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Framework for risk management in service supply chains

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ABSTRACT:

Palvelut vastaavat globaalisti yli 61 prosenttia koko maailman bruttokansantuotteesta. Riskienhallinta on myös ajallisesti relevantti tutkimuskohde, sillä covid-19 pandemia ja Ukrainan sota ovat lisänneet hankintaketjujen riskitasoja. Aiemmat tutkimukset toimitusketjujen riskienhallinnasta ovat perustuneet valmistavan teollisuuden toimitusketjuihin, ja palveluiden osalta toimitusketjujen riskienhallintaa ei ole tutkittu juuri lainkaan. Tarve laajemmalle tutkimukselle palveluiden toimitusketjujen riskien hallinnan osalta on myös tunnistettu aiemmissa tutkimuksissa.

Tässä tutkimuksessa kehitettiin kokonaisvaltainen viitekehys palvelujen toimitusketjun riskienhallinnalle yritysten välisessä toiminnassa. Tutkimuksessa riskienhallintaa tarkasteltiin hankinnan näkökulmasta. Aiemman tutkimuksen pohjalta rakennettu viitekehys, joka pohjautui pääasiassa valmistavan teollisuuden tutkimuksiin, ei sovellu empiirinen aineisto perusteella soveltunut palveluiden toimitusketjujen riskienhallintaan. Empiirinen aineisto antoi syvempää ymmärrystä palveluiden toimitusketjujen luonteesta ja osoitti tarpeen muokata teorian pohjalta kehitetyn viitekehysten tähän kontekstiin sopivaksi. Empiirisen aineiston pohjalta päivitetty viitekehys kattaa riskien luokittelun, riskien tunnistamisen, riskianalyysin ja riskien vähentämisen, joita aiemmissa tutkimuksissa on käsitelty osana kokonaisvaltaista riskienhallintaa. Tutkimus on tapaustutkimus, jonka kohteena on yksittäinen yritys. Empiirinen aineisto on kerätty haastattelemalla seitsemää kohdeyrityksen hankinta-ammattilaista.

Tuloksien perusteella riskit luokiteltiin sisäisiin, ulkoihin ja toimintaympäristön aiheuttamiin riskeihin. Tämä luokittelu soveltuu palveluiden riskienhallintaan paremmin sillä se ottaa huomioon palvelujen luonteen ja eri toimijoiden merkityksen palveluiden toteuttamisessa. Tutkimustulos esittää myös laajan valikoiman riskien tunnistamisen ja vähentämisen toimintatapoja sekä kuvaa riskienhallintaprosessin, joka sisältää tunnistamisen, analysoinnin, lieventämisen ja hyväksymisen. Tutkimus osoittaa myös, että kaikkia palveluita ei voida kohdella samalla tavalla riskienhallinnan näkökulmasta, koska palveluiden välillä on eroja vaikuttavien riskien osalta ja niihin sovellettavissa toimintamalleissa. Eroista huolimatta palveluissa on paljon yhtäläisyyksiä riskienhallinnan näkökulmasta, sillä monet riskit vaikuttavat kaikkiin palveluihin ja riskienhallintaprosessia voitaisiin soveltaa kaikkiin palveluihin. Tämä mahdollistaa viitekehysten hyödyntämisen yrityksissä perustana kokonaisvaltaiselle riskienhallinnalle palvelujen hankintaketjuissa. Tutkimus tukee riskienhallinnan tutkimuskenttää, josta puuttuu kokonaisvaltainen viitekehys palveluiden toimitusketjujen riskienhallinnalle.

KEYWORDS: Risk management, service supply chains, risk categorization, risk identification, risk analysis, risk mitigation

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Abbreviations

IHIP - intangibility, heterogeneity, inseparability, and perishability

1 Introduction

Unexpected disturbances negatively affect to companies supply chains. For example, the Covid-19 pandemic created difficulties to supply deliveries for both product and service supplies and therefore increased supply chain risks. (El Baz & Ruel, 2021) During the Covid-19 pandemic companies needed to swiftly adapt to changes in supply availability as lockdowns affected manufacturers especially in China. Research that analyses the effects of Covid-19 on both products and service supply chains suggests that companies should increase disruption awareness and improve supply chain risk management. (Belhadi et. al., 2022) Most recently war in Ukraine has disrupted global supply chains (Hamilton, 2023) yet there is still need for greater focus on supply chain risks (Gurtu & Johny, 2021, p. 11). Supply chain risk management is not just a way to prepare for unexpected as risk-factor based supply chain strategy could improve organization performance and improve customer value. This is based on the robustness and agility of supply chain that could be achieved when supply chain risks are well understood and handled. (Wieland & Wallenburg, 2017)

Risk management in service supply chains is important. Research shows that product and service supply chains vary significantly when the effects of internal integration and external integration are studied (Yuen & Thai, 2017). Due to the clear differences in service supply chain and product supply chains there could be differences from risk management perspective also. Manufacturing firms face greater effects from supply chain risks compared to service-oriented companies. Partly this could be explained by the nature of supply as input supply is visible in manufacturing companies. (Truong & Hara, 2018) Because of this the focus of research has been in manufacturing supply chains and service supply chain risks have not been focused.

Service industries has increased a lot and already in 2009 services created over 70 percent of the gross national product in multiple countries (Gloppen, 2009, p .40-41) and percentage of services in global GNP was 61,7 percent in 2022 (The World Bank, 2024). Despite increased percentage of gross national product, service supply chain risks have

not been studied. Wang et. al. (2015) suggested that risk management in service supply chains should be studied more and current studies only focus on the relation of service supply and demand management. Their suggestion is to study service coordination and risk management in service supply chains widely. Same suggestion was made in 2020 by Nagariya et. al. (p. 359) as need for more research on service supply chain risks were mentioned as potential future research approach. Even though suggestions are from 2015 and 2020, there is still lack of studies that focus widely on the risk management in B2B service supply chains and there is no framework that would focus only service supply chains instead of overall supply chain risks. Service supply chain risk management is also timely relevant topic due to the covid-19 pandemic and ongoing war in Ukraine that have affected supply chains around the world.

1.1 Research questions and structure

Purpose for this research is to create a framework for service supply chain risk management by reviewing and analysing B2B service supply chains risks from buyer's perspective. The main research question of this study is:

RQ1: How risk management can be effectively implemented in service supply chain?

This study also has two sub-questions that are:

RQ2: How different services vary from risk management perspective?

RQ3: How can risks be categorized for service supply chain risk management?

Based on the research question answers a framework for service supply risk management, that takes account the characteristics of service supply and could be utilized in practice, is proposed.

1.2 Keywords

Risk management stand for the combination of plans, strategies, and actions to decrease supply chain vulnerability and control resilience (Gurtu & Johny, 2021 p. 1)

Service supply chain refers to the network of service providers and service consumers. Within service supply chain service providers create and deliver requested services for service consumers. (Baltacioglu et al. 2007. p. 112)

Risk categorization refers to different ways to view different risk factors. Multiple earlier research have used risk factors as the keyword (Ho et al. 2015) but risk categories describe it better as different risks can be categorized under risk categories.

Risk identification is part of risk management process where different risks are monitored, and purpose is to identify potential threats. (Ho et al. 2015. p. 5038; Gurtu & Johny, 2021 p. 7)

Risk analysis is a stage in risk management process where identified risks are analysed to get best understanding of current situation, and decision of next steps is made. (Ho et al. 2015; Diehl and Spinler, 2013, p. 317)

Risk mitigation refers to practices that can be used to manage risk levels and avoid disruptions. Practices are selected case by case based on cost/benefit analysis. (Ho et al. 2015; Diehl and Spinler, 2013, p. 317)

1.3 Structure of the study

This research is divided into five main parts. The first part is introduction and after that earlier studies about service supply chains are analysed in the theoretical framework part. Based on the earlier studies a preliminary framework for supply chain risk management is developed. As there is a lack of studies that focus on risk management in service supply chains, theories from the manufacturing supply chain perspective are applied to develop the framework. The third part contains description of the empirical research conducted by interviewing procurement specialists from the case company. Fourth part focuses on data analysis, where empirical data is reviewed and analysed. In this part the

preliminary framework is revised. In the final part findings of this study are summarized and future research directions are discussed.

2 Theoretical framework

This section builds the Theoretical framework of the study. The section begins with an overview of the features of service supply chains and continues by discussing earlier research of service supply chains and manufacturing supply chains from risk management perspective. The developed theoretical framework is consequently based on earlier studies conducted from both service and manufacturing supply chain perspective.

2.1 Service supply chains

Services differ from physical goods in multiple ways. Services are intangible, homogeneous, and more difficult to resell. Overall services are highly dependent on the service provider. Due to the nature of services, the quality of service can vary and all resources that are not used, cannot be used ever again as the resource is lost forever. (Arlbjorn et. al., 2011, p. 279) As services are not only dependent on the provider instead also customer involvement, they are more customizable and flexible compared to goods. Overall services are not as structured as manufacturing processes, making services unique. (Nagariya, et. al., 2022, p. 1333; Baltacioglu et. al., 2007, p. 114)

An essential part of the service nature are the IHIP features, that create the unique nature of services compared to products. (Ritala & Vilko, 2014, pp. 114, 116) Intangibility refers to the lack of a physical existence in the output of a service company and therefore also inputs may also be intangible. Heterogeneity describes the variance of service as similar services are different depending on customer needs and service provider. Services are produced and consumed simultaneously, making services inseparable because services require both service actors. Perishability refers to the time dependency of the production and consumption, as services cannot be stored and there cannot be a stock of produced services. These four features make services unique and different from physical products.

In B2B environment the variety of services is large. Common outsourced services are advertising, call center services, facility management services and consulting services (van der Valk & Wynstra, 2014, p. 198), but the list can be extended with all digital tools, telecom services, travel, recruitment, and training services. Consulting services can be divided into many different categories like engineering, marketing, or strategy consulting. Where manufacturing supply chains share quite similar characteristics the variety of B2B services creates difficulties for service supply chain management as the nature of flights and facility cleaning differ almost as service and manufacturing supply chains do.

The importance of the service supply chain has been noted since the beginning of 21st century. In history, service supplies have not been managed well instead the focus has been on products. This has led into missed opportunities and even problems as management, control and involvement have been lacking. (Ellram et. al, 2004, pp. 20-21) Due to the nature of services the balance between service cost and quality is a challenge for companies. Reducing costs while keeping high quality is challenge that companies often face. (Kathawala & Abdou, 2003, p. 140) As an extension to cost-quality balance, quality management is a main challenge for service supply chains (Arlbjorn et. al., 2011, p. 279).

As service supply chains have specific characteristics that differentiate them from traditional manufacturing-oriented supply chains, the definitions of supply chain and supply chain management need to be specifically defined for service supply chains and service supply chain management (Arlbjorn et. al., 2011, P.279).

The first definition for service supply chain management was made in 2004 by Ellram et. al. (p. 24-25):

“Supply chain management is the management of information, processes, capacity, service performance and funds from the earliest supplier to the ultimate customer.”

In 2007 Baltacioglu et al. (p. 112) proposed a revised definition for service supply chain. This definition states:

“The service supply chain is the network of suppliers, service providers, consumers and other supporting units that performs the functions of transaction of resources required to produce services; transformation of these resources into supporting and core services; and the delivery of these services to customers.”

They argued that the definition from 2004 by Ellram et al. is only relevant for management and there is no definition for service supply chain. Baltacioglu et al. defined service supply chain management as follows

“Service supply chain management is the management of information, processes, resources, and service performances from the earliest supplier to the ultimate customer.”

Definitions by Baltacioglu et al. focus on service supply chains that have services as the core product.

In 2015 Wang, et. al. (pp. 685-686) divided the service supply chain into two different categories. They categorized service supply chain into Service Only Supply Chain (SOSC) and Product Service Supply Chains (PSSC). Supplies in SOSCs are only services so no physical goods are involved in the service process. This is the most homogenous version of services as the products used POSCs limit customization of service. Many digital services like apps, internet and tele-communication are categorized in SOSCs along with financial and tourism services. Definitions for SSCs by Baltacioglu et al. (2007, p. 112) have similar scope as SOSCs by Wang et al (p. 685-686), whereas PSSCs extend the SSCs analysis. PSSCs are combinations of services and products. Common examples include restaurants, logistics and product design. All these have an end product, but a lot of services are also included in the process. This was first studies in 2008 when the study topic was servitized products. The first framework for servitization supply chain management was created that included factors from both manufacturing and service supply chains. (Johnson and Mena, 2008, pp. 27 & 30)

Ellram, et. al. (2004, p. 28) defined six different characteristics where manufacturing and services supply chains differ from each other. These categories are expectation, quality, demand predictability, cost, payment, and verification of contract completion. Service

expectations are not often as precise defined as in manufacturing instead they are often vague service level agreements. Manufacturing quality is measurable, whereas service quality is often subjective and dependent on the user's perception. Demand predictability can be forecasted in manufacturing whereas services are dependent on the project scope. Pricing for manufactured goods is often preset, whereas in services it can be negotiated but final price is often dependent on the final scope that could vary during service. Contract completion is easier in manufacturing as goods are complete when they are shipped whereas services need to be signed off internally. Payment is related to pricing because for goods payment can be matched with orders and is verifiable whereas for services, billing could be done without any tangible evidence, and in some cases verifying can be challenging. (Ellram, et. al. 2004, p. 28)

Service supply chains could be seen as bidirectional. This is not possible for manufacturing supply chains, as their product flow goes to one direction. Bidirectional means that in services the service flows in both directions (Sampson. 2012. P. 184-185), for example, Microsoft Teams needs companies that use the service to be able to provide their services. This highlights the unique nature of services as services require input from both service provider and customer (Arlbjorn et al., 2011, p.279; Nagariya, et al., 2022, p. 1333 ; Baltacioglu et al., 2007, p. 114).

2.2 Service supply chain risk management

This chapter focuses on the risk management of service supply chains and builds understanding of the theoretical framework. Risk can be defined as the uncertainty of outcome (Knight, 1921) and this uncertainty could lead to unwanted situations if something goes wrong. Service and manufacturing supply chains share similar risks, but they are not identical, and risks vary between supply chains. The main difference between risk and disruption is that disruption turns some theoretical risk into reality. (Gurtu & Johny, 2021, p. 2)

Risk management stand for the combination of plans and strategies to decrease supply chain vulnerability and control resilience (Gurtu & Johny, 2021, p. 1). Earlier research of service supply chain is limited and there is a lack of a complete service supply chain risk management framework. The proposed service supply chain risk management framework includes four parts: risk categorization, risk identification, risk analysis, and risk mitigation. This follows the same structure as Ho et al. (2015, p. 5031-5033) in their study that focused on risk management in the supply chain. This partition covers all risk management related activities and therefore is most useful for a complete risk management framework.

2.2.1 Service supply chain risk categorization

The first part of the framework is risk categorization. Many studies define this part as risk factors but in this study risk categorization is used as the title. Risk factors can be seen as different risks within the categorization. Alternative approach for service supply chain risks categorization by Ritala & Vilko (2014) provide useful tool for risk analysis and risk identification yet not really define risks as they do not have any clear definitions for risks. Therefore, it could be used in identification or analysis part instead of using as risk categorization definition.

Service supply chains are affected by supply and demand risks (Wang et al., 2015, p. 695) and therefore they will be risk categories in the framework. Juttner et al. (2003, p. 202) combined demand and supply risks into one category called network risks but characteristics of demand and supply risks vary significantly and therefore there is no reason to combine them into one. **Demand risk** and its affect in service supply chains was also studies by Truong & Hara in 2019 (pp. 231-235). Despite the effect to service supply chain was significantly smaller compared to manufacturing supply chains, it cannot be removed from the framework. Demand risk is slightly different depending on the service supply chain. Companies that sell services are directly affected by the demand from customers whereas companies that outsource services for their internal processes for

example consulting purposes, the demand changes come internally and are more related on internal changes. It could be argued whether demand risk should be included in organizational risk that takes account of internal risks in internal process outsourcing cases. As this framework focuses on service supply chains more widely, demand risk is own risk category in this framework.

Supply risk is validated as service supply chain risk category in earlier research (Wang et al., 2015, p. 695; Truong & Hara, 2019, pp. 231-235). Supply risk is categorized as a supply chain risk category in multiple studies (Ho et al., 2015; Baryannis et. al. 2019; Manuj and Mentzer, 2008) Supply risk has the biggest impact on the service supply chains. (Truong & Hara, 2019, p. 231-235) and therefore it is one risk category for service supply chains. Supply risk is broad category, and it could be argued that should the category be divided into multiple categories. Obviously, quality is the main aspect of the supply risk, but it is not limited to it. Similarly supply risk is the part of service supply chain that is most manageable by risk mitigation practices. As there is no good way to divide supply risk, it will be remained as one in the framework.

Information risk in service supply chains risk management context has been studied and noticed to be affecting risk category for service supply chains by Truong & Hara in 2019 (pp. 231-235). Many B2B services are focused on some information usage and information sharing and therefore information risks are often involved in service supply chain context. Information risk also include multiple risks that have been defined in earlier research for example system risks and intellectual property right risks that are especially important in service supply chain context. All these risks can be combined under information risk as all of them include information sharing, usage and are vulnerable to information misuse. Information risk could lead into disruptions like information leakage, information misuse or information system failures. Information risk levels could increase in the future after Industry 4.0 adaptation. Industry 4.0 is term for Fourth Industrial Revolution that included smart technologies and utilize for example IoT, AI, blockchains and Big Data to increase automaticity (Queiroz et al., 2021, pp. 1762-1763). Industry 4.0 will

digitalize supply chains by moving supply chains to cloud that utilize previously mentioned technologies (Queiroz et al., 2021, pp. 1762-1763; Ivanov et al., 2022, pp. 1-3). Simultaneously new digital innovation like blockchain could decrease information risks by improving traceability of data and improve transparency (Gurtu & Johny, 2021, p. 10; Ahmed & MacCarthy, 2023, p. 10).

Fourth risk category in service supply chains is **operational risk**. Rao and Goldsby (2009, p. 106-114) and Manuj & Mentzer's (2008, p 201) studies operational risk and defined it as risk that are caused by internal factors. Both studies were made from manufacturing supply chain standpoint and therefore include machinery malfunctions, but it also includes internal processes, relationship risks, and personnel risks, that this context personnel risks include employee misbehaviour. Manuj & Mentzer's (2008, p 201) also included credit risks but Truong & Hara (2019, p. 231-235) studied financial risks as an own risk category in their study that focuses service supply chains. As their study show that financial risk does not have clear impact on service supply chains, it does not need to be a separate category instead it could be included into operational risks. Therefore, the scope of operational risks includes financial, process and personnel factors.

Fifth risk category is **environmental risk**. Environmental risk includes everything that does not happen within the service supply chain but affect service supply chain for example changes in industry, financial environment, wars, and nature disasters. Environmental risk is noticed by Juttner et. al. (2010, pp. 201-202), Ho et al. (2015), and Rao and Goldsby (2009, pp. 106-114) and definition in the framework is based on them. Environmental risks are often sudden changes that create unexpected disruptions for supply chains. As environmental risks are not directly caused by any service supply chain network partner, management and mitigation of environmental risks is more difficult.

2.2.2 Service supply chain risk identification

Risk identification does not have major differences between manufacturing supply chains and service supply chains. Earlier studies have not been directly focused on risk

identification differences but as it often is shortly covered in all risk management studies, there has not been found differences. Risk identification process was described by Diehl and Spinler (2013, p. 316) and the process works for service supply chains also. Despite being part of earlier studies and multiple different risk identification approaches studied, there is limited descriptions of actual risk identification practices

Supply chain mapping was one of the mentioned steps in risk identification process by Diehl and Spinler (2013, p. 316). Mapping improves understanding of the larger picture of supply chain and therefore helps risk identification. Supply chain mapping is more common in manufacturing supply chains but it's useful for some service supply chains for example travel agencies use multiple sup-suppliers for providing services to customers and even though the customer does not have direct connection with sub-suppliers they affect significantly on the received service.

IHIP – Service Level analysis is the framework that was first introduced by Ritala & Vilko (2014, pp. 116-118). Ritala and Vilko introduced framework as more complete risk management and risk factor analysis tool but in this framework, it fits to risk identification category better. IHIP – Service Level analysis takes account of all different service levels that are service process, service actor and service system and therefore it takes account of internal factors also. Actual analysis reviews service from the 12 different angles as IHIP features and service levels are aligned in matrix table (Figure 4). This gives good insight on the overall service and helps identifying potential risks that could affect the service supply chain.

IHIP - Service Level matrix	Intangibility	Heterogeneity	Inseparability	Perishability
Service Process				
Service Actor				
Service System				

Figure 1. IHIP - Service Level matrix, adapted from Ritala & Vilko (2014, pp. 116-118).

2.2.3 Service supply chain risk analysis

Similarly, to risk identification, risk analysis is a topic that do not significantly differ between manufacturing supply chains and service supply chains. Biggest difference is coming from the service nature as IHIP features make the analysis more complex.

Risk level analysis is a broad term that includes everything else that is related to risk analysis including consequence analysis, risk estimation and risk assessment (Adhitya et al., 2009, p. 1450). Basis for risk level analysis needs to be person's or company's willingness to carry risk and is based on potential consequences of identified risks (Ho et al., 2015, pp. 5038-5039). Willingness to carry risks needs to be seen in preset requirements for the supply chain. Base from all risk management work is lost if there are no set requirements as then analysis do not have any baseline. (Adhitya et al., 2009, p. 1450) Requirement setting is affected by supplier's location and provided service and therefore there cannot be requirements that fit for all.

2.2.4 Service Supply chain risk mitigation practices

Risk mitigation refers to minimizing risks and that way managing the risk levels through different mitigation practices. Risk mitigation practices need to be aligned with the analysed risks categories. Earlier service supply chain risks were categorized into five different categories that are demand risk, supply risk, information risk, operational risk, and environmental risk. Risk mitigation practices do not go one-to-one instead some mitigation practices could affect multiple or even all the risk categories. When implementing risk mitigation practices, they need to be aligned with the risk analysis as for example mitigation practice that is focused on environmental risk do not help at all if risk analysis has not shown any risk from environmental perspective. Ellram, et. al. (2004, p. 30) have analysed risk mitigation practices from service supply chain perspective but their mitigation practice segmentation does not fit to this framework as such because of alternative approach to risk categorization.

Different mitigation practices in service supply chains are multi-sourcing, risk sharing contracts, hedging and blockchains. **Multi-sourcing** allows purchasing companies to divide the whole spend between multiple suppliers and therefore decrease the dependency of single supplier in supply chain. Despite the effect of multi-sourcing is more visible in manufacturing supply chains, it is useful in service supply chains also. Based on earlier studies having more than one supplier is beneficial from supply risk perspective yet the benefit of having more than two suppliers the benefit is not that significant (Ho, et al., 2015, p. 5049). Heterogeneity of services could affect the possibility of multi-sourcing as it might not be possible to source certain service from alternative supplier, but from risk management perspective the benefits of multi-sourcing cannot be looked down. In practice centralization of purchasing could create financial benefits through better prices and therefore multi-sourcing decision is balancing between risk level and financial benefits. Reflecting to risk categories, multi-sourcing could help with supply risk, as company would have alternative supplier if one supplier fails, and demand risk as potential capacity to match increased demand is higher.

Risk sharing contracts could be used to avoid poor quality of supply or costs from demand changes. Especially risk sharing contracts that are tied on performance levels are useful in service supply chains. Having incentives or penalties for supplier based on performance could minimize the service level changes that heterogeneity of services create (Selviaridis & Norrman, 2014, p. 155). As mentioned, contracts could also be linked to demand changes (Ho et al., 2015, p. 5048). Because of the intangibility and perishability, demand changes do not have as big effect as there cannot be a stock of services, but risk sharing contracts could benefit purchasing organization if supplier is committed to certain services but demand changes.

Despite the lack of risk impacts from financial perspective (Truong & Hara, 2019, pp. 231-235), **hedging** is a useful tool for purchasing companies to effect operational risk. Hedging is used to set currency or commodity process beforehand. This improves the predictability of supply costs. (Ho et al., 2015, p. 5050) One example of hedging in service supply chains could be electricity prices that could be set for years ahead and therefore increase predictability of electricity costs. Despite the main impact of hedging is on financial risk, it also affects environmental risks as it helps avoiding disruption of prices that could be caused by environmental hazards or crisis. As we have seen lately Ukrainian war have affected inflation levels and energy prices significantly (European Council, 2023) and hedging could have been beneficial for companies before the crisis. As a stand-alone risk mitigation practice hedging is not as beneficial as it could be when used along with other practices (Kouvelis, 2023, pp. 5, 8-10).

Blockchain is a solution that could be used for tracking and transparency. Blockchain is a way of creating a log of actions that cannot be changed by single source and therefore it is used for payments and material tracking and despite some challenges it is useful for supply chain management (Gökalp et al., 2022, pp. 100-101). Despite the lack of physical materials, some services require material or data delivering and blockchain could be a solution to improve security of data and material as for example blockchain allows to follow digital actions to documents and payments.

2.3 Framework for Service supply chain risk management

Based on the discussion above, a framework for risk management in service supply chains is developed and adapted to the service supply context from buyers perspective in B2B environment. The complete framework for service supply chain risk management is tailored for services and takes account if the nature of services. Homogeneity creates difficulties to manage quality as the variation between services could be large and therefore service quality risks is difficult to manage. This framework takes into account service specific risk but notices that all risks cannot be managed.

The theoretical framework is described in Figure 2 and it takes account all different aspects that are needed for complete framework. Different parts of the framework have been discussed earlier and Figure 2 is combination of them. Theoretical framework is divided into four parts: risk categorization, risk identification, risk analysis and risk mitigation. All of these different parts have been reviewed earlier and Figure 2 collects main findings into one complete framework. Risk categories in the framework are demand risks, supply risks, information risks, operational risks, and environmental risks. These risks are defined based on earlier research and authors practical knowledge of the topic. Key parts for risk identification are supply chain mapping and IHIP – service level analysis and for risk analysis risk level analysis. Different risk mitigation practices in the framework are multi-sourcing, risk sharing contracts, hedging and blockchains. For every part of the theoretical framework there is earlier researched to support them but authors professional experience is used for critical evaluation and selection for service supply chain context. As the framework is based on theoretical studies, the theoretical framework is refined through empirical data.

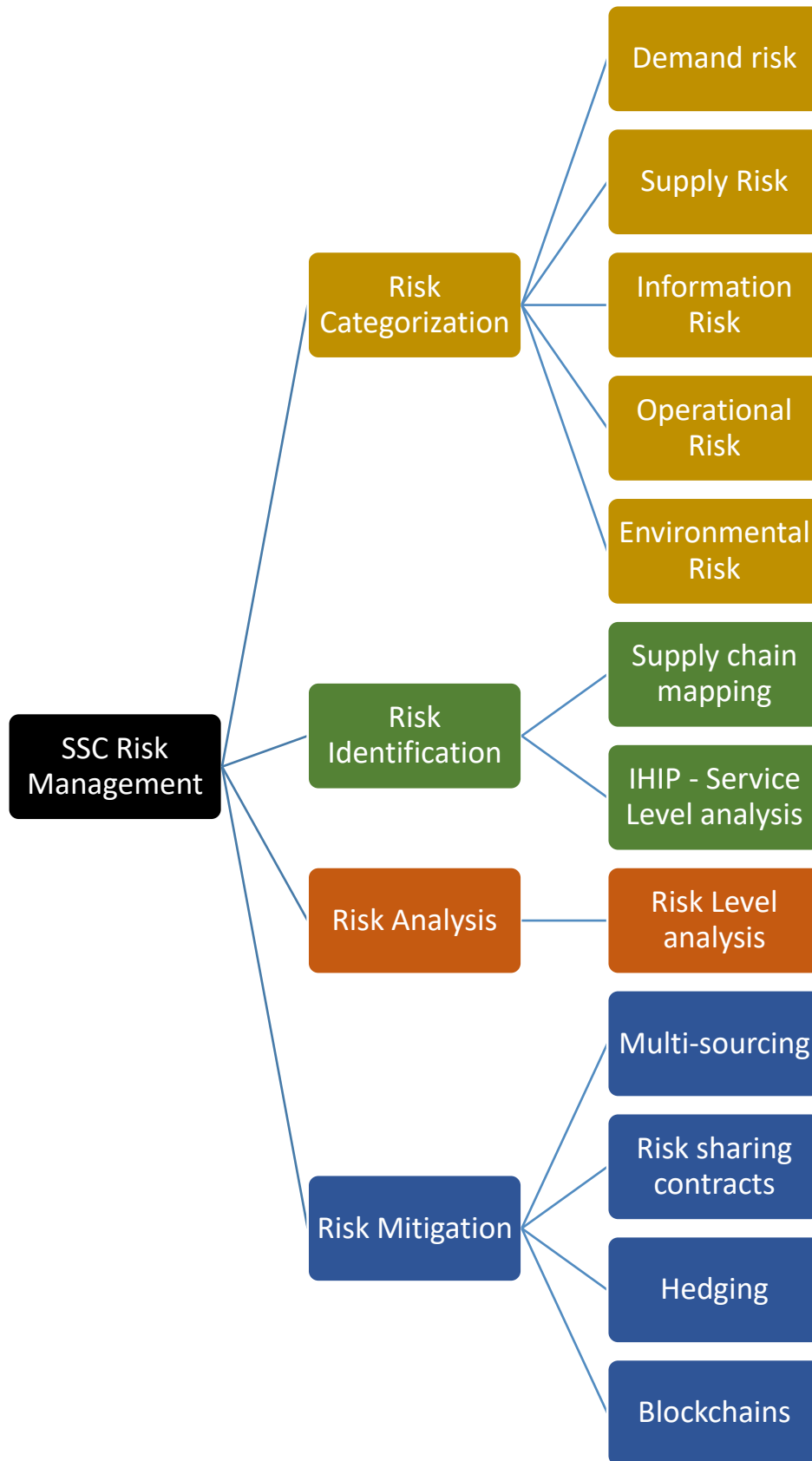


Figure 2. Theoretical framework for service supply chain risk management

3 Methodology

Methodology part begins with research design description followed by data collection introduction. After data collection part, data analysis approach is discussed and methodology part ends with reliability and validity discussion.

3.1 Research design

“The general plan of how research question(s) will be answered” is the definition of research design by Saunders (2007, p. 131). This main question for this study is “How different risk management approaches can be effectively utilized in service supply chains?” and objective is to answer the question by creating framework for risk management in service supply chains. Sub-questions are “How different services vary from risk management perspective?” and “How can risks be categorized for service supply chain risk management?”. Answers to sub questions can be found from the framework. Research design include mentioned objective along with relevant data sources and challenges for the study such as time, location, data availability.

This study utilizes a single case study strategy. A case study strategy is defined as “a strategy for doing research which involves empirical investigation of contemporary phenomenon within its real-life context using multiple sources of evidence” (Robson, 2002, p. 178) Single case study can be utilized for studying phenomena that only few have studied before making it suitable for this study (Saunders, 2007, p. 140). Simultaneously case study strategy has ability to create answers to “why?”, “how?” and “what?” questions. As all three research questions are “how” questions, case study strategy is suitable for the study.

Case company’s procurement professionals’ practical experiences are the core perspective for the empirical investigation. As there is lack of earlier studies about risk management in service supply chains, there is also limited amount of empirical evidence of risk management in service supply chain in practice. Case company’s procurement

professionals work with various services and therefore they could give good overview of risks and risk management processes of B2B service supply chains. Abductive logic is utilized in this study because of the size of the case company and coverage of different geographical locations and service categories, findings can be viewed in general level but at the same time most of the utilized practices in service supply chains come from manufacturing supply chains.

3.2 Data collection

Main data collection technique in this study is interviews conducted in Microsoft Teams with procurement professionals from the case company. Many academics have suggested utilizing qualitative interviews as a way improve understanding (Eriksson and Kovalainen, 2008, p. 95). Therefore, the methodology of the study is based on the case study strategy consisting semi-structured interviews with professionals. Semi-structured interviews were selected to give interviewee possibility to keep discussions informal and continue conversations on certain topics if interviewee have a lot of valuable information.

For this study seven interviews were conducted. Interviews were 30 to 60 minutes long and were held on Microsoft Teams. All interviews except one were recorded with the permission of the interviewed person. One of the interviewees did not allow recording due to the sensitivity of discussed topics but have approved gathered meeting notes. Interviews were conducted in two languages, in English and in Finnish depending on interviewed persons preferences. Interview guide, information statement and interview questions in English are described in Appendix 1. Interviewees were provided a list of questions before interviews. List of questions did not include questions that described risk categorization in the theoretical framework to avoid probing and giving interviewees possibility to express their own views first. All questions, including risk categorization specific ones, are presented on the Appendix 1.

Interview questions were divided into six different categories: background, risk categorization, risk identification, risk analysis, risk mitigation and extra. Background questions

allowed gathering relevant information for the research purposes, four main risk management categories were based on the theoretical framework and extra part allowed gathering information without restrictions and getting ideas that might not have been yet discussed.

Interviewed persons represent case company's indirect procurement department. Indirect procurement is dealing with different service providers and manage service supply chains and therefore have relevant information for service supply chain risk management. Case company's indirect procurement is divided into operative and strategic purchasing and interviewed persons come from strategic purchasing side. Strategic purchasing is responsible of supplier relationships, contractual matters and supply chain risks and therefore have understanding and overview of risk management. Interviewed persons come around the world and interview invitations have not been limited to any category or geological area. Interviewees background including position, experience years and relevant categories are presented below (Table 1). Experience years is limited to cover the overall experience of procurement as the purpose of the study is to focus on risk management on overall level despite being a one company case study. Interviewee code allows identification of interviewee in analysis part.

Table 1. Background information of interviews' participants

Position	Experience years	Categories	Date and duration	Interviewee code
Indirect Procurement Manager	12 years	Professional services	18.12.2023, 42m 1s	A
Strategic Purchaser	21 years	Marketing	18.12.2023, 51m 6s	B
Senior Strategic Purchaser	14 years	Professional services	18.12.2023, 46m 1s	C
Category Manager	15 years	ICT	19.12.2023, 39m 22s	D
Indirect Procurement Manager	23 years	HR & ICT	19.12.2023, 46m 8s	E
Strategic Purchaser	20 years	Projects, no specific category	5.1.2024, 28m 55s	F
Indirect Procurement Manager	8 years	Mainly but not limited to HR and Facility management	6.1.2024, not recorded	G

3.3 Data Analysis

Studies can be conducted in cross-sectional or longitudinal time horizon (Saunders, 2007, p. 148). For this study cross-sectional time horizon was selected and therefore study focuses on the phenomena in certain time. Reason for selection is the purpose of the study, as framework needs to be suitable for current time and therefore longitudinal study would not be suitable for the purpose. It is worth mentioning that time and resources for the study are limited and it affects time horizon selection also.

Abductive reasoning is used in the study. Deductive reasoning is used in the theoretical background section as the framework is built around earlier studies and inductive reasoning is used on the latter section as empirical data is widened to theoretical

implications. Utilizing both deductive and inductive logics are common in qualitative analyses (Eriksson and Kovalainen, 2008, p. 328).

The theoretical framework is built around earlier studies about risk management in service supply chains and complemented with concepts from risk management studies conducted from manufacturing supply chain perspective, the framework is revised with the help of the results of the empirical study.

Interview transcripts were collected into a qualitative database. Main goal of data analysis resulted in an unambiguous, clear and systematic understanding of research concepts (Maylor and Blackmon, 2005). After the database were built, material could be analysed. First common themes, that are related to the study topic and are relevant for research questions and objectives, are categorized and then analysed comprehensively. Finally, findings from different themes are presented along with supportive direct quotations from the interviews to fill in theoretical gaps or validate parts of theoretical framework.

3.4 Reliability and validity

Validity and reliability of a research determine the credibility of research results (Newman and Benz 1998). This study utilizes multiple methods to improve the quality of the research. For example, theoretical framework is built around previous studies that are discussed in the theoretical background section. Studies that have been used are peer reviewed to avoid false information. Findings from empirical data correlate with theoretical findings and empirical findings have similarities and therefore findings can be inducted to the general level. Most of the interviews were recorded and transcripts were made and notes from interview that was not recorded were approved by the interviewee after the interview to improve credibility of the interview that was not recorded. This way all important empirical information is safe and available for analysis. Finally, direct quotations are provided in the analysis section to ease following the analysis development process.

Semi-structured interviews have multiple issues like data quality, biases, reliability, validity and generalizability. Potential issue with semi-structured interviews in qualitative research is the repeatability as it cannot be redone in exact same circumstances as in the first time (Marshall and Rossmann, 1999). Despite the issues, reliability could be reached by avoiding both interviewer and interviewee biases through the whole process of research. Interviewers' behaviour like gestures and comments affect results as interviewer's biases could affect through behaviour. Therefore, it is important to provide information about interview process (Saunders, 2009). Interviewee should not give any comments or share own opinions during the interview yet in the interviews of this study interviewee had to explain theoretical concepts during the discussion as risk categorization was not shared to interviewees beforehand to allow them to share own thoughts first. Interviewees had opportunity to familiarize themselves to the interview questions beforehand and they were informed about anonymity of the interview and possibility for recording. All interviews started by asking permission to start recording and sharing anonymity information again.

Interviewer work in the same organization as all interviewees and interviewer have been in contact with most of the interviewees earlier. Knowing interviewer beforehand should ease the discussion as risks and cases that have happened can be shared in friendly environment to a person, they were familiar. Being familiar with topic and organizations practices allowed interviewee to focus on topics as interviewees did not have to explain basics. Also, interviewees knowledge helped understanding interviewees comments and thoughts and therefore allowed in depth analysis of empirical data. Interviewee's biases could be connected to the perception of interviewer or willingness to participate. In this study there was no biases noticed. (Saunders, 2009, pp.326-327).

4 Empirical Findings

This part of the study focusses on the empirical data collections and its analysis by first introducing the case company and then covering all four parts of the theoretical risk management framework from empirical data perspective. At the end of this chapter the theoretical framework is revised based on the empirical findings.

4.1 Case company background

The case company is a multi-national company that operates globally. Company is a manufacturing company, and its procurement is divided into direct procurement and indirect procurement. For this study the interest is in the indirect procurement side, more specifically on services. Company's indirect procurement department has been established less than 10 years ago and current practices that have been adopted from manufacturing supply chains were modified to fit service supply chain context.

The author of this study has been working in case company's indirect procurement department for three years. Most of the time author has been a strategic purchaser trainee but during the research process was promoted to the position of a strategic purchaser. Author has been involved in development projects and has hands-on experience of risks within service supply chains especially from travel category.

The case company's headquarters are located in Finland, and it operates in marine and energy industries. The case company employed over 17000 employees in 2022. Company develops sustainable energy solutions and therefore change the maritime industry and energy industry towards more carbon neutral future.

Case company's indirect procurement is divided into three main teams: development, operative purchasing and strategic purchasing. This study focuses specifically on strategic purchasing, which operates within a matrix organization covering various regions and procurement categories. Different indirect procurement categories in the company

include ICT, Telecom, Facility management, Marketing, Professional services, Travel and HR whereas different regions are Finland, North Europe, South Europe, Americas, Africa, and Middle East & Asia. As second research question for the study is to analyse differences between categories, the focus of the study is in the different categories yet interviewed persons come around the world to also get perspectives from diverse geographical locations.

4.2 Data Analysis

In data analysis part empirical data from interviews is analysed from risk categorization, risk identification, risk analysis and risk mitigation perspective to allow revising the framework based on empirical data.

4.2.1 Risk Categorization

Interestingly interviewees clearly divide risks into internal and external while also mentioning environmental risks as one affecting aspect. Internal risks refer to risks caused by internal people and processes whereas external risks refer to risks coming created by suppliers or whole supply chain. Environmental risks are those caused by the operating environment, which neither buying company or suppliers cannot affect significantly. While risks were divided into internal and external not all interviewees mentioned both but as most of the interviewees had mentioned both it could be seen as the approach of the majority. Environmental risks were mentioned by only two interviewees but later when questioning on environmental risks all interviewees claimed that it affects their work.

From the answers four most discussed external risks are quality, personnel safety and ethical or legal risks. Starting from **quality risks** it is always concerning weather supplier will keep the service level throughout the project. For example, interviewee B who works with marketing puts it:

Usually, we have presentation or beauty contacts with different suppliers before we make our decision. They cannot keep their promise, and then sometimes the service level will show during the project.

Therefore, purchaser cannot completely trust the expected quality especially with new suppliers when there is no earlier experiences or evidence. Yet it was mentioned by Interviewee E that

“if you are not satisfied so level of the services or the satisfaction of the service level are quite different from person to person.”

Personnel safety was mentioned by interviewees who work with professional services that include subcontracting or facility management. Personnel who work in case company’s sites need to follow safety regulations and use all needed personal protective equipment’s (hereinafter referred as PPE). Safety hazard and long-term injuries (hereinafter referred as LTI) has been increasing according to Interviewee E. *“It (LTI’s) increases our own cost in the operation”*, and therefore could lead to financial losses revealed Interviewee E. Injury risk is increased

“if they don't have for example the knowledge on the things, they are doing for us and that is a risk”

stated interviewee A. Despite personnel safety risk risen multiple times in the interviews, it should be noted that this was category specific risk instead of effecting all service supply chains.

Ethical or legal risks were mentioned by four of the interviewees that work with different purchasing categories. Legal aspect for example following local legislation is the main concern as interviewee E mentioned that

“if they are not the following the rules and regulation, we are facing some penalties because we are a principal employer.”

Despite comment being focused on personnel that work in case company’s sites, lack of following law was mentioned by purchaser that do not work with purchaser that involve being on case company’s site. Legal risks were mentioned also in HR and marketing

categories. Ethical risks are harder to analyse compared to legal risks but according to interviewee F

“supplier might look good at the first glance but when looking deeper there could be some dirt.”

Interviewee D gave an example case where

“case company had three beneficiaries but data that we had only showed one beneficiary.”

There might be acceptable reason for the example case, but it shows that suppliers need to be known well to get under the surface.

Main internal risks brought up by interviews are lack of following policies and lack of time. Based on answers these are connected to each other as lack of time is often created by not following policies and lack of could lead into not following policies and therefore it keeps on looping. In this context **lack of time** refers to purchasers limited time for negotiations if there even is time for negotiations. According to interviewee E

“they (stakeholders) do not provide the information on timely manner and that is the biggest risk”

as need for service might be next day when purchaser gets the information. This leaves limited possibilities for purchaser to evaluate used suppliers. Interviewee E declared:

We are not able to evaluate the requirement on all the risk aspect with the supplier because if you are talking about the safety risk, if you are talking about the any financial risk, if we are talking about any legal risk or legislation risk or any regulatory risk, if you don't provide the time to the purchaser, they are not able to evaluate on an each and every aspect of the risk.

Despite answering in professional manner, purchasers' frustration was visible from the answer as at the end purchasers need to carry the risk.

One reason behind having limited time for negotiations is **misbehaviour and lack of following policies**. Interviewee E mentioned that

“they (internal stakeholders) are directly dealing with or promising (purchases) to the supplier.”

and Interviewee B stated

“they (internal stakeholders) choose their preferred suppliers, but we see they are overcharging compared to the benchmark”.

As stakeholders are directly in touch with suppliers and might even accept quotes before involving purchasers, company loses its negotiation power. According to interviewee E

“we see that we are losing the opportunity for negotiating with the supplier. that is one big risk.”

If suppliers know beforehand that we will buy their services, they have power in negotiations and purchaser loses opportunity to create value. Reasons behind misbehaviour were not discussed as purchasers would have been asked to answer for stakeholders. Clear connection with misbehaviour and lack of time can be seen from the answers.

All interviewees revealed that **environmental risks** affect their work. *“Delivering the service over there is quite challenging for a procurement professional”* answered interviewee E and referred to middle east countries where *“many countries are under the war zone”*. Earthquake areas and tornado areas for example east coast of USA were mentioned also when environmental risks were brought up with interviewee D. Interviewee B mentioned that *“in my supplier pool I have suppliers in Ukraine Kiev and now they are at war.”* Answer shows that despite being located in area that is not in war zone or facing frequent natural disasters, things that affect in nearby countries affect purchaser supply chains. Along with wars and natural disasters economic cycle changes create risks for purchasers. *“Environmental changes can be seen in prices”* mentioned Interviewee F referring to economic cycle changes. Economic cycle does not affect only prices but also availability and the whole operation environment. Therefore wars, natural disasters and economic cycle were three environmental risks that were risen from the interviews. Interviewee A summed up environmental risks within one sentence *“with the world so unstable as it is, it (environment) is also of course a risk”*.

During the interviews all five risk categories from theoretical framework were discussed with interviewees. **Supply risks** were covered by many interviewees already during the

initial question of risks interviewees face, and in fact only two interviewees had anything to add from supply risk perspective: one pointed out potential risks of merges and other pointed out quality issues. Quality issues were covered earlier but risks from merges were interesting point. As companies merge interviewee B pointed out that

“there is some changes within the people, how they organize or in terms of financial aspects”.

Despite being pointed out separately at the end this is also related to quality aspects if personnel or practices change. As conclusion answers show clearly that main supply risks are quality, personnel safety and ethical or legal risks.

Demand risks were not discussed by any of interviewees before really asking about it and even then, many interviewees had troubles to understand the concept of demand risk. Answers show that in service supply chains there really is not risk caused by decreasing demand but increasing demand could create issues. Interviewee C pointed out that decreasing demand is *“mainly a disadvantage of the supplier”*. This describes the specific dynamic of service supply as companies are invoiced based on hours and it’s easier to inform that we do not need the service anymore whereas in manufacturing purchases might be made a long time ago without possibility to cancel. Increasing demand is often more problematic for purchaser as interviewee E mentioned *that “We cannot predict (the need), we are not in a manufacturing”*. Almost all interviewees pointed out the mitigation practice for demand risk already at this stage as they want to have *“a supplier like plan A, Plan B, plan C”* like interviewee E revealed, to meet demand changes and according to interviewee D *“do not put all eggs in one basket”*. It’s worth mentioning that even if supplier could meet the increasing demand, it might affect the service quality. Interviewee B mentioned that negative feedback towards a supplier has increased and

“maybe it's because they cannot cope with our demand because during the year, we have doubled the demand”.

Based on the interview answers increasing demand is the main risk from demand perspective and often the risk itself is not that big. This finding is in line with Truong & Haras

(2019. P. 231-235) research as demand risk is not having a big effect on service supply chains.

Information security including both intellectual property rights (hereinafter referred as IPR) and other confidential information were mentioned by multiple interviewees in the first interview questions. Similarly, to personnel safety, this risk is again focused on professional services category where for example engineers and consultants belong. Similarly, to demand risk the main mitigation practice for information risks came up when discussing about information risks. Non-Disclosure Agreements (hereinafter referred as NDA) is made with almost every supplier and that should cover information risks. Interestingly cyber security aspect was only raised by interviewees who work with software purchases. Obviously, they need to be aware of the software security but also suppliers that could provide consultancy will use different software and might save some information in their systems. Interviewee C also raised bank detail information risk:

We've had some cases where - our suppliers have been hacked. There're people that have gained access to their emails and they have been able ultimately to fake invoices with fake bank account numbers and they have actually been able to get 10s of thousands of dollars into their account.

Bank detail information is important from purchaser perspective as company could lose a lot of money because of fake invoices and therefore there is processes to avoid those cases.

When asked about information risk also **internal information sharing** was raised by multiple interviewees. As this is linked to operational risks it analysed as a separately from information risks. Many interviewees pointed out that the information does not come to them in timely manner, and it creates issues. Comment from interviewee E describes well the benefit of good communication:

"If we have a information well in advance, we can we can control so many things or so many aspects that are there".

Internal information risk could also be caused by personnel changes. Interviewee F stated:

“When we only have one expert of the field and he or she leaves the company or changes position that leaves a gap that needs to be filled and often that is not a quick process”.

Answers about information risk can be divided to internal and external similarly to risks that were identified from the first questions. Main information risks are information miss usage and lack of internal information sharing.

Operational risk overlaps with information risk when discussed about internal information sharing. Main operational risks were already discussed from before and interviewees did not have anything to add for this risk category later in the interview. Therefore, main operational risks are lack of time and lack of following policies along poor internal information sharing.

Table 2 conclude identified risks with along with their category, impact level and risk source. From the table it is visible that many risks come from external sources meaning from suppliers. Impact levels are marked based on interviewees comments and frequency of mentioned risk and how it is described by interviewees are taken account on the impact analysis. Table also indicates that many of the risks affect all different service categories, but it needs to be acknowledged that the impact level varies between categories.

Table 2. Identified risk factors from interviews.

Risk	Category	Risk source
Quality	All	External
Safety	subcontracting, facility management	External
Ethical or legal risks	all	External
Lack of time	all	Internal
misbehaviour	all	Internal
Natural disasters	All	environmental
wars	All	Environmental
Economic cycle	all	environmental
Financial risk	All	external
Demand risk	all	external
Information security	All, but importance varies	External, internal

4.2.2 Risk Identification

Interviewees pointed out multiple risk identification methods including questionnaires, audits, stakeholder discussions, risk monitoring and performance measuring. Most often **internal feedback** was pointed as the main risk identification method. Internal discussions could be used for both getting information from earlier usage or understanding the scope of the current need. Especially getting feedback from users is used in all different purchasing categories. Despite case company having different tools for risk identification, interviewee B revealed that in marketing

“the way to identify is by ongoing check in with stakeholders and to have feedback about suppliers”.

It is worth mentioning that feedback does not limit to current users instead feedback from different organizations could give valuable insights for risk identification.

Performance measuring is often linked to interviews as for services measuring the quality is often based on personal experiences.

Case company also has a risk management process that includes **questionnaire** that covers different potential risks from quality to employee's health and safety. Interviewee C explained benefits and disadvantages of the questionnaire well:

So we basically send out a form to our suppliers and the good news is that it's a very complete form. The bad news is that it's exactly the same form for all kinds of suppliers, and that creates an issue even direct suppliers that you know are much more sensitive.

The tool that handles questionnaires automatically point out potential risks based on answers to multiple choice questions. Questionnaire works well in some categories but as it is not adaptive it does not work for all.

“(Questionnaire) creates a problem because for some suppliers it's absolutely unnecessary to fill this form but to our extent in professional categories, it's quite useful”

summarized interviewee C.

Line between analysis and identification is not visible in practice as identification and analysis is often done simultaneously. For example, questionnaire helps identifying risks but also makes user analyse the risk at the same time. In case company questionnaire is part of risk management tool and it helps analysing answers from questionnaire. Case company has also another risk management tool that provides information of the supplier and the environment it operates by gives risk rating for the supplier. *“We get kind of news flashes about suppliers' risks”* Interviewee D described the tool and its ability to monitor suppliers. This tool is a third-party service that utilized AI for the risk identification and based on answers it is not widely used tool.

Audits and supplier meetings are great way to identify risks, but it could also be used for analysing risks. Depending on the meeting or audit could be arranged based on some identified risk or it could be done for identification purpose. Interviewee A described

the risk identification for subcontractors as follows *“we need to be there and see how it does it”*. Interviewees answers shows the importance of actually seeing service providers in action as questionnaires might not give full understanding of the potential risks like interviewee A mentioned:

“Visiting there more actually to see that it's actually true what they are replying to on the VMS rating (questionnaire) for example”.

Risk identification is continuous process. Interviewees answers show that feedback is collected all the time and larger identification processes such as questionnaires are done regularly. Interviewee E stated:

So what we used to do that we are evaluating each and every supplier every year, generally the critical supplier we try to get all the documents specifically their legal status, legal documents, whether it is a uh they renewed that trade license, they renewed their wet certificate whether they renewed their some of the insurance policies which is required for performing the work for us.

Interviewee F concluded that *“risks are always here and it's part of the job to notice them”*.

4.2.3 Risk Analysis

As described in risk identification part, many risk identification and risk analysis tasks are being done simultaneously. For example, audits, questionnaire analyses and external data analysis is closely linked to identification process. Therefore, none of the interviewees brought up any completely new analysis practices when being first discussed about identification. Only risk analysis practice that were not already discussed in risk identification part is **interviewees**. If some risks have identified, supplier could be interviewed about them and they are given opportunity to explain or make correcting actions. Interviewee A revealed that

“(when a risk is identified) the next step then is to have a meeting with the supplier and asked them to maybe give more information around the red flags that we have noticed.”

Instead, the focus on the answers were on the interviewee's decision process.

“It is not necessarily about avoiding or mitigating risks but recognizing them and making informed choices about whether to accept, transfer, mitigate, or avoid them”

described Interviewee G. Also, interviewees pointed out the professional experience and skills when discussed about analysis:

“I feel that after so many years I kind of have the knowledge to decide if this risk is too big or not”

claimed interviewee A and *“I would say that the experience gives you some tools”* stated interviewee C.

More interestingly follow up question about the final decisions of carrying risks brought up the fact that at the end it's always the stakeholder, for example project manager or the end user, who will make the final decision. Purchaser's task is to just analyse risks and describe them to stakeholders who could then make the final decisions. None of the interviewees revealed that they would have the power to call off a purchase because of too high risk but in those cases, they make sure that stakeholders understand the situation and take responsibility. This was called risk acceptance by interviewees. Interviewee G described the risk acceptance accordingly:

A well-structured and inclusive risk acceptance process involves collaboration among key stakeholders, systematic risk assessment, and clear documentation of decisions. This approach ensures that organizations make informed choices about which risks to accept while aligning with their strategic goals and risk tolerance levels.

Answers show that risk analysis might not even involve any common tasks. It is a part of risk management process that include discussions with stakeholders that will carry the risk, but the main work is done in risk identification part. It could be argued that audits, questionnaire analyses, interviews and external data analysis should be only included in risk identification in the framework and only risk acceptance and mitigation plan are parts of risk analysis. Alternatively, identification and analysis could be seen circulating as there is some analysis done after each identification practice but there might be a need for further investigation and therefore process would go back to identification part.

4.2.4 Risk Mitigation

Risk mitigation practices were risen in earlier stages of the interviews when discussing about risk categories and risk analysis. Interestingly interviewees approached some of the risk categories and risk analysis from the mitigation perspective. For example, non-disclosure agreements (hereinafter referred as NDA) were brought up first before discussing the actual information risk and having multiple suppliers for one purpose before discussing the demand risk. Interviewees approach Describes the mentality towards risk management as there are common practices in the case company for risk mitigation and those practices are applied automatically. Like mentioned in the risk analysis part, experience could bring certain knowledge for most usual cases, but could it lead to always mitigating all possible risks without understanding or properly analysing different cases.

Especially when discussing about information risks the NDA was brought up often. Interviewee C mentioned that

“we always have NDAs in place with suppliers if we share some (confidential) information, and it covers us”.

Interviewees described that NDA includes high penalty clauses for breaking it but there is not really evaluation done behind about the risk level for example sensitivity of information and quality of suppliers' systems and processes. This leads to practice of just making the contract and not really evaluating the risk. Obviously, it is better to have the NDA in place rather than not but there is a lack of understanding the big picture. It is worth mentioning that one of the interviewees mentioned studying the background when discussed about NDAs and information risk.

Based on interviews main risk mitigation practices are contract coverage, multi-sourcing and proactive supplier relationships. All three of them are linked to each other closely and are valid for all categories. Starting from **contract coverage**, that was already slightly covered when discussed about NDAs, it is important to have contracts in place with used suppliers to have well defined liabilities and other terms in place. Contracts are a common way to mitigate risks as proper contract allow moving parts of the supply risk to

supplier and contracts are the first thing to check when there are some issues. Interviewee B stated that *“usually I will refer back if we have some black and white in documents”* describing the importance of proper contracts with suppliers. Contract could be used also for quality and service level handling like Interviewee B described

“You take a Word-document, you write down what is your KPI (key performance indicator) requirements and what is your SLA (service level agreement) you want from the supplier?”.

KPI's and SLA that are linked to contracts allow monitoring the quality aspect of service and gives power to take actions that are not based on subjective experience. Important note from Interviewee F is the transparency when negotiating contracts:

“Conversation needs to be transparent so that supplier understand where they are committing and what are consequences of not performing according to contract”.

Multi-sourcing meaning having multiple preferred service providers for one job increases the strength of supply chain and mitigated the risk related to one supplier. For example, if there are three suppliers for some job

“Then you can just stop using them because you still have two love two options left, and then it's possible to source a new one, for example, if that is necessary”

described interviewee A. Similar approach of having one main supplier and two alternatives ready when needed. Selecting the main one is based on offered terms according to interviewee C:

“one preferred supplier which is your first go to player. (It is) the one that gave you the best terms and conditions and then we have one or two that are alternative suppliers”.

Proactive supplier relationships refer to active supplier management where collaboration between companies is on high level. Proactive relationship management include regular meetings and common targets to develop co-operation. Proactive supplier relationships increase trust and improve the co-operations and therefore discussing about quality or safety issues are easier and supplier might be more willing to improve if they feel valued. Supplier relationships are closely linked to multi-sourcing and contract coverage as when there are only few suppliers with co-operation frame created by contracts

“it's easier to have follow up meetings with them” stated interviewee A. According to interviewee F meetings allow *“regular performance evaluations and adherence to safety standards”* that again is one way to mitigate both quality and safety risks. Important point that interviewee A raised is that purchasers should try to meet suppliers face to face instead of virtual meetings. According to interviewee it is easier to build partnership when being physically present which has not been possible during and even after Covid-19 pandemic. Supplier relationships or *“partnerships”* like interviewee D described could be beneficial also for negotiations as *“partnerships could be used for better rates”*.

Interestingly there were only few that mentioned any mitigation practice that was linked to internal processes or personnel. Interviewee D mentioned that *“procurement need to keep thing under our control”* and *“understand what is okay and what not and be specialist on the field”*. These answers came from ICT perspective and therefore it might not be applicable to other categories as interviewees had mentioned in earlier questions that stakeholders or project owners are the ones who make the decision and are expert of the field. Other comment that was related to marketing category was focused on the **collaboration and educating stakeholders**. This is not limited to internal stakeholders but supplier also as interviewee B claimed that *“It will be good to guide the suppliers and also to guide the stakeholders as well”*. When discussed about risk categories, multiple internal risk related to timing and misbehaviour were mentioned and mitigating internal risks by educating stakeholders is natural approach. Partially aligned with educating stakeholders is *“having clear policies and guidelines”* that one interviewee mentioned. Policies and guidelines need to be clear and easily understandable to make following them as easy as possible.

4.3 Revised framework for service supply chain risk management

Interviews and the empirical data allow revising the theoretical framework and possibly make corrections that earlier research have not seen. In this part all different parts of the framework are discussed based on earlier theories and empirical data.

Based in the interview answers risks are often categorized into internal, external, and environmental. For interviewees the perspective for **risk categorization** is more practical and for them it is easier to focus on different actors that create risks instead of specific risk areas. In most of the cases interviewees had troubles understanding concepts of for example demand risk or information risks and therefore it is worth questioning should risk categories be divided differently in the framework. Interviewees approach had similarities in their risk categorization with Juttner et al. (2010, p. 201-202), who divided supply chain risks into organizational risks, environmental risks, and network risks. Network risk and organizational risk are not same as internal and external risks that interviewees mentioned but overall structure is similar.

Answers also showed that some risks are both internal and external and therefore if risks are divided into external and internal, few things need to be analysed from both perspectives. For example, information risks are something that need to be analysed from external perspective and internal perspective. Similarly, there are aspects that overlap both environmental risk and external risk as supplier's location can be seen as both external and environmental risk. For the framework, suppliers' location is more relevant from the environmental perspective as at the end all three categories are parts of one purchaser-supplier relationship and Environmental risks should be analysed based on companies' locations and industries.

Adopting structure from Juttner et al. (2010, p. 201-202) and modifying it to apply service supply chains creates most suitable risk categorization for the framework. As there have not been earlier studies on this topic the empirical findings are valued more than earlier research that is not conducted from service supply chain perspective. The revised risk categorization is described in Figure 3 where different risks within the three main categories are listed. Revised categorization is more complete than the theoretical framework and is suitable for practice without modification. Benefit from this categorization is that it could be used for whole supply chain, parts of supply chains or just for single supplier. For example, external risks could be analysed with averages of all

suppliers or within selected purchasing category and that could be also measurement for risk mitigation.

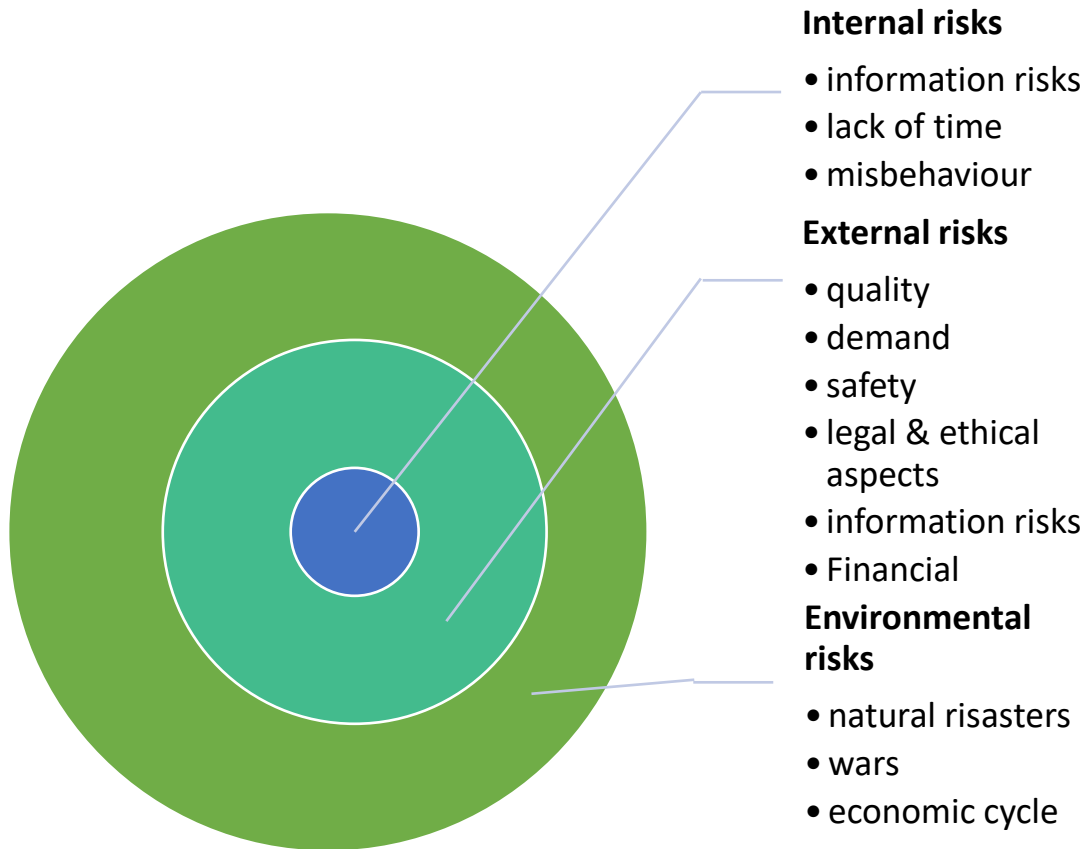


Figure 3. Revised risk categorization and examples of risk factors within categories (own work)

Identified risks are mapped in the Table 2 but Figure 3 describes them in visual way. As described categorizing risks into internal, external and environmental is most suitable for service supply chains based on the data from interviews. Different circles in the Figure 3 describe the layers of the whole ecosystems. For example, environment include company and its supply chain and external is around internal because supply chain network is larger than the company which internal risks are analysed. Descriptions and the main questions for different risk categories are short and simple. Internal risks are “risks that are created within the company” and main question is “what kind of risk internal processes and personnel create for the supply chain?” External risks are “risks that are risks

that are related to suppliers” and main question is “what risks company face when working with the supplier(s)?”. Environmental risks are “risks that are caused by environment and companies have little to none affect to them” and main question is “what threats do we and our supply chain face from the environment?”.

This revised categorization described in Figure 3 replaces risk categorization that was discussed in theoretical framework in the chapter 2.3. Both models consist same risks but the way they are categorized vary. Biggest single difference is having external risks category that include all supply related risks instead of being split into supply, information, and demand risks. The revised categorization take account IHIP features better especially the intangibility and inseparability. As services are based on interaction between service provider and service user, it is relevant to also view risks from actor perspective instead of risk type perspective. Despite being different model than Ritala & Vilko (2014) this follows the same basic idea of understanding the nature of services and service actors and viewing risks based on them.

From **risk identification** perspective interviews did not provide that much new information. Feedback, questionnaires, AI tools, and supplier interaction are the main ways to identify risks whereas IHIP – Service level analysis or supply chain mapping is not utilized in practise. Despite not being used actively, supply chain mapping is relevant tool for some services also especially when subcontracting some work to third parties. There is also legal requirements for knowing secondary suppliers as European union’s sanctions do not allow doing business with partners who have sanctioned suppliers on secondary level (Tamašauskas, 2023). IHIP – service level analysis by Ritala and Vilko (2014) might be too theoretical for practical use so it is worth questioning should it be part of the risk identification model. As there is lack of earlier empirical data, this framework is having bigger impact from interview data and therefore IHIP – service level analysis is not part of revised framework.

Interviews did not provide clear answer to the **risk analysis** phase. It is worth questioning what risk analysis is and who really does it. Interviewees pointed out that end user is the one who is responsible of the risks at the end so from purchasing perspective analysis is only a suggestion based on gathered information. Basically, risk analysis is a step between identification and mitigation where analyser decides whether more information is needed or are we able proceed to risk acceptance or mitigation. There is no real actions for this instead there is decision based on information, requirements and stakeholders thoughts. Figure 4 describes three possible decisions that could be achieved from the risk analysis. If analysis shows that there is not enough information for mitigation or acceptance, process goes back to risk identification part where more information is gathered for better understanding. When there is enough information risks can be either accepted and proceeded without mitigation or proper mitigation practices could be conducted for the supply.

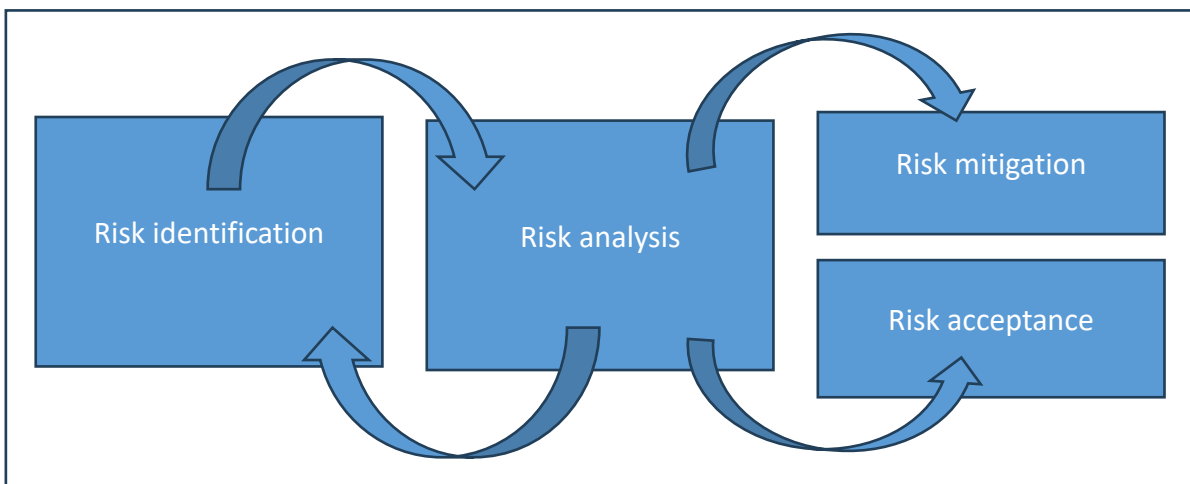


Figure 4. Risk management process chain (own work)

Theoretical framework is mostly in line with the empirical data when focusing **on risk mitigation** practices. Multi-sourcing, risk sharing contracts that include fixed pricing and supplier relationships were mentioned by multiple interviewees. Only things from the theoretical framework that was not discussed by interviewees were blockchains which can be reasoned by the limited capabilities currently available and hedging. Blockchains will impact risk management in the future but in the current environment it is not

relevant mitigation practice in service supply chain environment. Hedging could be suitable mitigation practice for investments but for risk management framework that should work in general level it is not suitable mitigation practice.

Stakeholder education and collaboration should be one risk mitigation practice. It was brought to the attention by interviewees, and it is in line with the approach change to the risk categorization. Proactive approach toward internal stakeholders is suitable mitigation practice for internal risks that were identified earlier. Impacting to stakeholder engagement could enable earlier involvement giving purchaser more time and ability to negotiate. Therefore, stakeholder engagement that include education and collaboration is viable part of risk mitigation practices.

Therefore, different mitigation practices in the revised framework are multi-sourcing, risk sharing contracts, supplier relationships and stakeholder engagement. Despite having limited amount of mitigation practices in the framework, it does not mean that these are only mitigation practices that can be used. As this framework focused on general level correctly niche mitigation practices like hedging and blockchain cannot be part of the framework.

Figure 5 describes the whole revised framework. Revised framework provides more accurate approach to service supply chain risk management as it takes account empirical data that has been lacking as there is limited number of earlier studies in service supply chain risk management context. Despite the view in Figure 5, it needs to be taken account that risk categorization is not direct part of the risk management process that is describes in Figure 4. Instead, different risk categories create the context for the process.

Revised framework include completely redefined risk categorization that focus on risk source instead of risk factor based categorization. Risk factors such as quality, information etc. are within risk categories as described in Figure 3. In revised framework risk

identification include more practices for identifying risks. These practices come from empirical information and are currently used by interviewees. Risk analysis is redefined as a step where decision on the next step is made. Also risk acceptance is adopted from empirical data as it was not mentioned as such in earlier research. Overall risk mitigation practices in revised framework have remained quite similar but there has been little more clarifying between practices and stakeholder engagement has been added based on empirical data. Despite changes the structure of the framework for service supply chain risk management has remained same but empirical data allowed making it more accurate and suitable for the service supply chain context.

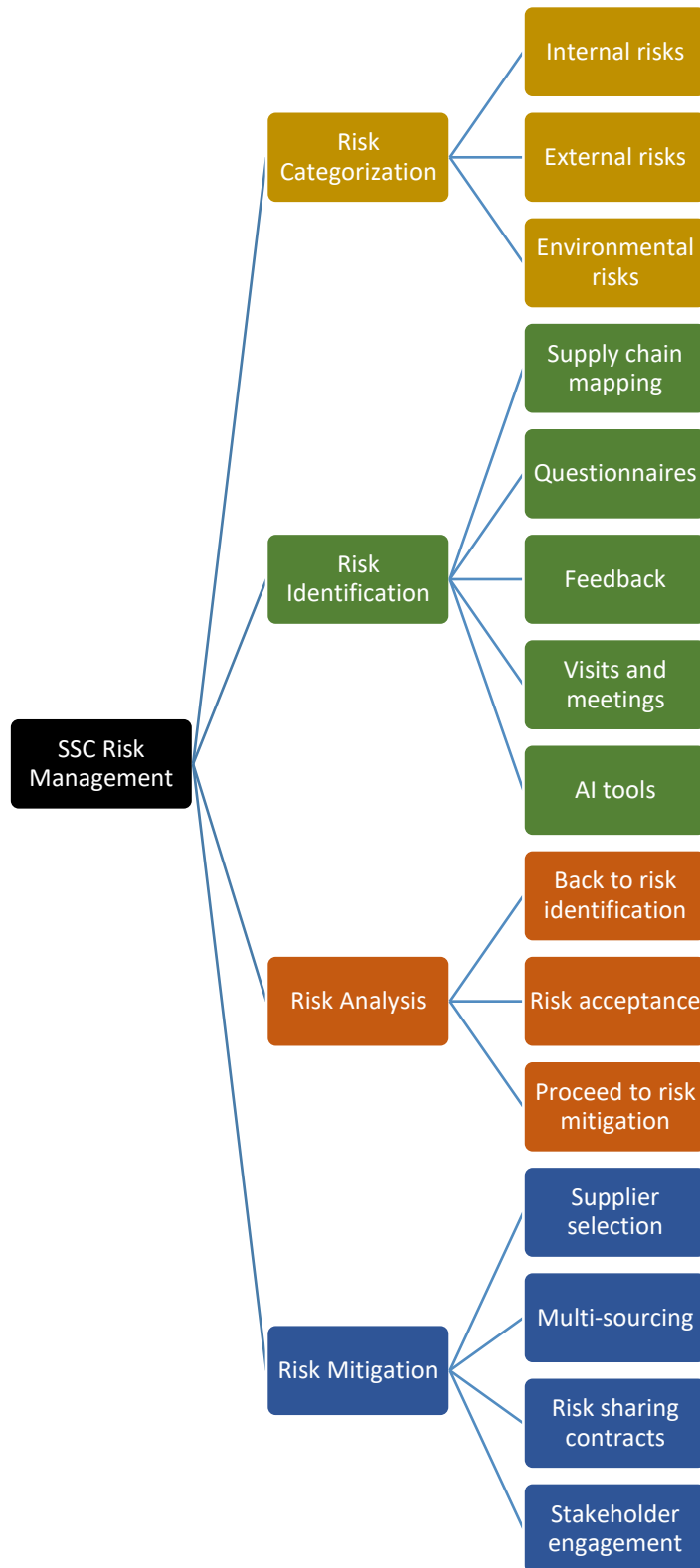


Figure 5. Revised service supply chain risk management framework (own work)

5 Discussion

Discussion part contains summary, theoretical and managerial implications, and limitation and future research. Purpose of this part is to discuss the findings of the study, its value and usability theoretically and in practice while also pointing out future possible research areas.

5.1 Summary

The aim of this study was to analyse risk management in service supply chains and create a framework for risk management in service supply chains. Study is conducted from buyer's perspective and focus on B2B environment. Together with earlier research and empirical data gathered from case company buyers a framework including risk categorization was created.

Theoretical framework presented in the study is created based on earlier research. As there is a lack of earlier studies of service supply chain risk management, theoretical framework is based on combination of earlier studies about manufacturing risk management, service supply chains and service characteristics. Theoretical framework divide risk management from four different parts: risk categorization, risk identification, risk analysis and risk mitigation.

Empirical data collection was conducted by interviewing buyers from case company. Interview structure and questions were based on the theoretical framework. Data from interviews showed that theoretical framework is not applicable in-service supply chain risk management, instead it needed to be revised. Because of the lack of earlier studies and earlier empirical evidence in this specific field, the empirical findings from this study have a lot of value in the framework revision.

Revised framework answers to the first research question that was "How risk management can be effectively implemented in service supply chain?" Revised frameworks

include risk categorization that helps analysing different risks and the whole process from risk identification to risk mitigation. Framework improves understanding of different aspects that affect service supply chain risk management and gives approach that is also practically applicable for complete risk management.

Effective implementation of risk management in service supply chains require understanding of the nature of services. Service nature include IHIP features and understanding that all services are based on interaction between service provider and service consumer. Service nature needs to be understood in risk management also and revised framework is built around the it. The service nature is seen especially in risk categorization.

Risk categorization from revised framework answers to research question 3 "How risks should be categorized for service supply chain risk management?" Categorization based on actors is completed in framework by categorizing risks to internal, external, and environmental risk based on actors or for environmental risks based on the lack of actors. Actor based categorization follows the structure by Juttner et al. (2010, pp. 201-202) but is modified to be suitable for service supply chains.

Third research question for this study was "How different services vary from risk management perspective?" Study shows that different risks affect differently in services. For example safety risks are specific risks that have big impact on subcontracting but does not have any impact for software or marketing services. Differences can also be seen in risk identification and risk mitigation as all risks cannot be identified similarly and all mitigation practices do not apply in all cases. Despite having differences there are lot of similarities between different services from risk management perspective. Risk management process is similar, and categorization can be applied to all risks. Therefore, it can be stated that services vary, but there are lot of similarities also.

Because of limited resources and broad study scope, there is no clear answer to how services vary. Based on the empirical data and earlier research only few service specific risks have been identified but broader analysis about differences is needed. Therefore, this study only provides general answer to this research question. Services vary from risk factor perspective and there are differences in risk identification and risk mitigation, but there is also lot of similarities between services as the risk management process and categorization can be applied to all services.

5.2 Theoretical and managerial implications

This study contributes to the current body of the literature in the field of service supply chain risk management and provides applicable approach to analyse risks in practice.

Service supply chain risk management framework is the main contribution of this research. From the framework especially the risk categorization is challenging the existing service supply chain risk categorization by Ritala and Vilko (2014). As this study has shown the risk categorizations for manufacturing supply chains do not work for service supply chains and the categorization by Ritala and Vilko (2014) is not usable in practice, the categorization to internal, external, and environmental provides new way to approach service supply chain risks. Benefits from the new approach is that it is utilizable from practical perspective, and it takes account the service characteristics by focusing on different actors in service contact.

Along with new risk categorization this study provides first complete framework for service supply chain risk management that takes account the whole risk management process. Despite being based on limited empirical data, it could be utilized on general level, and it could be modifies based on service specific risks. The framework creates a foundation for further research on service supply chain risks management.

Along with the framework study showed that all services cannot be treated similarly. Differences between services need to be taken account when conducting studies on

service supply chains. Despite having differences, there is also multiple similar aspects in all services but not enough to not take them account when studying or applying risk management practices. Because of limited resources of this study there not further understanding on the differences between services.

Risk categorization developed for service supply chain gives new angle to risk management as it allows focusing on internal risks that are often forgotten as the focus in on external risks. When company want to focus on all risks in service supply chains, the new risk categorization is a useful tool.

The framework gives tools to analyse company's approach to service supply chain risk management. When implementing practices, the findings of differences between services need to be taken account as the generalized framework do not work for all services. When services differences are taken account, the framework gives complete approach for risk management and could be utilized in practice.

5.3 Limitations and future research

First **limitation** of the study is the single case approach. There is no generalizable results from the study instead findings could be used as a basis for service supply chain risk management. Framework is suitable for companies that buy broad variety of external services and there is no concept for managing them. Framework is not suitable for specific services as the framework would need to be modified for the need. Despite modification need framework is still better basis than manufacturing supply chain risk management models.

Secondly, limited time and resources limit the amount of gathered empirical data. Having broader pool of interviewees would have provided more information on the topic and potentially some findings or practices have not been found because of the limited number of interviewees.

Thirdly, authors biases could have affected interviews and study results. Author has worked in case company for three years and have faced similar issues than interviewees. Author has biases towards current risk management practices but remained neutral during interviews. Despite being a limitation, it is worth noting that authors experiences and position allowed open discussion with interviewees and allowed focus on things that really matter instead of spending interview time to understanding common practices. Therefore, it has also been a positive thing for the research that author has been into the topic beforehand.

For **future research** broader analysis of differences between services from risk management perspective needed. The amount of empirical data of this study is limited and does not give enough information about the differences between services. Despite being limited study, the empirical data implicates that there are differences in both risk factors and risk mitigation practices and therefore provides a ground for further studies.

Despite being heavily based on empirical data the framework is not tested in practice. A further study where the framework is tested needs to be conducted for framework validation or correction to see the if framework work in general level as it should be. Further study should not be single case company study to improve the applicability on general level.

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Appendices

Appendix 1. Interview questions

Background

What is your position?

How long have you been working as a purchaser?

What purchasing categories are you working with?

What characteristics are in the categories that you deal with?

How would you describe the difference between manufacturing and service supply chains?

Risk Categorization

What kind of risks do you face while working with suppliers?

What are the most important risks?

How would you describe supply risk in your work?

How would you describe demand risk in your work?

How would you describe operational risk in your work?

How would you describe information risk in your work?

How would you describe environment risk in your work?

Risk identification

What different ways you use to identify risk?

How do you analyse identified risks?

Have you utilized AI tools in risk management?

Risk Analysis

If you identify a risk, how do you analyse it

How do you decide if some risk is too big to carry?

Risk mitigation

How do you deal with risks?

What mitigation practices have you used?

Extra

How would you like to improve your personal risk management work?

How would you like to improve the risk management of the company?

How does risk affect your work?