gaps in the data collection, summary and display capabilities of procurement and ERP systems". They state that without a formal data strategy and approach, most

analysis on indirect procurement is very basic and done case by case, which is hardly justified as the indirect procurement spend in large companies might be up to millions or billions of dollars.

Almost two decades ago, Zsidsin (2003) has noted the necessity of collecting more information on how procurement managers perceive risk in future research. Sodhi, Son and Tang (2012) have more recently addressed that the current literature of supply risk management lacks a clear consensus of the definition and there is still a lack of empirical research in the field. Lavastre, Gunasekaran and Spalanzni (2011) have similarly suggested conducting more case studies on how companies identify and manage the risks in their supply chains. A survey conducted by Snell (2010) illustrates the demand for more research on supply risk management, as even though 90 percent of the responding companies admitted to fearing disturbances in their supply chains, only 60 percent felt they had the knowledge or tools to manage such issues. Christopher, Mena, Khan and Yurt (2011) have alike reported that most organizations lack structured systems to negate and manage supply chain risks.

This study aims to contribute to the existing literature by considering existing definitions of supply risk and collecting empirical evidence of how they are perceived by procurement professionals. The goal is to have a more holistic viewpoint into supply risks among multiple product categories and focus on indirect procurement of a manufacturing company. As a global organization, the case company provides a great opportunity to examine the varying types of procurement risk management needs. Especially the indirect procurement, containing several different product categories ranging from IT services to product additive chemicals, allows examining the risk management requirements related to diverse order process designs, supplier relationship levels and characteristics of procured goods and services. On a practical level, the study intends to create a general framework for assessing different dimensions of supply risk and therefore contribute to developing more structured risk management practices in the case company.

## 1.3 Research questions

As established, existing literature and academic research already contains an extensive amount of material regarding supplier risk, supply chain risk management and supplier risk management (Ho 2015; Jüttner 2005; Rao 2009; Sodhi & Tang 2012; Fischl 2014). However, no industry, supply chain, business or product category is the same, which means neither are the related risks. This makes risk management, and particularly supply chain risk management, very case sensitive. As contingency theory suggests, there is no single best way to manage the processes of organizing and decision making (Fiedler 1964), and supplier risk management is no exception. The main purpose of this study is to determine which kind of risk elements are essential for successful risk evaluations, risk management and therefore category management in the case company. Attention is also paid to availability of the necessary data. Therefore, the main research question to guide the research process formed as:

*"Which risk dimensions should be included in the supplier risk evaluation?"*

While choosing the elements, it is important to make sure that the chosen factors are in fact relevant for the category management and the existing best practices and knowledge is not discarded. To ensure this, it is important to examine how decisions related to supplier risk are currently handled in the company. To ensure that these factors are considered, the first sub-question was formed:

*"How are supplier risks currently being handled in the case company?"*

While the knowledge and expertise of the people in the organization can be essential, the data gathered in systems can sometimes be a better reflection of the reality and contribute to the evaluation of risk. While risks are very case specific, it is important to examine it in the specific context. Therefore, the second sub-question was formed as:

*"What kind of data can be utilized for risk evaluation in indirect procurement?"*

# 2. DEFINING AND MANAGING SUPPLY CHAIN RISK

To manage the risks, they must be identified. In order to identify a risk, a clear definition of the term in general and in the context of this research needs to be specified. Luckily, the existing literature provides an extensive collection of research papers and other publications regarding risks, from several different fields of study. This chapter aims to examine the existing literature to define the relevant terms and how supply risks can be assessed and managed. It is divided into five subchapters. The first subchapter discusses the construct of risk in a general level, while the second subchapter focuses on the definition of risk in a supply chain context. The third subchapter presents different ways of categorizing supply risks, while the fourth and fifth subchapters focus on supply risk identification, assessment and management practices.

## 2.1 The construct of a risk

Fischl, Scherrer-Rathje and Friedli (2014) have studied the concept of risk thoroughly. Quoting Rao, Goldsby (2009), Wagner and Bode (2006, 2008) they state that "risk" has been a recurring subject in various fields of literature, such as psychology, marketing, decision theory, finance, insurance and management. The notion of "risk" being discussed across several fields further indicates the relevance of having a clear definition of it. Baird and Thomas (1990) have further emphasized that risk has a variety of meanings. Likewise, Ritchie and Brindley (2007) have highlighted the existence of “an almost infinite variety of the term risk, relating to specific decision contexts and types”. This makes sense, as different fields of study tend to ask different questions and focus on differing aspects of phenomena, the definition of risk in one field may differ significantly from the definition used in other branches of scientific literature. Fischl et al. (2014) has stated that therefore the term itself must be defined separately based on the research and its focus.

To define the term “risk”, we also need to examine uncertainty, a term often used while discussing risk and sometimes even used interchangeably. According to Sharpe (2018) in economics the distinction between risk and uncertainty has been very clearly made by Knight (1921), explaining that uncertainty indicates circumstances which are not characterized by ‘objective’ probabilities, whereas risks most likely can be. Keynes (1921)

has made a similar distinction and this seems to be a generally accepted way of differentiating the two in the literature of economics, as stated by Sharpe (2018).

However, Yates and Stone (1992) have argued that the concept of risk itself contains the implication of existing uncertainty regarding the possible outcome and if the probability of each outcome is truly known, there is no risk. Slack and Lewis (2001) have taken an approach that somewhat encapsulates both points of view. While acknowledging uncertainty as a key driver of risk, they state that managers are often able to reduce the risks driven by uncertainty via different risk prevention, mitigation and recovery strategies. To examine uncertainty, Knight (1921) has taken a broad view and states that since the world we live in is constantly changing, the world itself is continuously full of uncertainty. According to him, we are only able to live by knowing something about the future and our problems arise from the lack of this knowledge and this is as true for business as it is for any other activity.

According to Paulson (2004), many authors have defined uncertainty as a special construct of risk. Rowe (1977) has seen it as a form of risk, where there is a lack of sufficient information, Richie and Marshall (1993) noted the decision maker's inability to identify every possible outcome in its presence, while MacCrimmon and Wehrung (1986) highlight the inability to adequately estimate the likelihood of the consequences in the presence of uncertainty. Waters (2007) has listed the levels of uncertainty as the following:

| Level of Uncertainty | Level of knowledge |
|---|---|
| Ignorance | Where we have no knowledge at all about what is going to happen in the future |
| Uncertainty | Where we can list the events that might happen but cannot give them probabilities |
| Risk | Where we can list the events that might happen an can give each a probability |
| Certainty | Where we know exactly what will happen in the future |

**Table 1.** Levels of uncertainty. Adapted from Waters (2007)

We can see that the listing and explanations made by Waters (2007) can be interpreted to coincide with the notions made by Rowe (1977) as well as MacCrimmon and Wehrung (1986), but somewhat directly contradict with the definition of Ritchie and Marshall (1993).

Ritchie and Brindley (2007) have stated that an extreme form of uncertainty can be described as a situation, where in spite of whether the outcome of a risk is negative or positive, there is a total lack of awareness of its outcome or probability of occurrence, which Waters (2007) would describe as the state of ignorance. Ritchie and Brindley (2007), however, also note that while uncertainty can be differentiated from risk by the above mentioned ways, in reality risks constructs tend to lie somewhere in the middle of the spectrum between risk and uncertainty and therefore the terms are often used interchangeably. From this, we can conduct the notion that uncertainty may mean the inability to estimate any of the components, which a risk is constructed of.

Spekman and Davis (2004) have made a very generalized definition of risk, as “probability of variance in an expected outcome.” This can be seen as a good base for risk definition for a research as it is not tied to a specific context. Pablo and Sitkin (1992) have given another general definition of risk as “the extent to which there is uncertainty about whether potentially significant and/or disappointing outcomes of decisions will be realized”. Their definition points out the significant notion which many tend to leave out: risks are not solely related to negative phenomena. Likewise, Blume (1971) have emphasized the fact that the whole point of risk taking is having the opportunity to achieve a positive outcome, not merely trying to avoid and cope with inevitable negative consequences. According to Omera and Bernard (2007) a key component of risk is making a choice. Similarly, Bernstein (1996) states that risk is all about the actions we take as a consequence of our ability to make choices.

According to Moore (1983) risk consists of two main components: an outcome in the future, with the possibility of several different forms and the probability that a particular outcome of the set occurs. Over 20 years later, Ritchie and Brindley (2007) have highlighted that generally the risk definitions in the existing literature tend to share three common dimensions:

1. The likelihood that a particular outcome or event occurs
2. The consequences of the potential outcome transpiring
3. The causal chain of events leading to the outcome

They argue that the likelihood of a risk is often expressed with probabilities and depending on the used scale, the probability can either be expressed in subjective or objective terms. The notion of having the possibility of expressing probability either from subjective or

objective is much in line with the earlier presented definitions made by Knight (1921) and Keynes (1921).

There are several authors that have highlighted the subjective point of view to risk (Kahneman & Trevsky 1979, Odean 1998) and raised the question of whether it should be considered as a viable alternative to the objective approach. According to Omera and Bernard (2007) the matter of risk being subjective, or objective has significant impact on how supply chain members approach risks and try to manage them.

Similarly, in the second dimension argued by Ritchie and Brindley (2007), the consequences of a potential outcome can be expressed using varying perspectives. The same outcome may also create consequences for multiple perspectives at the same time. They use the example of a company failing to launch a new product, which may have consequences of the enterprise's reputation and financial performance.

The third common dimension of risk definition, the causal pathway relates to the sources which lead to the outcome or an event and is especially important for risk management. The causal pathway determines the nature of an event, its sources, likelihood and scale of the subsequent outcome or consequences. (Ritchie and Brindley 2007) A commonly used term to express these causal pathways or individual sources in them is 'risk driver'.

Referring to the above-mentioned distinction of expressing risk probability as subjective or objective, according to Omera and Bernard (2007) this debate between risk being subjective or objective has been present in academia for a long time. According to Lupton (1999) the different ways to view risk in the subjective-objective dimension may range from the social constructionist perspective to the technico-scientific perspective, the former seeing risk as determined by the subjective viewpoints of the concerned actors and the latter viewing it as something which can be objectively measured. Bernstein (1996) has claimed that ultimately the whole argument can be encapsulated by a single fundamental question: To which extent the future is determined by the past?

Omera and Bernard (2007) rise the question that even though we have learned to use quantified numbers to present the past, to what degree can we rely on the recognized patterns and expect them to hold true for the future? It is a reasonable question to ask, since

as the commonly used phrase regarding risk and profit in investing states: “The past success is not a guarantee of future profit.”

There are many examples of quantifying risk management tools that have been developed in the past, such as Failure Mode Effect Analysis, Cost Benefit Analysis and Risk Benefit Analysis (Omera & Bernard 2007). However, even though these tools are widely used in decision making, there has been critique towards them as they tend to replace human decision making with mathematical formulae. Whether this critique is fair, is up to interpretation, as for example FMEA weights and values are often based on judgement of experts.

To further debate against the objective approaches to risk, Adams (1995) has made a statement that risk decisions are very rarely made based on sufficient information that would allow reducing all of the elements into quantifiable probabilities, yet the decisions are made anyway. While his first assumption about insufficient information is likely to hold true, that does not necessarily justify the subjective approach to risk. Omera and Bernard (2007) further note that even though this discussion is an ongoing one, the supply chain literature does not conclusively acknowledge the debate or take a holistic viewpoint on it. For real life businesses and managers, however, it might not ultimately matter since as they conclude, the key question regarding risks is: how can it be managed?

## 2.2 Risk in the context of supply chains

Omera and Bernard (2007) claim that even though the management of supply chain risks has attained more attention only recently, the interest on risks regarding organizational purchasing is no new phenomenon and can be traced to such tools as BuyGrid-model developed by Robinson, Faris and Wind (1967) and Williamson’s (1979) effort in Transaction Cost Economics, in which he pointed out the positive correlation between the level of uncertainty in buyer-supplier relationship and the probability of increasing transaction costs.

Er Kara & Oktay Fırat (2017) have defined supply risk as a concept with multiple dimensions. They state the term itself covers various factors, including loss of a supplier, late deliveries, inadequate raw materials or problems in the communication between the buyer and supplier. Jüttner (2005) has pointed out that supply chain risks revolve around the disruptions of

different flows between connected enterprises. These flows can be information, money, material or products. According to him, the flows are all somewhat connected to each other and an essential feature of supply chain risk that its source is likely to originate from one of these flows crossing the boundaries of different companies and the consequences similarly extend beyond the same boundaries.

Fischl et al. (2014) studied literature, focusing specifically on price risk, especially price volatility and increases. They found that very little attention is paid to these elements as the main focus in supply chain literature, but they are rather used as examples to illustrate different risk types, such as operational, environmental, financial and supply risks. However, they also argue that as the business function responsible for purchasing is expected to deal with these risks related to price, they themselves have also made the conclusion that “supply risk” is the most suitable term for their piece and therefore decided to use it while describing price risks. This clearly elaborates how the same terms are used in the existing literature, but the definitions are vague and still have much variety in what they are constructed of. Often “supply risk” is used to elaborate the phenomenon of not being able to acquire the desired goods and raw materials the company needs for its business, due to disruptions in the supply chain. In fact, Fischl et al. (2014) have used the same term to have a relatively different meaning.

Another problem besides the complexity of risk evaluation is how to identify the sources and drivers of risks. For some risk types, there seems to be a clear gap in literature regarding driver and source identification. Fishcl et al. (2014) themselves point out that such gap exists for price risks, however they note that various categories listing the sources and drivers of general supply chain and supply risks do exist.

They state that those categories offer several possibilities for different price risk phenomena, but the classes are very different from the one they have used and all of them would contain overlaps with each other. Additionally, they note that the existing classifications often lack the ability to distinguish between price risk phenomena that are sources and those which are consequences. They finish the the notion that mapping the causal risk chains regarding price risks could improve the existing classifications. (Fischl et al. 2014)

In today’s business environment, where supply chains have become longer and the way of doing business naturally embeds a wider array of risks, supply chain risk management has

become all but a minor topic for procurement professionals. As such managerial trends as process efficiency across all business functions, focus on core competencies and increasing the level of outsourcing have emerged, so have the consequential internal and external risk events, which have in turn woken companies to realise the need for more competent supply chain risk management (Aqlan & Lam 2015).

As for supply chain risk specifically, Zsidsin (2003) has described it as a probability of such an event occuring, which disables the purchasing company to fulfill the requirements of their customers or alternatively causes a threat to the customer's well-being. He has also made a point, that risks in supply chains might result not only from a failure by a single supplier, but from the whole supply market itself.

Supply chains are often seen as flows of materials, information or products. Based on this view, Jüttner, Peck and Christopher (2003) have included all the risks linked to these flows from the original supplier to the end user under the definition of supply chain risks. It is noteworthy that many of the supply chain risk definitions only seem to scope the risks on the events that happen between a single buyer and its supplier, while Jüttner et. al (2003) have taken a broader view, including the whole supply chain. Similarly, Ho, Zheng, Yildiz and Talluri (2015) have used a definition which explains supply chain risk as the probability and impact of an undesired event which has influence on any part of the whole supply chain. They have also emphasized the consequences more as a part of their definition, stating that the risk may lead to failures in operational, tactical or strategic level.

According to Wagner and Bode (2006), both risk and supply risk definitions can either take the commonly adopted view of risk in finance literature, where the event related to the risk can have either negative or positive results, or one where risk has purely negative effects in relation to the commonly expected outcome. They claim that considering the several catastrophes in supply chains following the financial crisis of 2009, the latter definition corresponds better to the reality in everyday business. This study will adopt a similar point of view, where risks are assumed to only have negative impacts in relation to the expected outcome in supply chains.

## 2.3 Supply chain risk classification and categorization

As stated, risk is difficult to define even based on the existing literature, as different branches of study tend to have different approaches on risk. It is important to have a clear classification, since the most important step of risk assessment is selecting and defining the risk categories, which can then be compared, quantified and weighted (Blackhurst, Scheibe & Johnson 2008). In their literature review regarding price risk in the supply context, Fischl, Scherrer-Rathje and Friedli (2014) have conducted an extensive research on the existing literature, examining how supply risks are being categorized. One of their main implications, regarding specifically price risk, is that the currently existing supply risk categorizations are “neither unambiguous nor lack overlap”.

More recently, Song et. al (2017) have constructed a piece in which they aim to define the critical risk factors for sustainable supply chain management. They categorize the risk factors into economic, environmental and social risk categories. This categorization can be very much linked to the triple bottom line commonly used in sustainability literature and management. Through an extensive and systematic survey of literature, they have constructed a table, in which they present twenty SCM risk factors grouped under 4 dimensions, consisting of the 3 mentioned risk categories plus a fourth category, operational risk factors. While looking at the individually listed factors, it is imminent that they have defined risk factors as the sources and the categorization is very much based on the same idea.

The problem in the existing literature regarding risks and risk classification seems to be that risks can be classified either based on source or outcome. Paulsson (2004) has divided supply chain risks into three categories: operational disturbance, tactical disruption and strategic uncertainty. According to Ritchie and Brindley (2007) this categorization reflects the three supply chain decision making levels - operational, tactical and strategic. It is also in line with the notions of Ho et. al (2015) in the previous subchapter, regarding supply risks leading failures in different levels of the organization.

However, Mintzberg and Water (1985) have noted that in practice, it is very hard to classify risks according to these levels, as strategic decisions are often in reality just a chain of patterned operational and tactical decisions. This can be seen also in different risk level category definitions, as Kleindorfer and Wassenhove (2003) have only divided supply risks

into two categories, supply disruption risks and co-ordination risks. Essentially, they have divided Paulsson's (2004) tactical level between the other two categories, as their two categories correspond to his operational and strategic levels. As Ritchie and Brindley (2007) have stated, different risks and risk management actions relate to different levels of decision making and therefore it is extremely beneficial to differentiate between them in supply chain management context.

As we can see, supply risks can be categorized in many ways and there is no clear general, commonly accepted definition. This can be seen in the work of several authors, for Ritchie and Brindley (2007) have suggested for future research , "the identification, categorisation and evaluation of different risk sources and causal pathways" as the best way to further contribute in understanding how supply risks affect the overall performance.

The risk management approach derived from the risk level classification by Ritchie and Brindley (2007) can be seen in practice in the case study by Burtonshaw-Gunn and Ritchie (2004) risk management in long-term oriented supplier-buyer relationships in the construction industry in the UK. They noted that the case companies had targeted risk management tools to the strategic level, assuming that actions taken in that level would eventually be reflected in better risk management in the tactical and operational levels as well. In terms of risk drivers, they noted that the companies had addressed such elements of their possible partners as good safety record, high quality standards, resources of excellent quality, a great track record of previous project performance and a solid financial situation (Burtonshaw-Gunn & Ritchie 2004).

Jüttner, Peck and Christopher (2002) have suggested that risk should be divided into risk sources and risk consequences, where the former presents the environmental, organizational and supply-chain related variables while the latter corresponds to the impact of the risk. Furthermore, they proposed considering the relevant risk sources for supply chains based on three categories: external, internal and network related. In this categorization, the external risks entail i.e. political or natural risks while internal risks range from labour risks to IT-system or machine malfunctions. Network-related risks connote disturbances originated from interactions between organizations that are part of the supply chain, such as lack of cooperation or insufficient sharing of information. They consider risk impacts as the outcome variables of the supply chain, such as health and safety, costs or quality.

Ritchie and Marshall (1993) have identified five sources, from which general business and organizational risks originate. Rao and Goldsby (2009) have given common definitions to the variables related to these sources, seen in the table below.

| **Risk sources** | **Description of the variables** |
|---|---|
| Environmental factors | Variables affecting overall business context, across industries. |
| Industry factors | Such variables, that do not affect the whole economy or businesses across all industries, but rather specific ones. |
| Organizational factors | Variables facing the supply chain at an individual company level, yet still affecting the whole chain. |
| Problem-specific factors | Variables affecting the contruct of the risk itself, such as complexity, constraints and interrelationships involved. |
| Decision-maker related factors | Variables related to the expertise of the ecision maker, institutional rules and procedures for taking decisions, bounded rationality and individual behavior regarding information seeking. |

**Table 2.** Risk sources. Adapted from Ritchie & Marshal (1993), Rao & Goldsby (2009)

Rao and Goldsby (2009) have further identified several variables affecting the first three sources based on the existing literature, and given definitions and exemplified the variables, which have been gathered into the table below:

| Variable category | Variable | Definition |
|---|---|---|
| Environmental variables | Political uncertainty | Changes in political regimes or overall political unstability e.g. as a result of war or revolution. |
| | Policy uncertainty | Governmental policies, e.g. fiscal and monetary reforms, price controls, nationalization/privatization |
| | Macroeconomic uncertainty | Fluctuations in the macroeconomic state, e.g. level of economic activity and prices. |
| | Social uncertainty | Beliefs, values and attitudes of the population, not reflected in the current governmental policies or business practies, which still affect supply chains. |
| | Natural uncertainty | For example natural disasters and other phenomena, which affect the businesses in a specific region, are the cause of natural uncertainty. |
| Industry variables | Input market uncertainty | Refers to the uncertainty regarding acquiring the required qualities and quantities of inputs for manufacturing. |
| | Prouct market uncertainty | Unexpected volatility in demand for the company's output. Might be due to changes in consumer tastes or availability of substitue products. |
| | Competetive uncertainty | Uncertainties associated with competition between companies and the effects it causes to the focal company and its supply chain. |
| Organizational variables | Operating uncertainty | Uncertainty regarding labor (strikes, availability of specialized labor), firm-specific supply on inputs and production uncertainty (machine failures). |
| | Liability uncertainty | The liability uncertainty refers to the possibility of legal or market actions against the company due to the production or consumption of its products. |
| | Credit uncertainty | Credit uncertainty regarding collectibles. In the supply chain context this refers to e.g. a primary supplier going out of business being harmful to the supply chain as a whole. |
| | Agency uncertainty | Agency uncertainty refers to situation where an agent, such as a top-end manager, may act opportunistically for their own benefit, and in return harm both the focal company and the supply chain as a whole. |

**Table 3.** Risk variables. Adapted from Rao & Goldsby (2009)

Rao and Goldsby (2009) suggest using similar typology as the basis for research related to supply chain risks. They point out that several of the risk sources are related, and while many (such as natural disasters or political disruptions) are generally being recognized by supply managers, other sources are often not identified at all. As a key implication, they suggest focusing risk management efforts on the “links that show the highest vulnerability or the highest probability of being affected.” (Rao and Goldsby 2009).

Manuj and Mentzer (2008) have exemplified categorizing supply chain risks into quantitative and qualitative risks. They state the quantitative risks include such risks as stockouts and overstocking, obsolescence and unavailability of desired goods or materials within the supply chain. Into qualitative risks they categorize the precision, accuracy and reliability of the goods and products in the supply chain. This categorization is quite simple, and if reflected to the abovementioned categorization by Jüttner et. al (2002) is done on the basis of the impacts of the risks. Manuj and Mentzer (2008) have, however, further created a risk categorization based on the risk sources illustrated in the table below, as they claim it is more relevant to the global supply chains of today.

| Risk Type | Risk Source |
|---|---|
| Supply Risks | Disruption of supply, inventory, schedules and technology access, price escalation, quality issues, technology uncertainty, product complexity, frequency of materials design changes |
| Operational Risks | Breakdown of operations, inadequate manufacturing or processing capability, high levels of process variations, changes in technology, changes in operating exposure |
| Demand Risks | New product introuctions, variations in demand (fads, seasonability, and new product introductions by competitors), chaos in the system (the Bullwhip Effect on demand istortion and amplification) |
| Security Risks | Information systems security, infrastructure security, freight breaches from terrorism, vandalism, crime and sabotage |
| Macro Risks | Economic shifts in wage rates, interest rates, exchange rates and prices |
| Policy Risks | Actions of national governments like quota restrictions or sanctions |
| Competetive Risks | Lack of history about competitor activities and moves |
| Resource Risks | Unanticipated resource requirements |

**Table 4.** Risk Categorization (Manuj & Mentzer 2008)

This categorization takes a quite different approach to risks than any of the previously examined ones. Manuj and Mentzer (2008) have noted that all of them affect the strategic decision-making level of the business unit and there is a significant overlap between the listed risks. As an example, the shifts in wage rates might turn up under supply risks, operational risks or demand risks depending on which step of the supply chain is influenced.

## 2.4 Risk evaluation and assessment

Jüttner, Peck and Christopher (2003) state that having knowledge of the sources and drivers leading to risks are essential for the phases of risk evaluation and monitoring. Quoting Chopra and Sodhi (2004), Fischl et al. (2014) have pointed out that as different risk types are related to different sources and drivers, they all require individual analysis. This further proves the importance of having a clear categorization of supply risks for the specific case, as examined in the previous chapter. It also implies the complexity of risk evaluation and makes it hard to have a unified framework or automated process for risk evaluation. Overall, risk evaluation is very much linked to supplier evaluation, which is a problem with multiple criteria, such as quality, cost and delivery, that naturally have a trade-off between each other (Nekooie & Sheikhalishahi 2015). As risks can be related to any of these criteria, the evaluated risks therefore also have trade-offs when deciding between them.

According to Kuo, Hsu and Li (2015) the supplier selection process is just as effective as the selection criteria. Similarly, the risk evaluation process can be no better than the evaluation criteria used. As stated before, supply and supplier related risks are very heterogeneous and highly specific to the case, and therefore assuring the fitness of the evaluation criteria for each case is massively important.

In their study to create a mathematical model for supplier selection based on risk, Er Kara and Oktay Firat (2018) identified 8 different risk categories, under which they classified 17 different risk criteria, which can be seen in the table below.

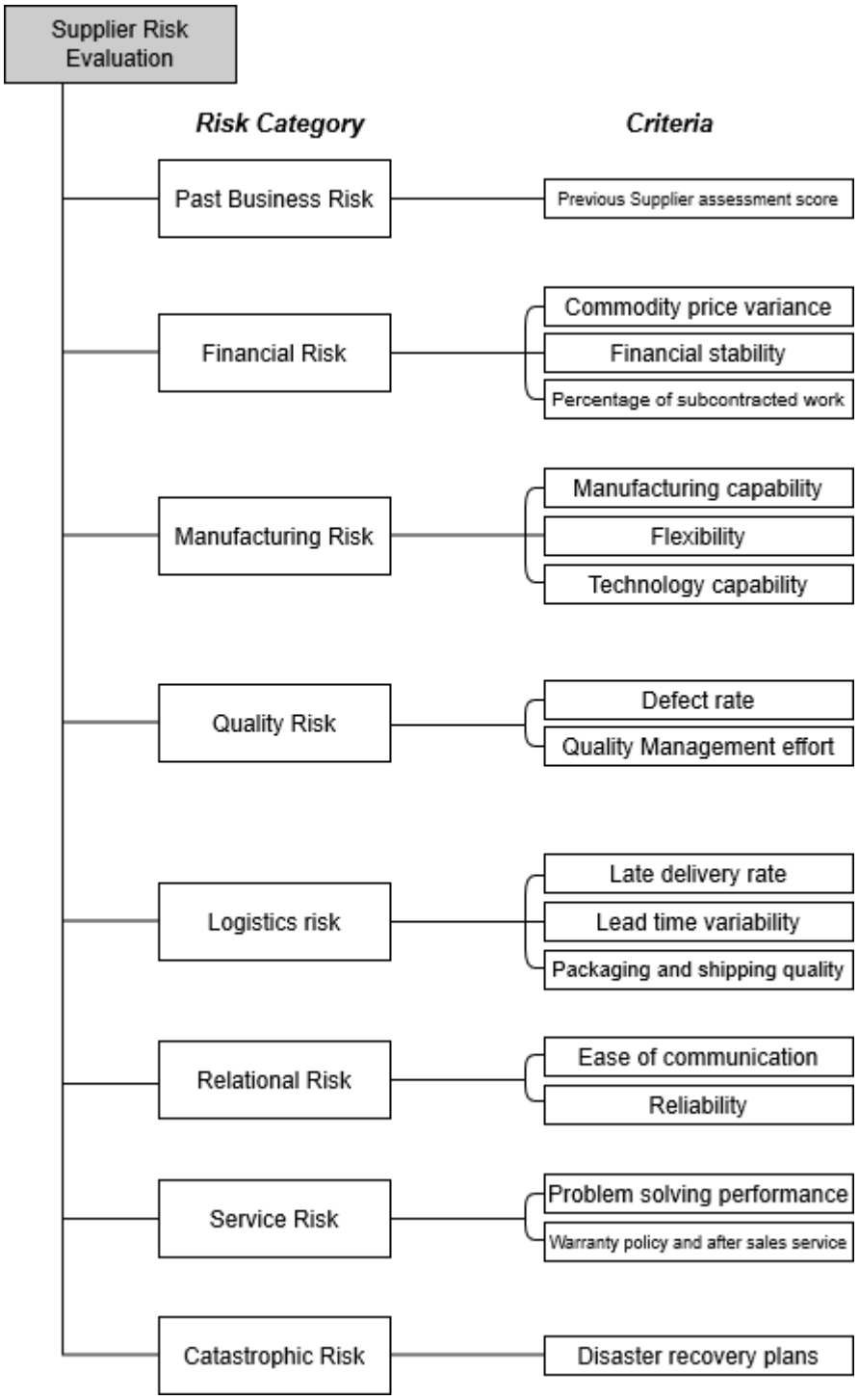


**Figure 1.** Supplier risk evaluation categories (Er Kara & Oktay Firat 2018)

According to the authors, it is relevant to note, that only 4 of their 17 criteria were quantitative in nature, whereas the rest 13 were qualitative. They explain the reason being because many of the criteria were extremely hard to convert into measurable variables. Therefore, subjective expert evaluations were used for most of the criteria. The used scale for these

evaluations was 9-point likert scale. The four quantitative criteria were calculated based on supplier history data and were not on the same scale.

Er Kara and Oktay Firat (2018) also applied a cluster analysis to the supplier data, in order to create groups of suppliers with similar risk profiles. Before doing this, they grouped the 17 risk types down to 4 factors based on their correlations. The 4 factors were: risks related to the general capabilities of the supplier (such as quality management, flexibility and financial condition), risks related to the supplier's reliability and commitment (such as previous experience with the supplier, disaster recovery plans, ease of communication), operational risks (such has defect rate, on-time delivery, lead-time) and price risk (commodity price variance, subcontracting). The aim of the clustering was to later create cluster specific risk mitigation programs.

The outcome of their study was having 3 clearly different clusters of suppliers based on their risk profile. It is noteworthy that none of the clusters had the highest risk value in all the 4 factors. One of them had the highest value on 3 of the 4 factors, so therefore it was clearly the riskiest. However, the remaining two clusters had similar average scores of the 4 factors but differed on which of the factors had high scores or low scores. While they still attempted to rank these 2 by general riskiness, this notion clearly elaborated the complexity of different risks and shows that they are often not very well correlated. This implicates that while it might be possible to define a group of suppliers that are overall riskier than others, creating somewhat general risk evaluation policies covering a broad range of heterogeneous risks and applying them on the defined "high-risk" supplier group is most likely not how risks should be managed. Instead, risk policies should target a set of homogenous risks with high correlation and each policy should be implemented to cover the group of suppliers, that has a high-risk score on the risk factor corresponding to similar set of risks.

Regarding the measurement of risks, while comparing two different supply chain risk management case studies, where first had the principal taking a proactive and long-term relationship approach to risk management (Burtonshaw-Gunn & Ritchie 2004) and the second one with the case company focusing more on "arms-length" management and reactive approach, Ritchie and Brindley (2007) noted that in both cases the companies had a strong desire to use metrics that illustrated the risk-performance interface. An interesting observation, however, was that the principal preferring "arms-length" approach had actually developed these metrics further and seemed to be fairly confident about their fit as tools of

better risk management, even though the researchers (Richie & Brindley 2007) themselves somewhat questioned the reliability of some of the more qualitative measures. Combined with the notes from Er Kara and Oktay Firat (2018) there is a strong implication that while qualitative measures are often easier to develop and implement, they are likely to be more indicative than absolute reflections of reality.

In their broader literature review regarding supply chain metrics, Shepherd and Gunter (2006) conclude the need of developing performance measures for the supply chain as a whole, instead of measures focusing on single buyer-supplier relationships. They have also highlighted the fact that qualitative and other non-financial measures are underrepresented in most measurement principles. At this point it should be clear that trying to understand and harness risks into quantifiable models is no easy task. Generally, the complexity of risks in the presence of limited amount of resources, such as information and time, forces more simplified frameworks, as opposed to complex mathematical models. As Borge (2001) has stated, “most real-life risk problems of any importance have to be simplified to be solved”.

Zsidsin, Ellram, Carter and Cavinato (2004) have analysed several risk assessment techniques from 7 different companies, out of which 2 had formal risk assessment processes, while the others utilized different informal methods to reduce the supply risk. As companies having formal risk assessment process seems to be the minority in this set of case companies, it is interesting to observe the motivation behind the formal process in the two companies. According to Zsidsin et. al (2004) the drivers for formal processes have been legislation, desire for a more proactive approach to reducing supply risk impact and ensuring the assessment of potential problems in supply early in the life cycle of each critical product.

## 2.5 Supply chain risk management tools and practices

Generally, the occurrence of any risk is linked to the unexpected outcome of a known event in the future and the related uncertainty, and supply chain risks are all but an exception. While business decisions in their essence are a trade-off between risk and return, risk management practices should first and foremost be set to achieve a more stable and controllable internal and external business environment. In the context of supply risks, this means having control not only on the processes inside the company, but also in the parts of supply chain operations which extend beyond company boundaries. Achieving this is no easy task, as naturally the company has less control and visibility over the operations which happen outside of its internal processes. However, through systematic identification, assessment, mitigation and monitoring, the amount of supply chain disruptions and their negative impact can be greatly reduced. This in turn would lead to increased profitability, as the company's decision making enhances and enables it to avoid the costs stemming from the uncertainty in the supply chain. (Aqlan & Lam 2015)

Even though risk management actions have been floating around supply chain management for a long time, research efforts to study them in a more coherent manner, focusing specifically in said field, have been only taken more recently (Richie & Brindley 2007). In their study regarding requirements for supply chain risk management in companies, Jüttner (2005) made the notion that while 44 percent of the respondents from participating companies expected an increasing risk in their supply chains, risk management in supply chain management was still very underdeveloped.

Going back to the general level risk definition and basing it on the literature of finance and statistics, risk is seen as "the variation from the expected outcome over time" (Kallman 2005). The definition of general risk management can be defined as pre-emptive or reactive actions, which aim to reduce either the impact or likelihood of a risk. As established, supply chains have become longer and more complex due to globalization, and consequently more vulnerable as they have a larger number of points for possible disruptions and overall lesser visibility. The complexity of supply chains means that it is harder to keep track how changes in one part of the chain affect the other parts, which means that often local adjustments or fixes in the supply chain lead to unforeseeable problems in other parts. (Sodhi & Tang 2012)

Generally, the purpose of risk management is to address all of the three dimensions, which risks are constructed of: Likelihood of occurrence, consequences of the outcome and causal pathways. The necessary actions are risk source analysis, seeking to gain an understanding of the drivers behind the causal chain of events and coming up with ways to manage the occurrence of each outcome by improving the probability of positive consequences and avoiding the negative ones (Richie and Brindley 2007).

There has been a lot of debate on whether risk management is a separate set of activities used when felt necessary or a part of everyday managerial actions (Royal Society 1992). Omera and Bernard (2007) state that most managers see risk management as a continuous activity, which is clearly related to the organization's strategy and its implementation. As stated by the Institute of Risk Management (2002), risk management should be driven by the senior management and integrated into the working culture by assigning responsibility for different areas of risk management to each manager and employee, preferably noted in their job description. On the contrary, Smallman (1996) has argued that risk management is not required to be a formal process enforced by the senior management to be effective but should rather be based on each person's well thought out individual judgement.

According to Omera and Bernard (2007) there seems to be a relatively clear consensus as to what the process of risk management should be. According to Fone and Young (2000) it is a function of the general management of an enterprise, seeking to evaluate and respond to risks affecting the organization's ability to achieve its goals. Dickson (1989) has more specifically defined general risk management as identification, analysis and control of such risks that are a threat to the organization's continuous operation and profit-making capability. Similarly, Gaudenzi and Borghesi (2006) have stated that the process of risk management consists generally of four steps: risk analysis and evaluation, risk reporting and decision making, risk treatment and risk monitoring.

Cox and Townsend (1998) state that in practice, the risk management process starts with assessment of two factors of the risk construct, identification of possible outcomes and the likelihood of their occurrence, which corresponds to the steps of risk analysis and evaluation, mentioned by other authors. The Royal Society (1992) has a very similar view to Cox and Townsend (1998), stating that the process of risk management is the implementation of risk averse decisions based on risk estimation and evaluation, which aim to reduce the impact of the risk by reducing the probability of its occurrence. However, the latter definition seems

to exclude the steps of risk evaluation and estimation from the actual risk management process and seems to imply that only the implemented reactive actions corresponding to the identified risks are actually considered managing the risk.

While there seems to be several different, though consisting much of the same elements, definitions of risk management process and many systems have been suggested and used, White (1995) has conducted that most of them are based on a general process steps:

1. Risk identification
2. Risk analysis
3. Risk evaluation

According to White (1995) risk identification aims to determine all risk factors which have a chance of occurring in the project or as a consequence of a decision, the purpose of risk analysis is to determine the probability of the most significant risks and risk evaluation seeks to choose the best possible managerial action for each identified risk.

The same steps are mentioned in most of the above-mentioned risk management process definitions, though it seems that different authors use different names for each step and some group White's (1995) steps together. For example, the abovementioned definition by Gaudenzi and Borghesi (2006) grouped risk analysis and evaluation together as the first step of the process and had the decision making and monitoring as later steps, which do correspond to White's definition of risk evaluation. What we can conduct is that White's (1995) process step definitions do correspond to the definitions used by most other authors, however the process step names do not.

Simon, Hillson and Newland (1997) have categorized the risk management techniques into three groups: qualitative, quantitative and control techniques. Qualitative techniques are used for risk identification and analysing, quantitative techniques seek to create a quantified model of the risk impact and control techniques seek to implement actions and controls to lessen the exposure to a risk.

Zsidsin et. al (2004) have similarly adopted the categorization into qualitative and quantitative techniques but used formal and informal as the other 2 distinct categories of risk management techniques. Mascini and Bacharias (2012) have studied the use of formal and informal risk management strategies. They have gone into more detail and divided

informal risk strategies as 3 different measurable categories, which along with their explanations can be seen below:

1. Discretionary specialization. The freedom to apply necessary safety rules at one's discretion.

2. Tacit knowledge. Facilitating the acquisition and use of experiential knowledge as an expert of the situation.

3. Taking personal responsibility. Attributing personal responsibility for the safety of oneself and others.

They argue that while generally formal risk management actions reduce unsafe behaviour, the informal strategies may in general lead to both negative or positive outcomes. For example, using tacit knowledge may lead to "tunnel vision" where the actor loses a sense of the big picture, while focusing only on the information directly at hand. However, contrary to the notion by Mascini and Bacharias (2012) regarding formal strategies, Merton (1957) has stated that applying too many formal risk disciplines may lead to a situation where the compliance of obeying the rules is given a higher importance than achieving the goal the rule was set to facilitate. While it is important to note that Merton (1957), Mascini and Bacharias (2012) have not studied risk management strategies in the context of supply chain risk management, the same principles of the strategies can be applied to managerial decisions regarding supply chain management.

The formal and informal risk management strategies can also be seen as top-down and bottom-up strategy implementations (Mascini & Barcharias 2012). Pascale (1990) has criticized top-down management as a mechanism promoting a creation of inward-looking culture in the organization, which may lead it to ignore the exogenous drivers of its business. In the context of supply chain risk management strategy implementation, this likely indicates that having a heavily detailed and structured risk management policy might lead into only identifying and managing the indigenous risk drivers on the focal firm, leaving it extremely vulnerable for risks originating from other parts of the supply chain, or other external sources.

Zsidsin et al. (2004) have similarly argued, that the main techniques of supply chain risk management practices can be categorized to formal, informal, qualitative and quantitative techniques. A different approach has been proposed by Frosdick (1997), who had divided the techniques into intuitive, inductive and deductive tools. As an example of intuitive tool, he has mentioned brainstorming, for inductive tool the FMEA model and as deductive tool accident investigation and analysis.

In their study regarding procurement best practices Jayaram and Curkovic (2018) benchmarked four maturity elements of procurement management: change management, customer relationship management, risk management and supplier relationship management. Out of these 4 elements, risk management was noted to have the lowest average maturity in the interviewed organizations, which is in line with the results of Jüttner (2005). In the best indirect procurement organizations risk mitigation plans had been based on risk types, such as meeting legal requirements, threats to market share or brand reputation, criticality based on potential impact on business and events that could cause project or business delays (Jayaram & Curkovic 2018).

What this indicates is that the best practice in the best indirect procurement departments seems to be categorizing the managed risks into risk types based on the effect they have instead of the source. Then again, the same companies did also formally define the sources of the risk types, called risk factors. The factors were categorized into groups, such as reputational/brand risks, labor law breaches, resource limitations, information security and privacy, fraud and data security, supplier capacity imbalances, cost pressures from business groups, geopolitical and market risks, financial and currency exchange rate risks, and physical safety risks. All of these factors were assigned to be either high or low risk. Critical suppliers were also evaluated based on their financial and physical disruptions. The leading companies had established standardized supplier risk ratings. Such firms gave special priority on fraud cyber security and financial risks and included questions regarding risks as part of their general RFP processes.

Grötsch, Blome and Schelper (2013) have studied supply chain risk management in the context of contingency theory, which itself suggests that effective managerial decisions result from relevant context (Fiedler 1964). They studied how the purchasing business functions management control systems, decision maker’s cognitive style and past buyer-

supplier relationships influenced the proactiveness of supply chain risk management in companies.

Proactiveness is believed to be the strongest measure for supply chain risk management (Tang 2006), but as Grötsch et al. (2013) point out, the definition of proactiveness is not self-explanatory or has a clear definition in the existing literature. As an example, Tomlin (2006) has discussed proactive contingency and mitigation actions towards supply chain disruption risks, of which the latter are initiated by the company before an accident happens and therefore creates costs regardless of the incident's occurement. According to Grötsch et al. (2013) this corresponds to the common definition of proactiveness in SCRM, since the tactics aim to prevent the incident's occurrence beforehand. However, they point out the possibility of implementing reactive SCRM activities before the occurrence of an incident as well. Therefore, supply chain risk management activities can't be perceived as proactive solely based on the time of implementation. Instead, what distinguishes the two is that reactive SCRM activities only have an impact on the event after it has occurred, even if they were initialized or implemented beforehand (Thun & Hoening 2011). Therefore, reactiveness is seen as an improvement to passiveness, however it does not reach the potential of proactiveness as such actions have no impact unless the incident occurs (Grötsch et al. 2013)

From this we could summarize that companies should aim for proactiveness over reactiveness in their SCRM, as such tactics have the potential for superior efficiency while not being tied to the realised occurrence of a potential disruptive event. However, the two approaches have different requirements and the trade-offs between investment and return in proactive vs reactive approach is not always evident. For proactive risk management, the company needs to implement such SCRM detection systems which support the purchasing function's managers' analytical decision-making processes (Grötsch et al. 2013). In particular, the detection systems should work as learning machines and enable the conduction of sensitivity analyses and hypothetical scenarios (Burchell 1980), so that the company is able to evaluate how the performance of its individual suppliers contribute to the company's ability to achieve its strategic goals, evaluate whether it is using the right measures and how the measures need to be adjusted to increase the level of the supplier contribution (Atkinson, Waterhouse & Wells 1997).

Reactiveness, however, does not require as analytical approach for the detection systems. Instead of having to detect causal relationships in order to take proactive actions to lessen the chance of occurrence of an incident, the system solely needs to be able to detect the risk and alert the correct persons in time to make reactive tactics to reduce its impact (Grötsch et al. 2013). The main tasks of reactive SCRM detection systems are to give an updated information on the suppliers' situations (Henri 2006) and allow the strategic decision makers to focus on the suppliers having the worst performance or most potential for improvement (Atkinson et al. 1997). Comparing this distinction between reactive and proactive risk management to the previously mentioned notion by Ritchie and Bridley (2007) regarding the importance of causal pathways for the purposes of risk management, we can conclude that of the two, identifying and mapping the causal pathways is more critical for the purposes of proactive risk management.

# 3. RESEARCH DESIGN

As the study's characteristics determine the used research methods, this chapter discusses the used approach. This chapter is divided into five subchapters. The first subchapter discusses the used research methodology in general, while the second explains the used methods of data collection and analysis. The third chapter further explains how action research, which is the selected research method, guided the research process. A brief description of the case company is given in the fourth subchapter, while the last section examines the reliability and validity of the study based on the used research methodologies.

## 3.1. Research methodology

While the research problem is very situation-specific, qualitative research was a more suitable approach over quantitative methods. As stated, the researcher was in a key role in the implementation of the risk management model, which also fostered an increased accessibility to information inside the company. This did lead to choosing action research as the main research methodology, which according to Torbert (1999) is used to describe qualitative such research where the researcher is a part of the organizational problem. As the researcher was already working as an active member of the case company, action research was an easy way to adopt the role of a researcher while also having easy access to the existing internal information and knowledge of the organization.

Compared to more traditional research methods, action research has also been considered as the most appropriate when the research concerns an improvement of a practical situation or aims to facilitate organizational learning (Runeson and Höst, 2009; Coghlan and Brannick, 2014). As organizational problems are often fuzzy, ill structured and complex (Avison et. al 2019), a neutral, non-participating researcher might not be able to discover the most subtle aspects of the problem. While business risks perfectly demonstrate such a complex matter, AR is likely to come out as superior method compared to i.e. a normal case study.

As the aim of the research is both to create a solution to a concrete problem as well as facilitate the improvement of organizational competences regarding category risk management, action research fits well as the primary method. Roth, Sandberg and Svensson (2003) have identified five different roles, which a researcher can take in action

research: 1) complete observer, 2) observer-as-participant, 3) participants-as-observer, 4) complete participant, and 5) membership role. Of these the complete observer has the most passive role, whereas the member is the most involved. As previously described, the researcher was in a key role in the study and therefore can be seen as having a clear membership role.

As mentioned above, a major motivation for the research was the development and implementation of a concrete tool or solution to category risk management for several product categories and fulfilling their specific needs, while maintaining a somewhat holistic view. From the beginning it was clear that the organization did not previously have a structured way of managing risks in its procurement categories or specific tools to facilitate such activities. As the procurement organization's maturity in this regard is still very low, a major part of the research is gathering tacit knowledge, opinions and requirements from the relevant members of the procurement teams and conducting a view on what information would be relevant and what is available. As the solution as well its requirements and available resources are so highly specific to the context, there doesn't exist a general method for the development and implementation in literature. The outcome is also very dependent on the participating people's expertise and willingness to share their thoughts.

Since there is a clear gap in the literature regarding category risk management in indirect procurement, a case study fits well as a method of gathering real-life data and knowledge. Cope (2015) has compared different case study designs of Merriam (2009), Stake (1995) and Yin (2014). Merriam's design treats the research questions as the base for guiding the construction of the research and collecting the data, while leaving a lot of flexibility to the researcher. Stake sees a comprehensive literature review as the foundation for conducting the research questions and creating a theoretical framework to guide the research. Yin's approach presents several design options for the researcher based on such characteristics as whether the aim is to i.e.: 1) test an existing theory 2) research a unique case or 3) gain a deeper understanding of a common phenomena, which determines for example whether one or multiple case studies should be carried out. Yin's approach also combines quantitative and qualitative data gathering methods, while Stake and Merriam's designs focus on qualitative data gathering. (Cope 2015)

While much of the final structure cannot be determined beforehand, Yin's sequential design is likely not the best reflection of this research. As the research structure builds up and clarifies as the study progresses and the research questions are likely to remain unchanged, the research naturally embodies the characteristics of Merriam's (2009) case study design.

## 3.2. Data collection and analysis methods

As discussed in the preceding theoretical chapters, the characteristics of risks are very dependent on the context in nature. Therefore, the case company's business environment as well as the internal competencies of the enterprise having a major impact on the kind of risks it has to face. Hence, the first step of the study was having a dialogue with the case company, in order to get an idea of their needs, requirements, objectives and preferable outcomes on a general level and formulate the research approach. This was done mainly with discussions with the case company's category managers and data analytics team manager. These discussions also continued through the whole process, as understanding of the subject improved on both sides, which further validated the decision for AR as the main research method, as among other methods, it is particularly strong at associating research with practice by facilitating continuous information exchange between the two (Avison et. al 2018). The topics of the discussions shifted from a high-level problem formulation to more concrete tasks and diving deeper into the requirements as the project progressed, by assessing the category specific needs in terms of category risk management. The end goal of this part was to agree on the elements needed for each category dashboard view.

After establishing an initial understanding of the practical problem, the next step was diving deep into the existing literature in order to gain sufficient understanding of the matter from a theoretical perspective. The initial discussions with the case company were used as base, while examining the existing literature and formulating the theoretical background for the research.

Based on the knowledge gathered from literature, started the empirical collection of empirical data from the case company. The main data collection methods of the research were workshopping, interviews and observations gained via participation. The aim of the

workshops was to exchange information between the two procurement category teams within the organization, and the supporting analytics team, in order to gain better understanding of the analytic tools and reporting required by the respective teams. Therefore, the workshops served a wider purpose in the procurement organization than just providing insights and data for this study.

Total of two workshops were arranged, one for each of the chosen products categories, IT and Chemicals focusing on their specific needs. The participants of each workshop consisted of the procurement category team members, including sourcing specialists and managers, internal company IT advisors and members of the procurement analytics team, including the researcher of this study. The workshops served the research mainly as a source of gaining a wider understanding regarding the current situation as well as development needs in each procurement team. They also clarified the purpose and goals of the research in regard to the overall goals of the organization for the current fiscal year. Another benefit of the workshops towards the research was gaining a better initial understanding of how the teams perceived category risk management and its current state in each team. Therefore, even though some of the knowledge gathered was not relevant for the purposes of this research, it still facilitated the researcher's ability to gain a more holistic view of the category teams' problems.

The workshops were carried out in a semi-structured way. First the participants were given a short recap of the relevant processes regarding category and supplier management in the case company. Even though the topic of the introduction was something most of the participants were already familiar with, it was seen as an easy way to further increase the effectiveness of the next phase of the workshop, brainstorming. For brainstorming the participants were divided into several smaller groups, each consisting of 2-3 members. The aim was to have at least one person from both the facilitating analytics team and the participating category team in each brainstorming group. The researcher and other members of the analytics team did not adopt a completely passive role here, but actively tried to suggest possible elements, reflecting back to the understanding gained via research on the academic literature. The objective was to identify and clearly determine the required business cases for each category.

As stated in the previous chapter, the focus of the research clarified as the work progressed and more information was gathered. From the beginning, the goal was to construct a common framework and tool for both category teams, while also trying not to restrict their work too much or ignore the teams' individual needs regarding the solution. On this basis, it became apparent that the needed interviews and further discussions might take very different directions at each step of the development process and a lot of freedom should be left to the interviewees.

Wainwright (1997) has described qualitative interview-based study as one that aims to gain an in-depth understanding regarding the interviewee's personal experiences towards a certain event or phenomenon. As elaborated before, this study is highly context specific and aims to build upon the knowledge of the members of the case company. In consequence, the interviews were qualitative in nature and their structures were expected to vary fairly significantly between each other.

Bryman (2001) has defined unstructured interview as a setting where the interviewer has a central topic for the interview, while leaving remarkable freedom in it. Therefore, the interview becomes more like a form of discussion than a traditional structured interview would be. The description matches the settings of the research interviews well, so they were decided to be conducted as unstructured, where the discussions would always revolve around the chosen research questions and current phase of the development while leaving room for extensive dialogue. This assured that additional questions could be asked, and the interviews could be steered to the direction that would most benefit the exchange of relevant information, which often emerged during the interviews.

The interviewees were chosen based on them being the future end-users of the tool created as a result of the research. They would also have the most knowledge regarding the current methods of risk management activities in the category teams as well as the subsequent requirements. Overall, the parties involved in the interviews and discussions consisted of sourcing specialists, category managers, sourcing managers, procurement development managers and the Chief Procurement Officer.

## 3.3. Action Research structure and data analysis

As mentioned in the previous subchapters, the research method was selected to be action research (AR), which involves having the researcher working with members of an organization, while trying to gain an understanding of a complex business case (Avison, Davison & Malaurent 2018). As briefly elaborated above, action research was selected as it supports both practical and academic objects in parallel, as the aim of it is to both take action and derive academic knowledge from the action taken (Coughlan & Coghlan 2002).

Action research is conducted in continuous cycles of planned and evaluated action. The commonly used steps are constructing, planning action, taking action and evaluating the taken action (Coghlan & Brannick 2014). For this research, the initial construction of the problem came from the procurement management team, evaluating the current state of category risk management in the organization. The researcher was in the leading role of the planning, supported by their supervisor in the organization at the time. The action planning phase was still very much ongoing in parallel with the beginning of the action taking phase, as the lessons learned from conducting the literature part of the study shaped the action planning.

## 3.4. Description of the case company

The reasoning for the particular company being chosen for the study was threefold. Firstly, the case company has a significant amount of spend coming from indirect procurement. Secondly, the organization responsible for indirect procurement was a separate entity in the company and therefore had its own clear objectives and responsibilities, which ensured a sufficient level of maturity in the procurement activities for this kind of research. Thirdly, the researcher had already been working in the company in the implementation of category risk management tool as well as other development activities, which enabled them to utilize their existing connections inside the organization as well as the previously gathered knowledge and information. These characteristics qualified the company as a great fit for this research.

The case company is a multinational oil refining company, shifting towards a more service-oriented business model and employs around 5 500 employees globally. The company has also taken great steps towards more sustainable core business. It has taken the initiation to expand further both geographically and new market segments. Consequently, its supply

base has become even wider and the supply chains and relations have become more complex. The company has faced increasing amounts of disruptions in its supply chains, which has raised the demand for more structured risk management. As the products and services managed by the indirect procurement organization are very heterogeneous by their characteristics, foreseeing the possible disruption scenarios becomes that much harder. To have a more holistic view on the managed activities, the aim in the organization has recently been to expand the managerial perspective from individual suppliers to managing the product and service categories as a whole.

The procurement organization has also taken an initiative for more data-driven decision making in all of its activities. In essence this has meant evolving from one-time ad-hoc analyses to the development and utilization of unified and continuous reporting as well as self-service tools over the past years. More emphasis has been put into data gathering and quality. Despite the steps taken into this direction, much of the created solutions have focused on monitoring such basic activities as operational purchasing and individual sourcing projects. The organizational willingness to utilize data more efficiently, together with the internal demand for more structured category risk management formed the basis of creating a risk evaluation and reporting model specifically for said use case.

## 3.5. Reliability and validity of the study

Action research has been criticized and is sometimes perceived as not being “as scientific as other research approaches”. (Avison et. al 2018) The critique towards the scientificness of AR often questions its rigour, in other words the theoretical contributions derived from such approach. It is easy to understand where the critique stems from, as AR is very practical in nature compared to most other methods. However, as Avison et. al (2018) point out “Rigor is a meta-methodological term as it is not attendant upon the method itself but rather requires that a method is used correctly with regard to the context where the research is conducted”. As a result, action research itself should not be perceived as less rigor than other approaches and therefore the critique more likely implies a poor understanding of the term itself.

The evaluation of the study's reliability should be continuous through the whole process (Eskola & Suoranta 2008). According to Yin (2003) there are four common tests used in case studies: construct validity, external validity, internal validity and reliability. The purpose of internal validity test is to determine whether causality exists in the research setting, in other words if an event leads to another certain event. As the purpose of this study was to create a concrete tool for risk evaluation, causal connections do not exist. This is because the purpose was not to examine the possible risks or their origin, but rather take them as given based on the expert discussions and opinions. Anyhow, the internal validity is partially applicable as the implementation method is being explained and reasoned.

External validity explains the extent to which the study results could be generalized. This can be seen as a key concern in many interview-based case studies, as the collected data is not factual but rather the researcher’s interpretation on the interviewees comments, which in turn are the interviewees perceptions and interpretations (Whalsam 1995). While this is true, it does not mean that generalization of case study results have no merit at all. Wahlsam (1995) has described four different generalization types to be made: generation of theory, development of concepts, drawing of specific implications and contribution of rich insight. Of these four, the results of this study fall mostly under the type of contribution of rich insight, as the study aims to gain a deep and rich understanding of a highly specific setting.

Construct validity explains what kind of measures have been selected to reflect the studied changes. The three common measures can be using several different evidences, having a clear path of evidence or have the study being continuously reviewed by the key informants (Yin 2003). As the data was collected via several discussions with multiple different parties, the evidence is based on multiple evidence. The discussions were based on the intended research and report construction so even though the report was not formally read by the key informants, they were continuously updated of the key information. Construct validity is therefore quite applicable.

Reliability is used to describe the ability to produce an identical study leading to equivalent results. As with the external validity, the reliability of the study can be questioned as the data collection is dependent on the researcher’s interpretations and the research topic is highly specific. Also, since the relevant capabilities in the organization likely evolved through-out the research project, it is likely that repeating a similar study later on would yield at least

slightly differing results. To increase the reliability, the data was gathered from multiple sources having different roles.

# 4. CASE STUDY: DEVELOPING A RISK EVALUATION CRITERIA FOR INDIRECT PROCUREMENT

The main goal of the study is to develop a suitable risk evaluation criteria for indirect procurement. Further, it aims to understand what is the current status of risk management in the procurement organization and which kind of data is available to be utilized in for the evaluation and if that has any impact on the final outcome.

The chapter is divided into five parts – the first subchapter will shortly present the practical business case and define how the action research process was designed. The second subchapter presents the observations gained from surveying the available data in systems used by indirect procurement, while the third assesses the current state of risk management in the organization based on the category workshops. The fourth chapter

## 4.1 Case description and action research design

As outlined in the background chapter, the case company had a strong desire to implement better risk management into its indirect procurement actions. Due to the lack of human resources in the procurement organization in recent years, a lot of the focus has been on keeping the operational tasks such as purchasing and sourcing ongoing. Consequently, many strategic managerial tasks and development work, such as procurement category management has been lacking either in planning or implementation.

Based on previous experiences, the procurement leadership team had identified the need for more continuous monitoring regarding the procurement category related risks. Therefore, developing a tool for category risk monitoring had been selected as one of the objectives for the starting fiscal year. As nothing similar had previously been done in the organization before, the original scope and goal descriptions were not defined in great detail.

Based on initial discussions between the researcher, the case company analytics team manager and the chemical category procurement manager, three main steps were defined for the development process: 1) Literature study on procurement risk management best practices and existing tools, 2) review of the available data and 3) surveying the needs of the procurement category team members regarding analytics and risk management. The

final outcome of the project for the company was defined to be a visual tool, such as a dashboard, for the purposes of risk monitoring. However, the technical execution of the tool was decided to be left out of scope for the purposes of this research paper and instead focus on the underlying risk management practices and implications, basically the criteria for risk evaluation. The scope of the project would include two product categories, IT and chemicals.

As far as project and research resource planning, it was decided that the researcher would have the responsibility of studying existing procurement risk management practices and drafting a proposal for the risk monitoring and management. The researcher would also have a central role in surveying the available data to be utilized for the solution based on first-hand experience. Two workshops would be organized, one with each of the scoped categories. The workshops were organized partially for purposes outside of the scope of this study but were nevertheless seen as a valid contribution and opportunity to grasp into the requirements of the organization.

After the creation of the initial proposal for the risk evaluation model based on literature study, workshops and data surveying, the category teams would give continuous feedback on the model and risk dimensions through group interviews and discussions. The aim was to take the feedback from both teams into consideration and aim to develop a criteria which would be suitable for both categories. The final model would then be approved by both categories. As the characteristics of services and products in the respective categories differed greatly, it would hopefully lay a good foundation to expand the use of the model for other product categories as well. The outcome would be a risk monitoring tool / procedure to be implemented throughout the organization.

## 4.2 Survey of the available data

In attempt to gain an understanding of the available data related to indirect procurement in the case company, the systems used by indirect procurement were examined. This was done via first-hand experience in using the systems as well as informal discussions inside the organization. The goal was to use the availability and possibility to utilize the existing data as one of the factors when determining which risk dimensions should be include in the evaluation criteria.

In total, 4 main systems were identified to be used for the core activities of indirect procurement and therefore could possibly contain data to be utilized for risk evaluation. The core processes range from strategic to operational tasks, and include such processes strategic sourcing, supplier onboarding, contract management, supplier relationship management and operational purchasing. The identified systems were Maintenance ERP system, the primary ERP of the case company, procurement system for sourcing and system for archiving contracts.

The company main ERP is used primarily for the purposes of the direct procurement. In other words, it mainly contains entries and data regarding the raw materials used in the manufacturing process in the company. However, some portion of the purchasing of indirect procurement, such as few chemical subcategories are purchased strictly through the primary ERP. This ERP also contains the master database for the case company, which contains the organization’s supplier master data. The data that could be utilized for risk evaluation in this system includes such data points as purchase volumes, spend and timestamps regarding order deliveries. However, there are currently no reporting or other utilization of data developed for the purposes of indirect procurement based on the existing information in this system. This is due to the indirect procurement being such a minor stakeholder for the ERP from the company’s perspective.

As the case organization’s primary business activity is a manufacturing, maintaining its production facilities is one of the core supporting functions of the business and as such, has a dedicated ERP in place to facilitate the activities related to maintenance. As the indirect procurement is responsible for the inquiry of products and services related to support functions, such as maintenance, and there is no separate purchasing system dedicated to

indirect procurement, the maintenance ERP acts as the main purchasing system for the function.

However, it is important to note that while the maintenance ERP has the functionalities of operating as a purchasing tool, the system is mainly used for other tasks, such as project management, warehousing and asset management. This has implications on the quality of data related to indirect procurement, as in some cases the system has either not been properly configured to collect all the relevant data to purchasing, or is prone to errors due to mismatch of the purchasing process and the system configuration. Similar to the primary ERP, for the purposes of indirect procurement, the maintenance ERP contains data regarding purchase orders with such items of data as quantity, price and delivery related timestamps. This data is already being utilized in the KPI's of the indirect procurement organization for monitoring such things as purchases from approved suppliers and supplier performance regarding delivery accuracy.

The indirect procurement sourcing system is a web-based application managed by a service provider. It is used in the indirect procurement for strategic sourcing, supplier onboarding and supplier relationship management. While the primary ERP of the company contains the official supplier master, the sourcing system acts as a second master database for the indirect procurement, as the initial onboarding of indirect procurement's suppliers is done through the system. There is however no connection between the two, which means the indirect procurement function is solely responsible for maintaining it for its own purposes. The service provider does not currently offer any services of collecting data for its customers, such as supplier market data or industry benchmarking. Therefore, while the database is managed by the service provider, the employees of the indirect procurement organization in the case company are fully responsible for entering and maintaining the data inside the system.

The data in the system contains information regarding sourcing projects' RFIs (Request for information) and RFQs (Request for quotation) as well as supplier information, mainly in the form of self-evaluation questionnaire, which the company uses to prequalify companies into its sourcing projects as a risk mitigation control regarding suppler risk. The questionnaire aims to gather supplier information regarding such areas as financial situation, employee count and human resource management, certifications on industry or other standards and a few category specific questions. However, as the most important and the only required

field to fill for the suppliers is to approve to the case company's code of conduct, and there are no set restrictions or guidelines regarding the questionnaire, this data information is not currently utilized much in the company, besides tracking the suppliers' statuses on have accepting the code of conduct and internally approving the suppliers as suitable for doing business with.

The contract system is a basic document archiving system, which mainly contains PDF-versions of the contracts managed by indirect procurement, as well as other documentation such as contract clauses, product informative labels and other documentation agreed upon with suppliers, such as work instructions. As the data only exists in PDF-format, it is very unstructured and there are no feasible ways to gather, refine or utilize the data. A good indication of this is that the case company does not have any existing reporting regarding contract statuses.

Gathered in the table below is the data coverage, data updating frequency and data gathering methods for each system regarding the total of indirect procurement activities.

| System used by Indirect Procurement | Procurement Use Cases | Data updating frequency | Data gathering method | Data coverage |
|---|---|---|---|---|
| Maintenance ERP | Purchasing | Live / Daily | Unattended | 45% |
| Company Primary ERP | Purchasing | Live / Daily | Unattended | 40% |
| Procurement Sourcing System | Sourcing, Supplier Onboarding, Supplier relationship management | Live / Daily | Sourcing: Unattended Onboarding: Attended, Supplier relationship management: Attended | Sourcing 95% |
| Contract Archive System | Contract Management | Live / Daily | Attended | 20% |

**Table 5**. Data in the systems related to procurement processes

The first column stated the identified system and its nature, such as ERP-system. Most of the systems are used widely in the organization, while some are exclusive to the indirect procurement purposes. The second column "Procurement Use Cases" indicates the core process of indirect procurement which the system facilitates.

Data updating frequency explains how often data is updated to the available storage related to the system and therefore how up-do-date it is likely to be. Live/daily -option is used to reflect a situation where data is presented as soon as it is acquired. For example, a new entry in the ERP system is acquired as it is entered and is either presented instantly in the database or at most uploaded there within 24 hours. Arbitrary -updating type is used to describe an instance where the time for the data to be used from its gathering moment is either not structured or is not visible to the case company.

The column of “data gathering method” categorizes the systems data collection to either unattended or attended. Unattended refers to the type of system, where the data relevant to procurement is automatically collected, as the core processes of procurement are carried out. For example, the purchasing systems automatically collect the relevant data from purchase orders, as most of the data fields are required to be filled out by the user or automatically filled out by the system. Attended method refers to a case, where updating (and therefore collecting) the data is entirely dependent on the actions of the user, but the procurement core processes can still be carried out just fine. An example of the attended system is the contract management system. The process of contract negotiations and forming the contracts is carried out entirely outside of the system and therefore the system does not act as anything more than a simple storage. The system itself does not facilitate any means of extracting relevant information from the collected data files and uploading contracts to the system is entirely reliant on the actions of the employees.

In the table, data coverage describes what percentage of the specific procurement related use case data the system collects and holds. For example, regarding purchasing, two main systems are used and therefore the data is split into two separate systems and data storages. As seen for this example, the percentages do not add up to 100 percent. This is due to some Maverick buying happening outside of the systems, which means the data is not acquired and might reside in other places, such as email. The percentages are rough estimates based on surveying example data, results from indirect procurement’s spend analysing tool and discussions with purchasing professionals in the case company. There is no estimation given for the supplier data in the sourcing system, as the coverage of data varies greatly from supplier to supplier, due to the reasons described previously in this subchapter.

Based on the survey, it was conducted that the availability of existing data would not be sufficient to be used as a qualifying or disqualifying filter for any considered risk dimensions, due to various reasons. For the company main ERP, the lack of existing reporting or other data utilization means there is are no existing metrics to use as input variables for the risk dimensions. For the contract archiving system, the lack of structured exportable data and low data coverage deemed to not be enough to determine any risk variables regarding the possible selected risk dimensions. The existing KPIs and other metrics based on the data gathered from the maintenance ERP and other information can, however, serve as a way to deepen the understanding of the procurement professionals regarding the existing risks and therefore indirectly contribute to the risk criteria.

## 4.3 State of the risk management in procurement category teams

As described in the research design chapter, two workshops were held, one with each of the procurement category teams involved with the project. This subchapter conducts the knowledge gathered from both workshops, which had the aim of gathering information on how the risk management is perceived currently in the teams, which kind of risks were seen relevant and what kind of risk management or evaluation procedures are currently in place. Also, any information related to data sources and the availability of data was seen meaningful for the purposes of the project, as it complements the observation made in the previous subchapter. The agenda of the workshops was discussing the requirements of the category teams regarding reporting and data analytics in their daily work, revolving around such topics as category management, supplier management and risk management.

*”Looking at our supplier management process, the scoped time frame extends to +3 years. On supplier onboarding we do the initial evaluation and segmentation, but after that the supplier information gathering might again stop for a year.”*

*Procurement Development Manager*

While discussing the supplier management process as part of category management, the procurement development manager brought up the medium-to long term thinking and initial evaluation, which can be perceived as a supplier risk management procedure. This initial evaluation happens has a part of supplier onboarding, usually during or after a sourcing process. While the evaluation is a formal step in the procedure and is included in the management guidelines, there are no unified instructions on qualifying or disqualifying suppliers, but the teams are individually able to evaluate the fitness of the suppliers. As described in the data survey subchapter, the only mandatory requirement for suppliers is approving to the code of conduct, which merely acts as a single risk mitigation tool. However, they also added that after the initial evaluation, there is currently no structured continuous risk assessment or risk monitoring towards the suppliers. It also became clear that in regard to the risk management overall, the case company has also adopted such risk mitigation tools as code of conduct, audits and contract clauses.

*“When I need a risk evaluation for a supplier, I ask our secretary for it in email and she sends me a PDF in return.”*

*Sourcing Specialist*

As commented by the sourcing specialist, currently most of the formal risk evaluations are done on an ad-hoc basis. The most common case including some sort of risk evaluation are the sourcing projects, which are often done once every 3-5 years. The referenced supplier risk evaluations are also provided by an external service provider, focus on the financial state of the suppliers and are not tailored to the specific needs of the case company. The procurement organization does not currently have a person or team responsible for solely for risk management. There is neither a common forum with internal stakeholders to assess risks in a structured way.

*“Another important thing would be monitoring the index based yearly price changes.”*

*“I would like to be able to objectively compare the costs of on-premise solutions versus cloud services beforehand.”*

*Sourcing specialist*

As elaborated by the above comments by a sourcing specialist, risk and category management is focused on monitoring costs from different origins, such as service design or price changes. The monitoring of price changes was mentioned on both teams as a valuable part of category risk management. While both teams mentioned several same risk factors, while talking about critical items in the categories, they seemed to have different perspectives on the matter. For example, while other products were defined as critical based on their relevance for the company’s end product or manufacturing process, the criticality of others was justified by the significant amount of yearly spend related to them.

*“There are many risk elements in procurement. For example, costs and availability. Would be great to know if there is a strike or layoffs going on with the supplier. The flow of all this information would be very beneficial to automate, however it is extremely difficult to do in practice.”*

*Sourcing specialist*

The sourcing specialist further pointed out the costs and availability as key risk elements for procurement, with examples of the risk origins. They also commented on the benefits of monitoring these risks, while acknowledging the challenges of automating such processes. Other mentioned risk sources of interest were natural and political disasters.

*“Would be great to have a PowerBI based tool, where I could see the information regarding key suppliers with just a few clicks.”*

*“The challenge is that the data is likely either scattered between various systems, or systems with the required data do not exist in the first place.”*

*Procurement Category Manager*

A procurement category manager also similarly commented on the benefits of having a structured and continuous risk monitoring. While there are no formal guidelines as to which risk elements to include in the internally made risk evaluations, the organization relies heavily on the expertise of the employees to identify the relevant risks and account for them where necessary. It was also noted that for many risks, such as quality, the procurement experts may require the help of internal stakeholders in evaluating the probabilities and impacts of a disruption. However, when asked about the teams’ ability to identify which elements of risk were relevant to evaluate as a part of sourcing project or other ad-hoc analysis, the category manager stated:

*“Generally, we know this very well. If we take for example a consultation service, it comes down to the basic things: cost, availability and possibly quality.”*

*Procurement Category Manager*

To summarize, risk management actions are currently being taken in the indirect procurement organization. However, for the most part risk management is informal and done case by case, along with the routine work in sourcing or purchasing processes. The actions to mitigate and manage risks are also usually focused on individual suppliers, instead of whole product categories or subcategories. The common perspective in the current risk management activities is for short-term and is not generally done in repetitive cycles for the same purpose, which may result into much of the relevant information not being up to date. There is however great trust in the expertise and capabilities of both the indirect procurement professionals and internal stakeholders to conduct an adequate evaluation of the risks related to the procured goods and service, when necessary. The comments very much indicate that while the teams recognize the benefits of having better tools to utilize in risk management, the difficulties related to the gathering and quality of data are acknowledged.

## 4. 4 Creation of the initial criteria

As stated, the objective of the study is to determine which risk elements should be included in the category risk evaluation. This subchapter describes the creation of the initial evaluation criteria based on the information gained from literature, survey of the available data and category workshops. The figure below illustrates how the gathered requirements and restrictions are likely to affect the final product, in this case the final evaluation criteria.


**Figure 2.** Conceptual model for developing the final product

Initially, the assumption was that examining the current state of risk management activities in the case company via discussions with the category teams would set the requirements, and the available data would be the restricting factor regarding the chosen dimensions and variables. From a broader and more practical standpoint, the final outcome would be restricted based on the available tools, available data and the capabilities of the end users, as illustrated by the figure below.

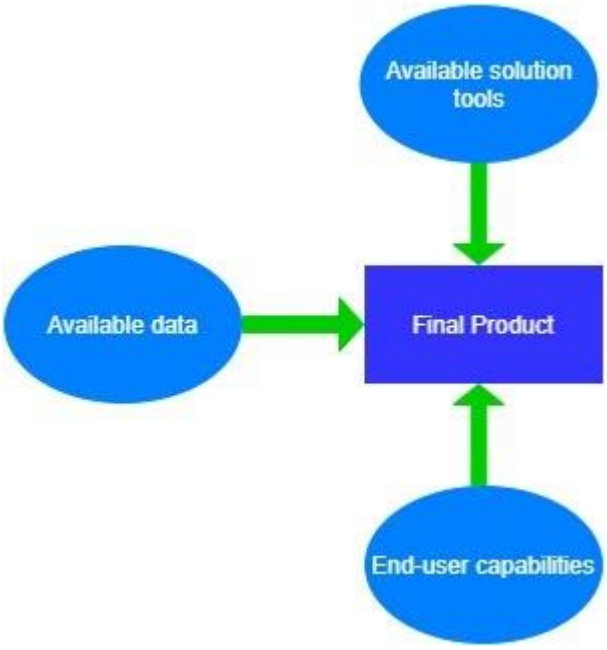


**Figure 3.** Restricting and enabling factors for the final product

Capabilities of the end users is a restricting factor in regards of the usability of the final product. In general, it may refer to both technical skills as well as professional expertise regarding risk management, however for the purposes of this research the technical skills of end users were left out of scope, though it was considered among other things during the development project in the company. The available solution tools refer to the technical solutions available to the case company, such as existing KPI-reporting in indirect procurement, which could be utilized as input variables for each dimension to some degree.

As mentioned earlier in the paper, the company did not initially have an existing criteria of risk dimensions to use in risk evaluation. As established in the chapter regarding the data survey, there was neither enough coverage with the existing available data to be used as a basis for the criteria. Therefore, an initial criteria proposal was created based on the observations made during the literature research phase of this project as well as the requirements gathered from the category workshops, which would be reviewed and refined by the case company representatives as a part of the ongoing discussions, according to the planned action research.

One of the notions made in the literature review, as quoted from Bernard and Omera (2007), the quantified patterns of the past do not necessarily guarantee how the future is going to turn out. Together with the notion of risk being a largely subjective phenomenon (Odean

1998) and the above mentioned lack of available data, the conclusion was to rely fully on the evaluations of experts instead of creating an automated evaluation tool, which would only include quantifiable risk elements or variables. As the organization was already relying heavily on the expertise of their employees, it would be a natural continuum to the current activities. This would still not exclude the utilization of existing metrics or other solutions in evaluating the risk impact of probabilities. A criteria allowing for more qualitative elements to be include, would also make sure any important information is not left out for the sake of being unquantifiable. Based on the information gathered, the model was designed to be utilized by procurement professionals and internal stakeholders in co-operation, which meant that the chosen dimensions could partially be outside of the expertise of the procurement personnel, yet critical for comprehensive risk evaluation.

The initial proposal was based on a formal supply risk criteria used by a German electronic component distributor company Chip1, seen in the table below.

| Risk Dimension | Explanation |
|---|---|
| Design | Ability to complete the design, follow design for manufacturing goals, validate the deisgn, assess the materials interactions and manufacture the item. This refers to both company and supplier design as well as statements for work for service to outsourcing suppliers |
| Manufacturability | Risk associated with manufacturing's ability to produce when material specifications are met. If the material has not yet been received, this may entail anticipating potential future problems, such as materials that meet specifications but do not meet design for manufacturing goals. |
| Cost | Determined by target costs from the customer, industry benchmarking, should-cost models and make-or-buy decisions where appropriate |
| Legal | Risk associated with the sebstantive legal status of the material, product or service, such as import/export restrictions and tax issues. Additional risk factors include legally enforceable restrictions or commitments relating to the use of material, product or service. |
| Availability | Assessing the risk of the sourcing, unit volume requirements, and the material tooling (where applicable). |
| Quality | The direct and indirect materials, service or product consistely meets requirements, and supporting processes are in place to ensure control |
| Supplier | Assessing and choosing suppliers of good financial health and manufacturing in politically stable or low-risk natural disaster areas. It also refers to instances when Semi becomes too large a percentage of a suppliers business, either through capacity or corporate revenue. |
| Environmental, health and safety impacts | Issues such as the handling and use of hazardous materials and compliance with EPA, OSHA, and other governmental agency policies by supplier as well as this firm |

**Table 6.** Risk evaluation criteria by Chip1 (Zsidsin et. al 2004)

The criteria was chosen as a base, as it covered the risk factors mentioned by the category teams of the case company well, such as quality, price and availability. Another reason was that the criteria contains several of the risk factors commonly mentioned in different risk categorizations and evaluation models found in the existing literature (Rao & Goldsby 2009; Song et. al 2017; Er Kara & Oktay Firat 2018), while being relatively simple. The other reasons for choosing Chips 1:s model as the basis was that the company is a Fortune 500 company and operates on a global scale, which means its supply chains are likely as complex and long as the case company's. The criteria is also being used as a part of formal risk evaluation procedure by Chip 1 (Zsidsin et. al 2004), which is the intended direction for the case company.

While other background literature, such as the typology laid out by Rao and Goldsby (2009) was considered, the intention was to start with a relative simple and resource efficient model, whereas verifying all the causal pathways suggested by Rao and Goldsby's (2009) model would take a major effort from both internal and external parties involved with the procurement organization. To further facilitate fast development and implementation, as implied by Er Kara and Oktay Firat (2018), the initial dimension definitions would be defined as qualitative variables. The case company did already have quantifiable metrics for some risk dimensions in the initial proposition, but the model would not define in detail how or if the existing metrics should be utilized. This would be left to be decided by the professional opinions of the procurement personnel utilizing the model.

However, as the purpose in the case company is to utilize the criteria as a part of category management, the criteria of Chip1 was already slightly modified for the initial proposition. The changes can be seen in the table below. In the example table the case company is referred to as "Procuring company" or "Procuring organization".

| Risk Dimension | Initial Proposal Definition |
|---|---|
| Design | Availability to follow the goals of required design. May indicate Procuring company's ability to determine the design requirements or the supplier's ability to meet em |
| Manufacturability | Risk associated with the ability to use the product/service, if it meets the requirements. High risk may be connected to e.g. product being new, required manufacturing design changing constantly etc. |
| Cost | Determined by target costs set by the Procuring company, can indicate e.g. expected price increases, high price compared to industry benchmarking etc. |
| Legal | Risk associated with the legal status of the material, product or service (e.g. taxes, import/export restrictions). |
| Availability | Risk regarding meeting volume requirements, lead-time, service availability etc. |
| Quality | Material or service consistently meets requirements, supporting processes exist to ensure control |
| Supply Base | Supply base consists of supplier with good financial health and are located in politically stable or low-risk natural disaster areas. Also refers to cases where the Procuring company's reliance on the supplier(s) becomes too high or vice versa |
| Environmental, health and safety impacts | Issues such as handling of hazardous materials, compliance with governmental policies etc required by the Procuring organization and/or supplier |

**Table 7.** Evaluation criteria modifications for the initial proposal

As the perspective was widened from individual supplier relationships to managing the whole product or service categories and subcategories as a whole, the "Supplier" dimension was changed to "Supply base" and the explanation modified to better describe the changed scope. For Design, Manufacturability, Cost and Legal the explanations were slightly simplified. For the dimension of HSE (Environmental, Health and Safety impacts) the references to EPA and OSHA were removed, as those are governmental entities for the US and therefore in most cases do not directly relate to the case company.

## 4.5 Further development and final criteria

As described in the action research structure - subchapter, the initial risk evaluation criteria was introduced to members and managers of both category teams. Several, semi-structured meetings were held with both teams, according to the action research design. Changes proposed by one team would next be discussed with the other, and the development would happen in cycles between the teams, as planned in the action research design.

Based on the discussions with IT-category manager and sourcing specialists, it became apparent that IT stakeholders perceived “Design” differently from the explanation indicated in the original proposition. Therefore, the name of the dimension was changed to “Product or Service Requirements” in order to better reflect the explanation and avoid unnecessary confusion and misunderstanding. Furthermore, the chemical category sourcing specialists pointed out, that the initial proposition did not clearly account for the risks originating from inability to estimate the internal demand, which negatively impacts both the sourcing and individual purchases. It was however noted that internal demand can be perceived as one of the key requirements for the product or service across many product categories. Therefore, it was not added as its own dimension, but rather added to the explanation of “Product and Service Requirements”. The aspect of internal demand also further supported the decision to change the dimension name from design to “Product and Service Requirements”, as internal demand is not intuitively included in the former.

For manufacturability, cost, legal, availability, quality and supply base there was relatively small amount of feedback, as the explanations were seen very intuitive and matched well to the experience and thinking of the procurement experts. For HSE a notion regarding “regulatory status of the product” was added to the explanation. This was due to the chemical category noting, that most of their products were under a policy, where the products HSE-related information needs to be tracked and archived by manufacturers and importers. It was discussed whether the this should be evaluated under the legal or HSE dimension. However, as the risk impact for the case company was strictly related to HSE-matters instead of risks related to being able to do business (such as the other implied elements under “Legal”) it was decided that such statuses of the products would be evaluated as a part of the HSE-dimension.

Based on the above-mentioned points made in the development discussions, the final version of risk evaluation criteria was drafted. The changes are indicated with bolded text in the table below, where the changes for risk dimensions or their explanations have been added or altered compared to the initial proposition.

| Final Dimension | Final Definition |
|---|---|
| **Product or Service Requirements** | Availability to follow the goals of required **product or service design, service level / internal demand.** May indicate the Procuring company's ability to determine the design requirements or the supplier's ability to meet em |
| Manufacturability | Risk associated with the ability to use the product/service, if it meets the requirements. High risk may be connected to e.g. product being new, required manufacturing design changing constantly etc. |
| Cost | Determined by target costs set by the Procuring company, can indicate e.g. expected price increases, high price compared to industry benchmarking etc. |
| Legal | Risk associated with the legal status of the material, product or service (e.g. taxes, import/export restrictions) |
| Availability | Risk regarding meeting volume requirements, lead-time, service availability etc. |
| Quality | Material or service consistently meets requirements, supporting processes exist to ensure control |
| Supply Base | Supply base consists of suppliers with good financial health and are located in politically stable or low-risk natural disaster areas. Also refers to cases where Procuring company's reliance on the supplier(s) becomes too high or vice versa |
| Environmental, health and safety impacts | Issues such as handling of hazardous materials, **regulatory status of the product**, compliance with governmental policies etc required by the Procuring company and/or supplier |
| **Contract Status** | **Risks regarding status of the contracts in the respective product group. May indicate lack of contract coverage, significant contracts expiring in the near future or undesired amount of purchasing happening without leveraging the existing contracts.** |

**Table 8.** The final risk evaluation criteria

# 5. OUTCOME OF THE STUDY

The goal of this study was developing a criteria of risk dimensions, to be utilized in risk evaluation in indirect procurement. The theoretical part attempted to examine how the key concepts, such as risk and risk evaluation, are defined in the existing literature both in general and in supply chain management context. The study then proceeded to explain the design of the research and present the observations made in the case study.

The main research question of the study is:

*"Which risk dimensions should be included in the supplier risk evaluation?"*

To further guide the research process and reach the objectives, two sub-questions were formed:

*"How are supplier risks currently being handled in the case company?"*

*"What kind of data can be utilized for risk evaluation in indirect procurement?"*

The observation from the category workshops clearly elaborated that the risk management was focusing on many of the basic things, such as costs, availability and quality. Current risk management and evaluations procedures related to these and other risk elements are done case-by-case and no formal criteria is being used. However, the teams are generally confident in their ability to identify the most relevant risk elements and take them into consideration. As elaborated in the case study chapter, the final selected dimensions of risk to evaluate were:

1. Product or service requirements
2. Manufacturability
3. Cost
4. Legal
5. Availability
6. Quality
7. Supply Base
8. Environmental, health and safety impacts
9. Contract status

The criteria aimed to categorize the risks from as diverse sources as possible, while also keeping all the dimensions relevant despite the characteristics of the evaluated product category. As supply chain risks are very complex in nature, the lines between the dimensions can become very blurry while trying to categorize the risks into these dimensions as a part of the evaluation. For example, tracing whether an error in quality of received a product or service has occurred due to disruptions in the product or service requirements or quality defection from the supplier side may be extremely difficult. While verifying the sources is highly based on the metrics used in such individual cases, defining strict metrics and input variables was seen redundant for the risk dimensions.

The selected dimension can roughly be categorized into internal, external and network-related groups, as proposed by Jüttner et. al (2002). Based on the definitions in the final criteria, the internal category would include dimensions such as product or service requirements, contract status and manufacturability, as these risks are likely to originate from inside the company. Risks related to the legal, availability, cost and HSE (Environmental, health and safety impacts) dimensions could be categorized into external risks as their sources generally reside outside of the supply chain. Quality and supply base related disruptions can be categorized as network-related, as such events commonly originate from the suppliers in the supply chain. However, he relation between the risk dimensions and sources is not as unambiguous. For example, risks in the HSE dimension may in fact originate from all the three sources: mishandling of a product at the focal company's warehouse might cause safety hazards, a supplier may require the focal company to follow a certain safety procedure in order to get the delivery and the product or raw materials itself, such as led, may have characteristics that cause risks for the environment or safety in general. Therefore, while this categorization proves the profoundness of the selected dimensions in relation to the different possible sources of the risks, it also elaborates the difficulty of categorizing them strictly by source.

An important common observation made throughout the workshops was that by default, risk management in the case company is still heavily focused on individual supplier relationships and the personnel intuitively tend to think about risks in terms of suppliers instead of product categories. While this is not necessarily a bad thing, evaluating each supplier individually causes a lot of work and might cause the organization to miss out on both risks and opportunities regarding the product main and subcategories, if the big picture is not taken

into account. Widening the risk management perspective into product category level would help the management to further prioritize development projects between categories.

Based on the information gathered from the case company, it was concluded that the expertise of the procurement professionals together with the capabilities of relevant internal stakeholders would lead to the identification of possible outcomes in each risk dimension during the evaluation process. Therefore, as stated, the decision was made to include all the dimensions in the criteria as qualitative, instead of predetermining quantifiable variables for them (where applicable). Consequently, the criteria assumes and allows for a limited amount of information in the risk evaluation process. Mirroring to the levels of uncertainty by Waters (2007), the criteria assumes a presence of uncertainty, where the possible events can be listed, but the ability to evaluate probabilities is very limited.

Based on the qualitative nature of the criteria dimension definitions, while evaluating at the final criteria from the perspective of supply chain risk management tool categorization by Simon et. al (1997) and Zsidsin et. al (2004), it clearly stands as a qualitative tool. While the accuracy of qualitative criteria in supply chain risk management can be questioned (Ritchie and Brindley 2007), according to Simon et. al (1997) the techniques used for risk identification and analysis are in general qualitative, whereas the quantitative tools aim to create a quantified model of the impacts. In terms of Frosdick's (1997) categorization of risk management techniques, the evaluation process using this criteria would sit somewhere between intuitive and inductive tools, as it facilitates the intuitive reasoning for identifying the possible outcomes for each dimension, while possibly having similar inductive properties as FMEA, if probabilities can be evaluated to some degree.

A second contributing factor for having strictly qualitatively defined risk dimensions was the data availability. As stated by Javara and Curkovic (2018) the common problem with indirect procurement is the lack of capability to collect, summarize and display data in procurement and ERP systems. Both the data survey and discussions with the case company further elaborate this notion in practice. The survey of available data revealed that the purchasing data was divided between at least two systems and was yet not comprehensive. The data regarding sourcing and supplier information seemed to generally reside in a single system, however as the data gathering and updating for supplier onboarding and management needs is reliant on attended, i.e. manual work from the procurement professionals, severe gaps in the timeliness and coverage of the data. Furthermore, the category teams in the

case company themselves raised the problem regarding the quality and availability of utilizable data.

While the quality of data proved to be a restricting factor for establishing strict variables for the evaluation criteria, the observations provided knowledge into what kind of data exists in the systems for potential use. The data points related to purchase orders, such as price, quantity and delivery timestamps could be used to create input variable metrics. For example, yearly changes in total spend and quantities may be used as an input for the risk dimension of cost. The case company already had some metrics in place for monitoring the supplier performance in delivery accuracy. This metric could be further developed to monitor the accuracy in different product category levels and used as an input variable for the availability risk.

The sourcing system also contains a lot of information that could possibly be utilized in the risk evaluation, given a better quality of data. With more structured and automated way of gathering and updating the supplier data, meaningful metrics regarding the financial state of the suppliers could be monitored in a continuous way and used as an input for evaluating the supplier base. With more capable contract management system, inputs for evaluating contract management system could likely be developed and used as well.

To conclude, the selected risk dimensions are likely to provide a good basis for more structured risk evaluation and management across all product categories in the case company. While the existing metrics and data quality does not currently facilitate the definition of clear input variables for more quantitative evaluation, improvements in the data gathering and utilization in the systems used by indirect procurement are likely to lead into better capabilities in risk management. The procurement professionals in the case company generally account for the common risk dimensions such as price, quality or availability and are confident in their ability to evaluate most of the common risks related to their respective product categories. There still exists a clear demand for developing further data driven risk management tools, as the value of them is very much acknowledged.

# 6. DISCUSSION, CONTRIBUTIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

This chapter discusses the managerial implications based on the observations made during the research process and the outcome of the study. It also presents how the study has contributed into filling the identified gaps in literature and lays out the proposed ideas for future research.

While several definitions of terms such as risk, supply risk and supply risk management exist in academia and several ways of categorizing risks have been prosed (Zsidsin 2003; Jüttner et. al 2003; Omera and Bernard 2007; Ritchie and Brindley 2007; Fischl et. al 2014), almost all the existing papers seem to suggest the relevance of more research in the topics. As it stands, the exact concepts are similarly often at best vague for the procurement professionals working in the presence of them daily. There is clearly no denying the criticality of identifying, evaluating and managing the risk related to both direct and indirect procurement in today's global and complex supply chains.

First of the identified research gaps found in literature was the overall neglection of indirect procurement, often due to gaps in data collection capabilities of ERP and procurement systems (Jayara and Curkovic 2018). The research applied the knowledge from existing supply chain risk management literature into indirect procurement in practice and therefore contributed into filling this gap. It also further proved the notions regarding the capabilities of procurement systems by Jayara and Curkovic (2018) to be relatively true in practice, as one of the problems with the evaluation criteria development was the lack of data quality in the source systems.

The second identified main topic needing further investigation in literature was how risk is perceived and defined by the procurement managers in practice (Zsidsin 2003; Sodhi et. al 2012). As the study aimed to gather information regarding risk definitions from the procurement professionals in the case company, the discussions and workshops of the case study offer insights into how risks are perceived in practice, mostly via examples.

More broadly, the study offers an empirical addition into applying existing supply chain risk management concepts and knowledge to practice. The evaluation criteria model adds

another way of categorizing the different intertwining risks related to supply chains and therefore makes them easier to manage and compare.

In total, three suggestions were identified for future research. The first suggestion would be trying to further determine and categorize the variables affecting each of the risk dimensions chosen for the evaluation criteria developed as an outcome of this research project. While Rao and Goldsby (2009) have given a possible way of doing this, based on the risk sources defined by Ritchie and Marshall (1993), more empirical evidence is needed, especially related to indirect procurement. This research could be conducted using either the same case company, or a different one, either preferably using either the same criteria, or choosing variables from specific dimensions to focus on.

A second proposal for future research would be creating a similar criteria for a different case company and seeing how it matches with the one produced during the research project of this research. This could also further validate the dimensions chosen for the criteria developed as part of this study. While the case company of this study is in the business of manufacturing, creating a supply chain risk evaluation criteria from the basis of indirect procurement organization in a more service oriented company in different industry could be interesting.

The third suggestion is a further investigation on the relation between data utilization and risk management practices of indirect procurement organizations and employees. As the data was seen both by the researcher and the case company representatives as one of the restricting factors for both the existing and possible risk management activities and tools, understanding the relationship and affecting factors in more detail could be valuable for managerial purposes and make the case for better data management strategies in indirect procurement.

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