Kaunas University of Technology

School of Economics and Business

Risk Management in Supply Chain Processes: The Case of Tamro

Master's Final Degree Project

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Summary

The thesis highlights the importance of effective supply chain management (SCM) processes in today's competitive business landscape. It emphasizes the need for companies to adapt and respond swiftly to disruptions and challenges in the SC as showcased by the COVID-19 pandemic. Companies that had integrated supply chain risk management (SCRM) into their operations demonstrated greater resilience and the ability to mitigate risks effectively.

Thesis also identifies a research gap in the literature regarding SCRM in the healthcare wholesale distribution sector. While there is extensive research on SCRM in various industries, there is a lack of studies focusing specifically on the challenges and dynamics of the healthcare wholesale distribution sector. The research aims to address this gap by examining the risks faced by a company called "Tamro" in the healthcare wholesale distribution sector and exploring the best methods to manage these risks.

The research question focuses on identifying potential SCRs and determining effective strategies to manage and reduce their occurrence. The study involves a literature review, case analysis, data visualization, and qualitative data collection through interviews with "Tamro" managers. The findings highlight eight key risks faced by the company and 18 risk management methods employed by "Tamro."

It is important to note that the research findings and recommendations are specific to "Tamro" and may not be directly applicable to other healthcare organizations or cases in different countries. The unique internal rules, systems, legal frameworks, economic conditions, and political environments of each organization can significantly impact SCRM strategies and outcomes.

Kančauskaitė Austėja. Rizikos valdymas tiekimo grandinės procesuose: „Tamro“ įmonės atvejis. Magistro baigiamasis projektas / vadovė prof. dr. Jurigita Sekliuckienė; Kauno technologijos universitetas, Ekonomikos ir verslo fakultetas.

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Santrauka

Baigiamajame darbe pabrėžiama efektyvių tiekimo grandinės valdymo procesų svarba šiandieninėje konkurencingoje verslo aplinkoje. Jame taip pat paminima, kad įmonės turi prisitaikyti ir greitai reaguoti į tiekimo grandinės sutrikimus ir iššūkius, kaip parodė COVID-19 pandemija. Įmonės, kurios integravo tiekimo grandinės rizikos valdymą į savo veiklą, pademonstravo didesnį atsparumą ir gebėjimą efektyviai sumažinti riziką.

Baigiamajame darbe taip pat identifikuojama mokslinio tyrimo spraga literatūroje apie tiekimo grandinės rizikos valdymą sveikatos priežiūros didmeninio platinimo sektoriuje. Nors įvairiose pramonės šakose atliekami platūs tiekimo grandinės rizikos valdymo tyrimai, trūksta tyrimų, skirtų konkrečiai sveikatos priežiūros didmeninio platinimo sektoriaus iššūkiams ir dinamikai. Tyrimu siekiama pašalinti šią spragą, nagrinėjant riziką, su kuria susiduria bendrovė „Tamro“ didmeninio sveikatos priežiūros paslaugų platinimo sektoriuje, ir išnagrinėti geriausius šios rizikos valdymo metodus.

Tyrimo klausimas yra skirtas nustatyti galimą tiekimo grandinės riziką ir veiksmingas strategijas, kaip valdyti bei sumažinti jų atsiradimą. Tyrimas apima literatūros apžvalgą, atvejo analizę, duomenų vizualizavimą ir kokybinį duomenų rinkimą interviu su „Tamro“ vadovais. Išvados išryškina aštuonias pagrindines rizikas, su kuriomis susiduria bendrovė, ir 18 rizikos valdymo metodų, kuriuos taiko „Tamro“.

Svarbu pažymėti, kad tyrimų išvados ir rekomendacijos yra būdingos „Tamro“ įmonei ir gali būti tiesiogiai nepritaikomos kitoms sveikatos priežiūros organizacijoms ar atvejams įvairiose šalyse. Kiekvienos organizacijos unikalios vidinės taisyklės, sistemos, teisinės sistemos, ekonominės sąlygos ir politinė aplinka gali reikšmingai paveikti tiekimo grandinės rizikos valdymo strategijas ir rezultatus.

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Abbreviations:

Prof. dr – professor doctorate

SC – supply chain

RM – risk management

SCR – supply chain risk

SCM – supply chain management

SCRM – supply chain risk management

Introduction

Relevance of the topic: In our ever-evolving world, where the population has reached a staggering seven billion, the progress of technology and scientific breakthroughs has elevated our expectations and needs as individuals. With these advancements, various aspects of manufacturing, logistics, and distribution have merged into what we now call the supply chain. It's a unifying thread that connects everyone involved in bringing a product to our hands - from customers and suppliers to subcontractors and shareholders (Pokusa, 2009). In this highly competitive landscape, companies strive to offer the finest quality products and the most efficient services to cater to our demands. This pursuit of excellence is intricately linked to numerous operational processes within the SC. From sourcing and procuring materials to managing inventory, organizing production schedules, arranging transportation and storage, and providing exceptional customer support, each step must be carefully planned and executed (Lummus and Vokurka, 1999). After all, a well-functioning SC is at the heart of any successful and profitable business endeavor.

Yet, amid this fierce competition, any hiccup in the SC can create obstacles that hinder procurement, production, storage, and distribution. When disruptions occur, these inefficiencies prevent companies from achieving their desired outcomes and hinder their ability to operate efficiently and scale their operations. It becomes clear that effective SC processes are essential for overcoming these challenges (Sengupta, 2004).

One such disruption that has recently impacted SCs on a global scale was the outbreak of the coronavirus (COVID-19) pandemic in 2020. The pandemic sent shockwaves through economies worldwide, slowing down global trade and exposing vulnerabilities within SC. Unfortunately, many companies were caught off guard and ill-prepared to handle such widespread disruptions. The need for resilient and adaptable SCRM practices became apparent. Despite the challenges of restructuring SCs and dealing with the economic downturn, some companies were able to adapt and respond effectively (Veselovská, 2020). The pandemic showcased that companies with a focus on risk management and flexibility were better equipped and adapted swiftly to the changing circumstances. Those that had proactively integrated SCRM into their operations were more prepared to face the uncertainties. They demonstrated the importance of identifying vulnerabilities, implementing contingency plans, diversifying suppliers, fostering open communication channels, and continuously monitoring and evaluating their SCs. By embracing these strategic measures, these companies were able to mitigate risks, minimize disruptions, and maintain the flow of their operations more effectively.

SCRM is not just about mitigating risks; it's about embracing a human-centered approach. It emphasizes collaboration, transparency, and a deep understanding of the interconnectedness among stakeholders. By prioritizing SCRM, companies acknowledge the importance of the people behind the processes and the value they bring to the entire chain. It empowers businesses to navigate disruptions successfully, build resilience, and position themselves for long-term success in our dynamic and ever-changing world.

In essence, SCRM is a reminder that even amidst technological advancements, the heart of every business lies in the relationships and connections it builds. By nurturing these human connections and embracing risk management, companies can deliver the quality products and services we expect while ensuring their own growth and prosperity.

Research gap: The literature on SCRM offers broad perspectives and frameworks that apply to many industries, but there is a slight gap when it comes to the difficulties and dynamics of the healthcare wholesale distribution sector (Mathur, Gupta, Meena & Dangayach, 2018). Various industries and sectors have been the subject of in-depth research on SCRM by other writers, who have provided frameworks, models, and best practices for recognizing, evaluating, and reducing SCRs. Topics including SC disruption management, supplier relationship management, risk assessment methodologies, risk mitigation tactics, and the application of technology and data analytics to risk management have all been covered in the literature. In many research studies, the emphasis was primarily on SC operations, performance measurement, lean and agile operations, and IT. Employee and customer training, visibility, and risk management were found to be the most important issues. However, there hasn't been much work done in the healthcare wholesale distribution sector (Dixit, Routroy & Dubey, 2019), especially in the context of a case study examination of a company like "Tamro". This research aims to address the gap in knowledge by examining the risks and their management practices employed by "Tamro" and their relevance and effectiveness.

The research question was developed with the intention of learning more about the potential SC risks that the company, operating in healthcare wholesale distribution sector, is facing, and the best methods to manage them.

The research question: What are the potential supply chain risks and what are the best ways to manage them in order to deliberately lower their arising probability?

The main **aim** of this study is to identify possible risks and adopt suitable management methods to deliberately lower their probability to a manageable level in the company "Tamro".

The main **tasks** of a study in order to identify these sources of risks in supply chains and find suitable management methods to lower the probability are:

1. Revealing the problem of risk management in SC processes.
2. Carrying out a literature review to comprehend the research problem and the finest techniques and strategies for enhancing SCRM.
3. Developing a research methodology appropriate for the research problem by selecting a research approach, developing a research design and data collection methods, collecting and analyzing data through interviews and using qualitative method to identify patterns and trends.
4. After conducting an empirical study of risk management in the supply chain at "Tamro" company, to identify good practices and provide recommendations.

Methods of the research: The research includes a review of the scientific literature, case analysis, data visualization, and a qualitative data survey using a semi-structured interview approach, which is then analyzed using the MAXQDA application.

Results: After conducting a case analysis with four separate firm "Tamro" managers, eight key risks that the company faces in its daily operations were identified, along with 18 risk management methods that the company is using to control these risks. Theoretical studies revealed that the SCR and SCRM techniques are also evident in the various situations examined in theoretical sources.

Possible solutions from both the historical and contemporary viewpoints were offered while using the theoretical framework to determine optimal practices in risk management.

Structure of the thesis: The thesis consists of 4 different parts, 65 pages, 16 figures and 18 tables.

Limitations of the research: In the case study of "Tamro" SCRM practices were examined. It is important to note that the findings and recommendations derived from this study are specific to "Tamro" and may not be directly applicable to other healthcare organizations, clinics, or cases in different countries. Each organization operates within unique internal rules, systems, legal frameworks, economic conditions, and political environments, which can significantly impact SCRM strategies and outcomes. The study focused on identifying the risks and understanding the SCRM practices within "Tamro" and areas for improvement.

1. Problem Analysis

Each company focuses and depends on the large web of suppliers, companies providing logistics services, brokers, operators responsible for the ports, dealers, and many others in this web, in order to get required parts into factories and delivering finished goods to customers (Sheffi & Rice, 2005). The SC, also often known and called as the web, enables the efficient production and delivery of the right amounts of the items, to the correct locations, and at an optimal time in a cost-effective and smooth way (Christopher & Peck, 2004).

However, it is critical to identify and mitigate possible risks in SC processes in order to preserve a competitive advantage. These risks are often considered as challenges in SCM. This is largely due to the dynamic global business environment, concerns about non-compliance, political instability, and stressful situations on SCs such as the most recent event of COVID-19, which affected social, economic, and environmental aspects of life back in 2020.

Very late in the 2019, a World Health Organization noticed a new virus. In a matter of two months this new virus had spread all around the world, across all the continents except for Antarctica, spreading a wave of panic alongside. Ever since that, COVID-19 and daily updates about this virus were appearing all over the media and the news globally (McAleer, 2020). The disruptions related to COVID-19 affected and had a massive impact to SCs, even in the very fresh stages of the spreading (Ivanov, 2020). While looking into the records from history, significant risks and disruptions, such as wars, famines, and pandemics, have had a significant impact on SCs, leading to long-term effects on individuals and nations globally. Such epidemic outbreaks are a significant example of long-term disruption of livelihoods and high uncertainty in SCs. Any epidemic breakout usually causes a serious problem since it is so harmful to human existence. Efficient processes must respond promptly to put the right measures in place in order to monitor the effect of such a crisis on SCs (Yu, Sun, Solvang, & Zhao, 2020). The Fukushima Daiichi nuclear power plant catastrophe, another significant event prior to the start of the COVID-19 pandemic, might also be taken into consideration along with numerous studies. The event also had significant ramifications for local economies and international SCs, in addition to recovery costs. For example, consumers had a skeptical attitude towards food products originating from the Fukushima area after 2011 incident, which resulted in severe economic failues caused by damaged company image. However, over time, such catastrophic SC disruptions can even have positive effects, such as the restructuring of Japan's energy market in the case of the Fukushima tragedy. Since every case is different and there aren't many instances of similar situations, it might be difficult to decide which actions to take and how beneficial they will be. The risks of SCs are complex and can result in significant disruptions that, in certain situations, may necessitate a total redesign (Veselovská, 2020).

It is crucial to have a complete awareness of the SC, its surroundings, and all associated procedures in order to effectively address and solve emerging risks in the SC. Additionally, it is important to identify specific risks that exist within the SC in order to propose effective solutions and determine key elements that increase the efficiency of management. To do this, an overview of SC definitions, processes and relevant risks will be provided.

1.1. Risk Management

Most individuals can comprehend the concept of risk and how to hanle it, but it would probably be impossible to find someone who has never had to deal with risk or looked for methods to manage or

avoid it. Understanding risk and managing it in daily life depends on a variety of factors, including the individuals involved, the activities they engage in, and the overall external environment. The extent of day-to-day risks is different from the risks that arise in SCs. Exposure to the risk of supply interruptions, supply delays, demand changes, and price variations in this field might result in extensive or perhaps irreparable harm. Everyone is aware that there is a very high likelihood of danger in practically every aspect of life, and depending on the activity, there may or may not always be a risk component.

Hundreds or even thousands of manufacturing sites, distribution hubs, and consumers can make up a SC, which is often made up of a number of distinct systems. Various sectors are increasingly in need of SCM to control costs and risks due to the fierce competition on the global market. Mathematical methods for SC optimization, price reduction, and risk management have grown in significance as a means of achieving the aim. Every year, big companies invest tons of money to create SCs that are well-equiped, ensuring that the goods they give and make are fit for distribution. Planning the tactical SC takes many months to a year and addresses concerns with manufacturing, inventory, and distribution.

However, often encountered risks and difficulties disrupt all processes, both in existing SC and in the one being developed. There are many various ways to define risks, and the majority of people understand it in a variety of ways as a result, leading to frequent misunderstandings and divergent points or view. Regarding this issue and how to manage it, scientists provide varying perspectives. SCR frequently has several definitions since how risk is understood relies largely on the scenario being considered. Though, there are certain commonalities of how authors define risks. While reviewing numerous articles, it can be noted that in most cases SCRs refer to any interruption or deviation from regular exchange of goods and services in a SC. There are two sorts of risks that might affect the SC: operational risks and disruption risks.

Operational risks in the SC are risks that relate to the regular activities and processes involved in managing inventory, scheduling production, and coordinating logistics. These risks can arise from:

- Inadequate quality control processes that result in defective products or delays in delivery.
- Equipment breakdowns or failures that cause delays or downtime.
- Lack of visibility into the SC that makes it difficult to track inventory or monitor suppliers.
- Human error or miscommunication that results in mistakes in orders or shipments.

Whereas disruption risks in the SC are risks that have the potential to cause widespread disruption to the entire SC and are usually not within the control of the organization. SC disruption risks can take many different forms and can be caused by a wide range of factors. In most cases it tends to be rare event and therefore difficult to predict. It is sudden and unexpected occurrence, disrupting the usual flow of goods within a SC. Even a relatively minor disruption can escalate and have a larger impact as it moves through the SC (Son, Chae & Kocabasoglu-Hillmer, 2021). Some common types of SC disruptions risks include:

1. Natural disasters: Earthquakes, hurricanes, floods, and other calamities can affect infrastructure and disrupt transportation systems, making it challenging to deliver commodities to their intended locations.

2. Political instability or conflict: Political turmoil or conflict in a supplier's country can disrupt transportation and make it difficult for companies to access raw materials or finished goods.

3. Transportation disruptions: Strikes, accidents, and fuel shortages can disrupt the movement of goods from one location to another.

4. Cyber attacks: Hackers can disrupt SCs by targeting IT systems and causing disruptions in the flow of information and goods.

5. Factory or equipment breakdowns: If a company's factory or equipment experiences a breakdown, it can disrupt production and affect the flow of goods within the SC.

6. Sudden changes in demand or market conditions: If there is a sudden increase or decrease in demand for a product, it can be difficult for companies to quickly adjust their SC to meet the new demand.

7. Health pandemics or outbreaks of disease: A health crisis can disrupt the movement of goods if travel is restricted or if there are shortages of materials or labor.

Any of these disruptions can have significant impacts on a company's SC processes, causing delays, shortages, and increased costs (Shekarian & Mellat Parast, 2021).

For example, the most recent disruption - the COVID-19 pandemic - has had a significant impact on different industries in various ways. Businesses in consumer-oriented industries such as foodservice, retail and travel have experienced a short-term drop in consumer spending and high fixed costs. On the other hand, the impact on manufacturing took longer to materialize as Wuhan, where the outbreak originated, is a key manufacturing hub for many industries. This highlights the fact that SCRs and challenges vary depending on the industry.

According to a report by Dun & Bradstreet (2019), there are different risks associated with the global SC depending on the sector, hence different measures for risk reduction should be used. The research examined how four major SC risks affected a number of different businesses, including manufacturing, construction, retail, infrastructure, wholesale, finance, and services. According to the research, the effect of supplier criticality grew across the infrastructure, industrial, retail, and construction sectors. The industrial sector, however, was where supplier financial risk had the most profound effects. Manufacturing, retail, and infrastructure were the industries most impacted by global sourcing risk, while manufacturing and infrastructure were the industries most impacted by foreign exchange risk (Srivastava & Rogers, 2022). As of 17th of June 2021, SC risks by sector/industry are shown in the chart (Fig. 1).

Fig. 1. Supply Chain Risks by Sector.

Another source, analysing the impact of COVID-19 pandemic on various industries, stated that even though many sectors and industries have been severely impacted by the pandemic, being heavily dependant on the workforce of people, the digital and pharmaceutical sectors have been relatively less impacted by this crisis. The demand for pharmaceutical products has remained steady, which allowed to adapt quickly to the changing circumstances and to continue operating smoothly (De Vet, Nigohosyan, Ferrer, Gross, Kuehl & Flickenschild, 2021).

1.2. The Importance of Risk Management in Supply Chain

SCs are not immune to unforeseen circumstances or disturbances. They are exposed to a variety of hazards, including unanticipated occurrences like the recent COVID-19 epidemic, natural disasters, economic swings, political instability, supplier failures, and SC disruptions. These risks can have serious repercussions, including manufacturing delays, a lack of essential components, higher prices, harm to the reputation of the business, and finally, disgruntled consumers (Gunessee, Subramanian & Ning, 2018).

This is where RM, a key component of SCM, comes into action. Organizations may proactively plan for probable disruptions and lessen their effect by actively identifying, assessing, mitigating, and monitoring risks. Through RM, firms may create strategies and backup plans to assist them deal with unforeseen circumstances while maintaining operational continuity and customer satisfaction (El Baz & Ruel, 2021).

Minimizing interruptions is one of the main objectives of RM in supply networks. Organizations may take preventative efforts to lessen the possibility and effect of disruptions by examining the possible risks that might impact different elements of the SC, including suppliers, transportation, inventory management, and manufacturing processes (Mentzer, DeWitt, Keebler, Min, Nix, Smith & Zacharia, 2001). This includes techniques like building redundant systems, diversifying the types of suppliers,

putting in place efficient inventory management procedures, and creating alternate sourcing possibilities (Beysenbaev & Dus, 2020).

RM helps improve SC resilience in addition to reducing interruptions. A SC's resilience is its capacity to take hits, bounce back fast, and adjust to shifting conditions. A SC that is robust can react quickly to unanticipated occurrences such rapid shifts in demand, interruptions in transportation networks, or supplier problems. Organizations may increase their resilience by identifying vulnerabilities, coming up with reaction plans, and implementing agile procedures using RM techniques like scenario planning, business continuity planning, and SC mapping (Duong & Chong, 2020).

Additionally, RM empowers businesses to take wise and efficient decisions. Managers may analyze various choices, weigh trade-offs, and improve decision-making processes by recognizing possible risks and their potential effects on the SC. Risk assessment, for instance, might assist in making decisions about whether to source from a single supplier or from a number of suppliers, figuring out the best inventory levels, or choosing transportation modes that strike a compromise between cost and dependability (Van Hillegersberg, Ziudwijk, Van Nunen & Van Eijk, 2001).

Collaboration and trust among SC participants are also fostered by effective RM. Organizations may establish trusting relationships with suppliers, logistics providers, and other stakeholders by exchanging risk information, maintaining frequent contact, and cooperating on risk reduction methods. In addition to assisting in risk identification and mitigation, this collaboration encourages a sense of shared accountability for the success and resilience of the SC (Chand, Thakkar & Ghosh, 2020).

Furthermore, compliance and regulatory requirements are directly related to RM. SCs must navigate a complicated web of laws, rules, and moral requirements. Various regulations, including those relating to product safety, quality standards, working conditions, and environmental sustainability, must be complied with by organizations. Businesses may identify compliance risks, implement required controls, prevent fines or reputational harm by incorporating RM into their processes. (Gupta & Maranas, 2003).

In general, RM is an essential subject within SCM that tackles the uncertainties and vulnerabilities present in intricate global supply networks. It helps businesses to reduce interruptions, improve resilience, make wise decisions, forge solid bonds with stakeholders, and guarantee regulatory compliance. Businesses may negotiate uncertainties, safeguard their SCs, and achieve sustained success in a changing business climate by taking a proactive and all-encompassing approach to RM.

Company “Tamro Baltics” is a pharmaceutical wholesale and distribution company, engaged in wholesale and distribution of pharmaceutical and healthcare products, including prescription medicines, over-the-counter medicines, medical devices, and healthcare supplies. Company sources products from a wide range of manufacturers and suppliers, and delivers them to pharmacied, hospitals, and other healthcare providers across the operating countries. “Tamro” also had a strong logistics and SCM capability, allowing to provide its clients effective and dependable distribution services. In its operational countries, the company has several distribution centers that are outfitted with modern methods of technology, such as automated storage and retrieval systems and temperature-controlled storage facilities. Company “Tamro” also offers its clients a variety of value-added services in addition to wholesale and distribution. These include patient support initiatives, business analytics and insights, marketing and sales assistance, and services for healthcare

professionals' training and education. Company has made investments in the creation of e-commerce and digital solutions that allow its clients to place orders and handle their inventory online. Customers can easily manage their purchases and inventories via an online ordering platform, which provides real-time product availability, price information, and order tracking. Tamro also places a high priority on regulatory and compliance due to being in a highly regulated environment. However, even though a company showed their stronger side of SC process management during COVID-19, having strong managerial force, regarding their daily tasks, some of the SC processes, such as the demand planning, inventory planning and logistics are lacking efficiency. This highlighted the need of studying this area since such processes should be improved as they might cause delays in the acquisistion and distribution of pharmaceutical items, disrupting their availability to clients. This could adversely affect company's operations and profitability.

Therefore, the main aim of this master's thesis and the conducted research is to find out what are the main elements of SC processes that lead into their efficiency.

In addition, to understand the key factors that contribute to the efficiency of SC processes, it is important to consider a range of factors that may influence a company's ability to withstand and recover from disruptions. Empirical research is needed to examine these factors and determine their impact. This can help identify strategies and approaches that can help companies improve efficiency of their SC processes and better withstand and recover from disruptions.

2. Theoretical Solutions

The academic community has extensively studied the importance of SC and identified many factors that contribute to a company's overall performance. SC is considered a crucial element in determining a company's success, and correct management is a vital aspect of business strategy in order to deal with the risks that can arise. The literature available on this topic presents various concepts and solutions for addressing SC risks, providing insight into how companies can best improve their management.

2.1. Supply Chain Concept

Although the term "supply chain" was first used in "The Independent" newspaper in the year 1905, the whole concept of a network of suppliers, producers/manufacturers and consumers was known long before that.

The general SC concept underlying the SC encompasses a complex web comprising multiple entities such as firms, personnel, machinery, and assets involved in manufacturing and distributing goods and services. From where they originate to where they are consumed or used up is how goods and services flow along with information and finances (Stevens, 1989).

The idea of SC in general refers to all the processes involved in obtaining raw materials, converting those resources into completed goods and delivering those goods to the client. It entails organizing and maximizing the movement of materials, data, and money across businesses, which may include suppliers, producers, distributors, retailers, and clients (Min and Zhou, 2002).

In today's global economy where companies often rely on suppliers and partners from all over the world, the general SC concept has gained immense significance.

Thus, the concept of SC has been studied by various scholars and practitioners over the past 100 years. The following table (Table 1) summarizes the evolution of the SC through several SC definitions and concepts up to the present day.

Table 1. Definitions of SC.

Author(s)	Definitions
Stevens (1989)	The SC is a networked collection of processes that organize, coordinate, and manage the transportation of raw materials, spare parts, and finished goods from suppliers to customers.
Mentzer, DeWitt, Keebler, Min, Nix, Smith and Zacharia (2001)	A SC is an integrated industrial process that transforms raw materials into completed items and then distributes them to consumers.
Min and Zhou (2002)	A SC is aprocess which coordinates a series of interrelated processes to acquire raw materials and parts, transform those materials and parts into finished products, add value to those products, and distribute those products to retailers. Or an integrated system that distributes and sells to customers and allows for exchange. Information sharing between different economic agents.
Grzybowska (2010)	The SC is described as a network of businesses engaged in mining, manufacturing, trade, and services, as well as their clients, through which streams of goods, data, and financial assets move.

Author(s)	Definitions
Mangan and Lalwani (2016)	A SC is a collection of companies participating in many operations and functions that produce goods that are delivered to end users through upstream and downstream links.
Wang, Li, Zhang and Chen (2019)	The manufacture and trade of products creates a network of separate or partially autonomous economic entities, known as the SC.
Safari, Etezadi, Moradi-Moghadam and Fathi (2021)	SC is viewed as being essential to the company's success.

A SC can be defined as a group of three or more entities (organizations or persons) that actively participate in the upstream and downstream flows of products, services, money, and/or information from a source to a client after taking these definitions into account (Stevens, 1989). "Direct SC," "extended SC," and "ultimate SC" are included in this. A company, a supplier, and a client who take part in the upstream and/or downstream flow of products, services, money, and/or information constitute a direct SC. All participants involved in the upstream and/or downstream flow of products, services, money, and/or information are included in the extended SC, as are the suppliers and clients of the immediate supplier and immediate customer, respectively. As for ultimate SC, sccording to Mentzer, DeWitt, Keebler, Min, Nix, Smith, and Zacharia (2001), it is made up of all the companies involved in the upstream and downstream transfer of products, services, money, and information from the ultimate supplier to the end consumer.

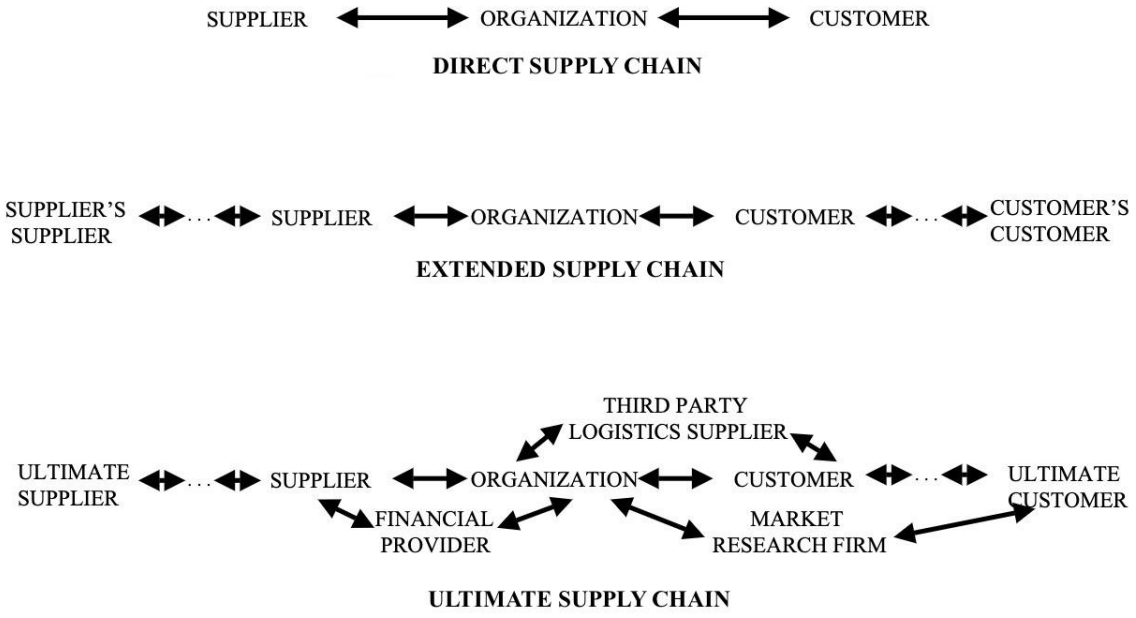

Fig. 2. Types of Supply Chains by Mentzer et al (2001).

As it is shown in Fig. 2., Mentzer, DeWitt, Keebler, Min, Nix, Smith and Zacharia shows how intricate ultimate SCs can get. In this figure, as they stated, a third-party financial provider might be offering financing, kaing on some of the risks, and providing financial advice; a third-party logistics provider is handling the logistics between the two businesses; and a market research company is

giving information about the ultimate cutomer to a business far up the SC. This exemplifies a few of the numerous tasks that sophisticated SCs may do and in a succinct manner.

It is also crutial to remember that any one organization can be a part of many different SCs given the possibility for limitless different SC topologies. Mentzer et al (2001) also gave a great example with the shopping network "Walmart", stating that it can be involved in the SC for a variety of items, including confectionery, apparel, hardware, and many more. Such concept of many SCs starts to explain the network-like structure that many SCs have.

However, the flow of goods, services, information, and cash must be coordinated and maximized in order for the right items to be given to the right customer at the right time and at the right price (Mangan and Lalwani, 2016). The coordination and cooperation of all parties involved in the SC, which is crucial to an efficient SC process and RM, is fundamental to the success of contemporary companies.

2.2. Supply Chain Processes

As mentioned before, SC encompasses all the activities involved in acquiring and delivering products or services to cliens. Among these processes, raw materials are moved from suppliers to manufacturers, and completed items are moved from producers to distributors and then consumers. Additionally, SC processes cover the handling of inventory levels as well as the movement and storage of products. Suppliers, producers, distributors, retailers, and customers are just a few of the many players in this intricate process.

SC processes typically involve demand planning, sourcing, procurement, manufacturing, inventory management, distribution, logistics and customer services.

- Demand planning entails predicting the level of demand for a certain good or service and creating plans to make sure the appropriate supply is on hand to satisfy that demand. Planning for demand well can assist reduce inventory levels and the chance of stockouts.

- Sourcing involves locating and screening possible suppliers, haggling over costs, and creating contracts. Finding the corrects resources at the proper price, quality, and quantity is made possible via sourcing, which is essential.

- Procurement process entails buying the supplies and labor required to generate the item or service. To reduce waste and prevent production delays, procurement must guarantee that the appropriate resources are bought at the appropriate time, quality, and cost.

- Manufacturing or production process involves transforming raw resources into finished goods. Work on assembly line and intricate bespoke production are both included in the manufacturing process, while the main aim is producing high-quality goods at the lowest cost and in the shortest amount of time.

- Inventory management process makes sure that correct goods are available at the proper time and place by monitoring and controlling inventory levels. Effective inventory management ensures that the business never overstocks, which can tie up money, and always has enough inventory to fulfill consumer demand.

- Distribution is a process when finished goods are transported from producing facilities to customers during this step. Logistics management, transportation, and warehousing are all part of distribution process, while the main objective is to guarantee that goods are delivered on schedule, in good shape, and for the least amount of money.

- Logistics process guarantee the prompt delivery of goods to clients, this procedure entails the coordination of transportation, warehousing, and inventory control. The management of logistics is essential for reducing transportation costs and speeding up delivery times.

- Customer service process mainly focuses on clients after they have made a purchase of a good or service. This procedure includes offering assistance, troubleshooting, and repair services. Improved customer happiness, brand loyalty, and reputation are all benefits of providing good customer service.

However, in many cases, some process management functions are often integrated into one another. Fig. 3. represents simplified SC process scheme and integrated processes.

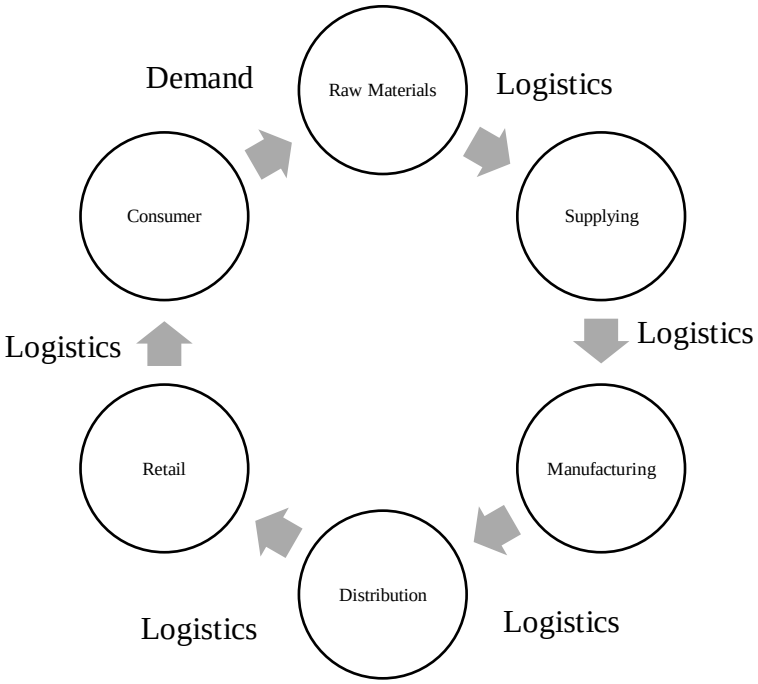

Fig. 3. Simplified SC Process Scheme.

Based on the simplified SC process flow scheme, SC includes several of them:

- Procurement: sourcing and ourchasing of raw matterials.

- Production: manufacturing, assembly, testing.

- Logistics: transportation, planning, distribution center management.

- Distribution: order fulfillment, transportation and delivery.

- Returns and reverse logistics: inspecting, testing, refurbishing, transportation, warehousng, disposition of returned goods.

2.2.1. Procurement

Procurement involves sourcing and purchasing raw materials, components, and other inputs needed for production. Even though the copes of procurement and purchasing are different, these two words are frequently used to refer to the same thing. Purchasing refers to both the actual material purchases and the actions involved in the purchasing process. Contrarily, compared to purchase, procurement has a wider reach. It covers all aspects of receiving inbound, commodities, such as purchasing and warehousing (Gunasekara, Sridarran & Rajaratnam, 2022).

As one of the crucial steps in the SC, procurement may impact the success of the whole company. Traditional processes have resulted in unhealthy behaviors including corruption, exorbitant expenses, delays in the development of projects, and the acquisition of products and services due to lack of transparency in many nations‘ procurement operations. According to McConnell (2009), they key process-related problems with procurement are complexity of buying products and services, the abundance or suppliers, the difficulty to adjust to complex processes, and the lack of transparency. So a person, responsible for procurement process in a company, has to guarantees enough supply of raw matterials at the proper price, in necessary amounts, at the proper location and at the proper time.

2.2.2. Production

Production process in the SC is any particular set of steps, taken to transform raw materials or component parts into a completed commodities. Manufacturing, assembling, packing, inspecting and shipping are the examples of this process, having several phases that involve variaty of tools and workers to achieve the main goal – to create a high-qiality producs as efficiently and cost-effecively as possible, while ensuring that the final product meets the needs and expectations of customers.

2.2.3. Logistics

Another crucial process in the SC is logistics, which controls how products go from their point of origin to their final destination. This comprises tasks including distribution, inventory control, warehousing, and transportation.

2.2.4. Distribution

All the actions and procedures used to move goods from production to the consumption are reffered to as the distribution process in SC. This covers both, the actual physical transportation of commodities as well as the planning and management of such movement.

The distribution process begins with picking the best mode of transportation, such as trucking, shipping, air freight, or rail. The products then combined at warehouses or distribution facilities, where they are typically kept and sorted before being delivered to stores or clients directly. Distribution also includes controlling inventory, which includes monitoring reorder points and keeping track of stock levels.

2.2.5. Returns and Reverse Logistics

Reverse logistics, also known as return flow, strives to carry out product recovery effectively. The best take-back and collecting tactics must be developed as well as recovery procedures that might involve either reuing the entire product or recovering materials from it by shredding it into little bits.

Because it may assist businesses in recovering value from goods that are no longer desired or needed, reducing waste and environmental effect, and adhering no laws, reverse logistics is a crucial process of cuppy chain.

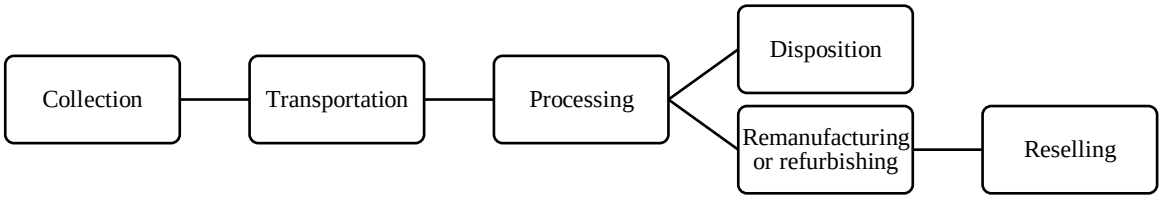

Fig. 4. Reverse Logistics Process Flow.

Reverse logistics involves everal types of processes:

- Collection – where goods that need to be returned are identified and gathered, or example through a product recall or a consumer return.
- Transportation – where the products are being collected and brought to a processing facility.
- Processing – where teh returned goods are examined, sorted, and tested to assess their statei f they may be resold, refurbished or recycled.
- Disposition – a final step for a product, which can no longer be refurbished or reused. After inspection, it is being disposed or destroyed.
- Remanufacturing or refurbishing – where the product can be renovated or remanufactured. It entails restoring the product‘s use through component repair or replacement.
- Reselling – where remanufactured or refurbished products can be sold again in a good shape.

Maintaining adequate amoints of inventory and reducing the risk of stockouts all depend on efficient reverse logistics management to make sure that items are recovered and disposed in an economical and responsible way. Reverse logistics processes frequently make use of sophisticated planning and scheduling software, complex ransportation and distribution networks, and real-time tracking and monitoring systems in orter to efficiently carry this process (Van Hillegersberg, Ziudwijk, Van Nunen & Van Eijk, 2001).

A method for organizing and regulating all the steps involved in SC processes, such as manufacturing and distribution of goods and services, from locating raw materials to giving clients the finished product, is known as supply chain management (SCM). To guarantee efficient and affordable customer delivery, it also entails regulating the movement of information, resources, and cash inside and between businesses.

The idea behind SC processes is to minimize costs and maximize value by establishing a smooth flow of products and services from the supplier to the final consumer. All parties participating in the SC, such as suppliers, manufacturers, distributors, the providers of logistic service, and customers, must coordinate their operations in order to achieve this (Mentzer, DeWitt, Keebler, Min, Nix, Smith & Zacharia, 2001).

2.3. Supply Chain Process Risk Classfication

A SCR is described as a possible departure from the value of an expected SC performance metric. Scholars have so far proposed a number of categories for SCR, including internal or external, source or result, likelihood or severity, macro or micro, among others (Chara & Zerin, 2021). Essaber, Benmoussa, De Guio and Dubois (2021) in their article about a hybrid SCRM stated, that there are five main categories of SCR: operational risk, financial risk, environmental risk, collaborative risk and disruption risk (Fig. 4).

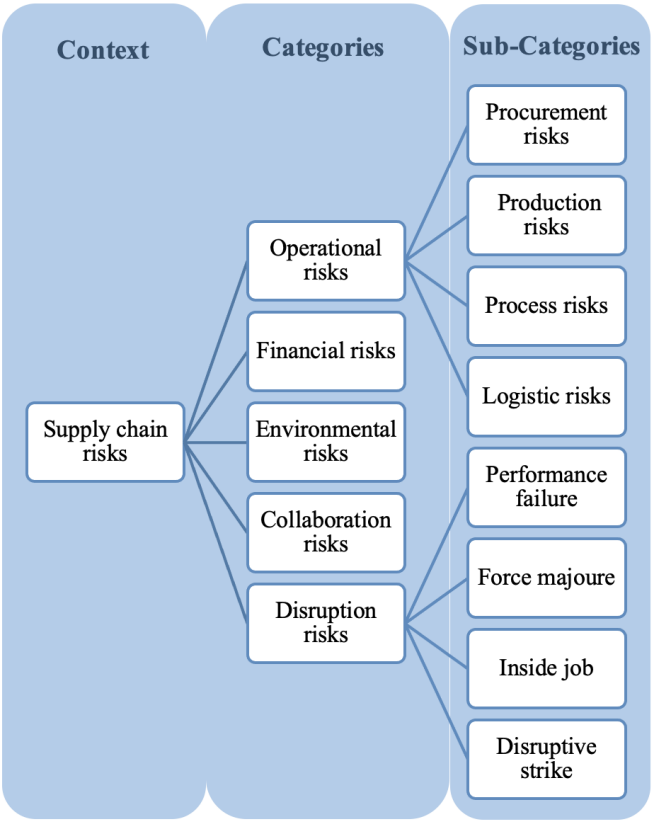

Fig. 5. Classification of SC risks.

2.3.1. Operational Risk

Operational risk is the possibility of suffering losses due to flawed procedures, human mistake, or the occurrence of an unanticipated external incident that prevents SC activities from proceeding normally. This category of risk covers such sub-categorical risks as procurement, production, process and logistic.

Procurement process risks are considered operatonal SCR due to the fact that procurement entils buying products and services from suppliers and vendors that are essential for the running of a company or organization. Procurement risks may have a substantial influence on a company's ability to meet consumer demand, meet production schedules, and sustain profitability:

- Lead time – it‘s a time interval between an order and product delivery. A very common uncertainty is the rising cost of a lead time. To avoid raising the overall costs and lowering the level of customer service, the lead time needs to be properly managed. Since supply lead times vary widely, it is more difficult to correctly use Material Requirement Planning

procedures in procurement planning. In order to avoid delivery delays that might result in inventory shortages and subsequently disrupted manufacturing, raising the overall costs and revenue losses, accurate lead time estimates for procurement and on-time delivery are essential for efficient production.

Safety stock, safety lead time and supllier backups are few measures that are employed to deal with this kind of unpredictability. The most popular method for boosting SC flexibility amid unpredictable demand and supply conditions is ho have satefy stock on hand.

- Demand – the main uncertainties and risks involve elements like inaccurancies in demand forecasting, modifications to client orders and uncertainty on the product specifications. In order to satisfy consumer demand, a demand prediction involves estimating future Stock Keeping Units. Demand forecasting is a difficult process that can result in inventory shortages or surpluses, poor service levels, rush orders, wasteful resource, ant the spread of the bullwhip effect across the SC, if it is managed incorrectly. This kind of uncertainty assumes a dignificant part in the sizing of production lines, transportation modes, line assembly, distribution centers, and cross-docking platforms, as well as a dignificant input function in procurement planning.

  Component similarity, risk pooling, safety stock, safety lead time, flexible supply contracts, subcontracting/outsourcing, and postponement are a few examples of methods for addressing demand risks.

- Price – main uncertainties refer to changes in the selling price of goods or raw matterials from suppliers as a result of market volatility or promotional sales. Pricing must be taken into account as a significant considerations in the procurement process since it affects both, operational and overall logistical, costs.

  Strategies for coping with price unpredictability include flexible contractsand price risk hedging.

- Yield – such uncertainties usually involve quality problems, such as limited capability or defected goods.

  Diversifying providers, choosing numerous suppliers fore ach unreliable supplier and supplier cooperation are primarily startegies emplyed to reduce this type of uncertainty. Additionally, capacity buffer is another tactic or way to deal with it.

- Supplier limitations, also reffered to as supply disruptions, are a group of occasionally unexpected circumstances that might influence a supplier‘s performance or even cause a partial or whole failure or delivery. Contrains must be taken into account in order to minimize their negative effects ehrn they do arise. Supplier shortages can be brought on by external events like earthquakes, snowstorms, power outages, terrorist attacks, custom holdups, fires, sluggish shipments or staff strikes, which can result in shutdowns, temporary closures, or lead-time delays owning lost production or transportation capacity.

  The most popular techniques to cope with this issue are supplier backups.

- Oder crossovers – issue based on orders being received out of order from the order which they were placed. Usually such issue occurs because of two parts of the replenishment lead time: the amount of time needed for the supplier to produce the order and the amount of time needed for the order to be transported.

  Safety stock is one of the tactic that is employed to deal with this kind of uncertainty (Barros, Cortez & Carvalho, 2021).

Production process risk is also an operational SCR. Possible risks that may arise in the production process might take the form of unanticipated equipment breakdowns, changes in the cost of raw matterials, or shifts in demand. The capacity of a company to reach its production objectives and sustain profitability can be significantly impacted by these uncertainties and risks, making managing them and essential component of production planning and operations.

The improvement of production process can be achieved by implementing efficient control systems and methods such as:

- Lean manufacturing, which focuses on eliminating waste and increasing efficiency through the use of variaty of tools.
- Six Sigma, which is a data-driven quality control strategy that uses startistical techniques to decrease errors and enhance operations.
- Total Quality Management (TQM) – a concept that aims to incorporate all staff menmers in the quest of excellence and ongoing improvements.
- Just-in-time (JIT) manufacturing – production approach, in which products are made just when needed, as opposed to being made ahead of time, in big quantities and kept in stock.
- Automation and technology – adding the use of technologies like robots, AI, and industry 4.0 to automate some operations, in order to enhance productivity and cut costs (Pereira, Silva, Domingues & Sa, 2019).

Uncertainties and hazards are not always avoidable in logistics processes as well, especially taking into account external reasons of disruption of this process. These risks, associated with the logistics process, include potential changes an difficulties that may arise throughout the distribution, warehousing, and transportation of commodities along a SC. Natural disasters, unforseen transportation delays, and shifts in consumer demand are also a few good examples (Choy, Li, So, Lau, Kwok & Leung, 2007).

- Transportation disruptions such as strikes, severe weather, road closures or equipment breakdowns can delay the delivery of goods and disrupt SC operations.
- Fluctiation in demand can cause challenges in forecasting and inventory management, leading to stockouts or excess inventory.
- Natural disasters or the other unexpected events can damage or destroy warehouses, distribution centers, or inventory, resulting in costly losses.

- Security breaches can compromise the integirty and confidentiality of logistics information and disrupt the operations.

In order to maintain proper amount of inventory and reduce these risks, good logistics management is essential for ensuring that items reach consumers in a timely and economical way. Companies frequently utilize tactics like real-time monitoring and tracking systems, diversified transportation routes, smart logistics planning and scheduling, and SC resilience building to reduce these risks. In addition, advanced techniques of analytics and simulation also appear from time to and may be used by businesses to decect hazards, evaluate them and create appropriate mitigation startegies (Beysenbaev & Dus, 2020).

The possible deviations and difficulties that may arise in the process of distribution, include the same uncertainties and risks as in logistics processes, including strikes, weather challenges, road closures, fluctuation in demand, security breaches, regulatory issues (Gupta & Maranas, 2003).

Achieving efficient distribution management is essential for ensuring that goods are delivered to consumers on time and under budget, as well as for keeping the right stock levels and reducing teh danger of stockouts. Distribution procedures, as well as logictics, frequently require complex transportation and distribution networks, real-time tracking and monitoring systems, and planning and scheduling doftware to do this.

2.3.2. Financial Risk

The financial risks arise from the movement of money between business, the payment of bills, the utilization of investments throughout the network, and the settlement of accounts payable and accounts receivable. Another defition of financial risk is “the risk that a prospective occurence may have a financial consequence.” For instance, if the company sells software to consumers, a possible patent infringement lawsuit might arise and cost the company money in legal fees and other expenses. There are many different kinds of financial risks. Initially, in many studies these risks were connected to embedded costs, varying capital costs and rates of expenditure occurrence, and cash flows and settlements between businesses as well as changes in interest rates, bond credit ratings, currency exchange rates, and accounting and tax rules. Many studies had shown that financial risks impair nor just financial performance but also SC efficiency as a whole (Shahbaz, Rasi & Ahmad, 2019).

Fiancial risks are mostly griuped into internal and external when it comes to SCs.

Any SC risks that have a significant component that the corporation may directly control are included in the internal financial risk category. One of the many internal financial issudes that credit risk may create is a shortage of liqudity and the potential for unrecoverable loans (Meng, 2022). The company‘s inability to meet its commitments to third parties is caused by liqudity risk. Companies could, for instance, increase their credit limits for clients or run up debt with suppliers.

External financial risks include market and trade credit risks. Market risk is the term for shifts in an asset‘s or a portfolio‘s value due to unanticipated shifts in market conditions that have an impact on the value of an organization‘s assets and liabilities. It covers risks associated with interest rates due to their inherent volatility, as well as exchange rate risks brought on by changes in the values of various currencies (a result of government decisions, as well as supply and demand on the global market). Contrarily, trade credit risk results from a counterparty‘s inability to honor the contract‘s

payment commitments (Settembre-Blundo, González-Sánchez, Medina-Salgado & García-Muiña, 2021).

2.3.3. Environmental Risk

Political instability, war, civil unrest, and other sorio-political crises are categorized as environmental risks, as are diseases or epidemic (such as SARS, COVID, foot and mouth disease), natural disasters (such as earthquakes, floodings, extreme climate, and tsunami), and international terrorist attacks. Macroeconomic uncertainties, social uncertainties, and natural uncertainties are also categorized as environmental risks (Shahbaz, Rasi & Ahmad, 2019).

However, Settembre-Blundo, González-Sánchez, Medina-Salgado, S., & García-Muiña (2021) in their article about flexibility and resilience in corporate decision making started another term for environmental risk, which refers to the potential harm that commercial activities may cause to the health of the environment. These risks can result in from either abrupt or accidental occurences (accidental pollution) or from the gradual buildup or toxic residues and/or polluting behaviors that may manifest themselves in a slow and gradual manner (gradual pollution). Due to the increasingly strict rules on the use and conservation of natural resources, emvironmental hazards now influence the competitiveness and profitability business. They have been investigated and studied to be one of the primary sources of return or investment, as such, a key area for the management of the firm if they are maximized. Tools and approaches have already been established for this purpose in accordance with a RM strategy (Huang & Li, 2018).

The risk to the environment that as business face is the possibility of financial loss brought on by irresponsible management or the environmental effects of its operations. They may be the result of processes that are wrong or inefficient, procedures that violate environmental standarts, procedures connected to an omission or inaction on the part of these subjects, or they may be the direct responsibility of a firm (or factory), its management, or the real owner (Dragomir, 2019). Costs are incurred by the company as a result of incorporating environmental risk into its strategy (cost of investment, cost of technologies, cost of the change in the purpose of the production process, cost of modernisation, etc.). Nonetheless, the environment may produce a competitive advantage in terms of business operations since, on one hand, it removes waste and inefficiencies, decreasing emissions or the expense of waste disposal, and on the other hand, incorporating environmental management into business startedies encourages managing directors to use their creative potential by pressuring them to make a number of ivestment that they otherwise would not have made. Hence, environmental RM term refers to a sophisticated social process that tries to lessen the uncertainty around the adverse effects of human activities on the environment and on society. As a result, managing this risk cannot be reduced to the notion of a single action but rather must refer to the process by which an organization learns about, understands, and evaluates the risk it faces. The alternatives and priorities for lowering environmental criticalities will need to be addressed on this basis, with a startegic approach, together with the resources that are available to address them, the implementing processes that will be used, and a decision to use them. As a result, in a social scenario in shich the orientation towards sustainable development and pollution prevention must become an opportunity constraint as well as a distinctive competence of the company in communicating with all stakeholders, corporate governance cannot ignore the management of environmental risk associated with products, services, and processes (Settembre-Blundo, González-Sánchez, Medina-Salgado & García-Muiña, 2021).

2.3.4. Collaboration Risk

Collabortion is a tactical solution to problems that are occuring throughout the chain. All SC participants are said to collaborate when they share information, resources, communicate, create knowledge together, make decisions together, and have common goals.

It has been observed that there are variations in terms of coordination and collaboration. Although coordination is the pooling of resources or other actions that make customer demand data available to the whole SC, collaboration entails more that just information sharing and resource sharing. Yet, coordination and collaboration have frequently been employed sunonymously in previous literature (Dubey, Gunasekaran, Childe, Roubaud, Wamba, Giannakis & Foropon, 2019).

According to various research, collaboration can result in more significant and effective outcomes, but it also has a lot of drawbacks. Collaboration risk is the concern that comes with cooperative manner. So, there would be a severe problem i fone SC member did not commit to cooperating as the other members had expected (Shahbaz, Rasi, Zulfakar & Ahmad, 2018). As partners are icluded in the SC, new problems such as cooperation risk will appear as the decision-making becomes difficult when more partners are engaged with different interests, cultures, and preferences. The complexity of collaboration has the greatest impact on SC risks, and collaboration risks are seen to be the main dangers that have the most potential to lower SC performance. Collaboration risks can be caused by the problems with the capacity to support operations, a lack of trust, the accuracy of the information, the securtity and disruption of the information system, inteletucal property, and information outsourcing (Shahbaz, Rasi & Ahmad, 2019).

In the presence of disruptions, there are two basic views on SC collaboration, including the commercial and humanitarian SCs. The main distinction between commercial and humanitarian SCs are demand forecasting and the implications of interruptions. The commercial SC benefits from previous demand, but it is nearly impossible to predict the time and location of a disruption. Despite that challenge, a breakdown in sunning humanitarian SCs might result in suffering or even fatalities. Additionally, while cost effectiveness is an important factor in a SC for a business, a SC for humanitariam purposes places more emphasis on reducing lead times that on cutting costs, at least for a few hours following the disruption. The humanitarian SC may also be affected by other conserns, such as those relating to authority, society, economy, policy, logistics, or finances (Duong & Chong, 2020).

2.3.5. Disruption Risk

Unexpected occurencies that alter a system and interfere with routine operations are disruption hazards (Essaber, Benmoussa, De Guio & Dubois, 2021). It is crucial to comprehend the nature of a disruption in order to handle it more effectively. The present literature provides a wealth of knowledge on the factors that lead to disruptions as well as practical theoretical models that help to explain behavior that surrounds the disruption event, with a primary emphasis on either before or after and event. Several levels of analysis can be used to examine disruptions, deoending on wheather they affect a single organization, a group of related enterprises, or a specific SC. But mostly they are classified into endogenous (from within the company’s chain) or exogenous (from outisde the SC) disruptions (DuHadway, Carnivale & Hazen, 2019).

While understanding the causes of disruptive events and how to manage them requires a srasp of the external/internal duality, this understanding should be also evaluated in the perspective of intent. A disruption that is caused by deliberate action on the part of the source of the disturbance is reffered to as an "intentional disruption". Endogenous causes of this include vendors that purposefully choose to utilize subpar materials or who willfully fail to provide particular things as promised. It may also be brought on by external circumstances, such as terrorist attacks or competitive disruptions to a company's SC. An intentional disruption happens when a single purposeful conduct results in a disruptive occurrence, even if the overall objective of the behavior may not have been to generate one. Hence, it encompasees actios that are intended to produce a disturbance as well as actions like "self-interest seeking with guile". The dynamics of appropriate preventative and reactive behaviors are completely altered by an international disruption because it results from the intentional action of a thrid party. As a result, the current understanding of disruption is insufficient for categorizing various disruption types and for recommending suitable RM tacticts (Shahbaz, Rasi & Ahmad, 2019).

Disruption risks can be devided into four main categories: Force Majeure disruption, Performance Failure, Targeted Strike and Inside Job.

Force Majeure. Disruptions that are deemed to be Force Majeure are those that are brought on by unavoidable, exogenous, and non-intentional occurences that take place outside of the SC. These occurences are caused by unintentional external factors that are not targeted at a specific company and that disturb the flow of commodities through a SC. Exogenous Interruptions that are unintentionally caused might include those brought on by terrorism, natural catastrophes, political unrest, economic instability, or poor closures (DuHadway, Carnovale & Hazen, 2019). Although Force Majeoure disruptins frequently garner the greatest attention from both the general public and scholary publications, they are the most well-developed disturbances in the disruption literature.

Performance Failure. An unintentional action that takes place somewhere along the SC results in performance failure. Even if they are not deliberate, they can nonetheless be quite harmful and point to a serious issues with the SC. SCM issues can cause performance failure interruptions. The SC is nevertheless disrupted by these unintentional actions. Examples might include subpar quality, incorrect routing or delivery, fires or accidents, or supplier insolvency. Depending on how widespread and what caused the disturbance within the SC, these disruptions might rande from small to large (Gurtu & Johny, 2021).

Targeted strike. The disruption category of targeted strikes has not received enough attention on the literature as of yet. A disruption brought on by a targeted strike is one that is brought on by intentional actions from outside the SC. They result from deliberate and exogenous reasons, which may include competitor-driven interruptions, protests by activists or outside organizations, targeted acts of terrorism, government involvement, such as litigations that affects output, electronic attacks, or theft. Although they originate from outside the SC, these disruptions are directed at a specific company or SC. A disruptive occurence might also come from rival business. One intentional tactic is to charge competitors more or participate in collective boycotting, in which a company puts pressure on its suppliers to treat other customers poorly (DuHadway, Carnovale & Hazen, 2019).

Inside job. Inside job interruptions are those brought on by a SC menber's deliberate conduct. These are deliberate behaviors inside a SC and may include things like dishonesty amongst businesses, theft, breach of contract, SC strikes, or various types of opportunistic behavior like purposefully utilizing

subpar or fake goods. These incidents, which may be categorized as inter-organizational fraud, haven‘t gotten much attention in the disruption literature (DuHadway, Carnovale & Hazen, 2019).

This categorization is outlined in Fig. 6 along with a few instances of disruptions from each category.

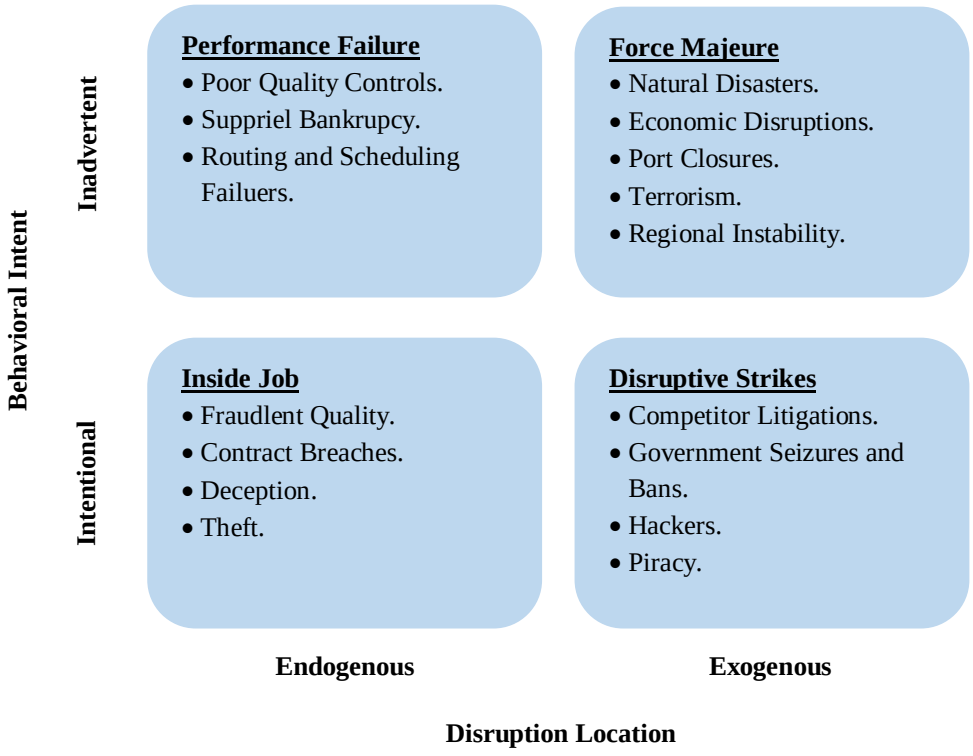

Fig. 6. Classification of disruptive events.

2.4. Supply Chain Risk Management

Nowadays, every company needs to discover efficient ways to run their operations, and for wholesale businesses, SCM is a key success component. It ensures that all corporate operations required to support the delivery of goods and services to clients are planned, managed and carried out. However, because of the complexity of their distribution networks, wholesalers may find it difficult to manage their SCs and arising risks.

The literature has a number of definitions of SCRM. For example, some define SCRM as the process of lowering the risk of vulnerability (Peck, 2006), while others define SCRM as the detection, evaluation, treatment, and monitoring of hazards (El Baz & Ruel, 2021). In this thesis, the main emphasis is on risk management as a procedure where the negative effects of potential occurencies are found, examined, and either eliminated or decreased (Stasytytė & Aleksienė, 2015)

Every business, according to Grötsch, Blome and Schleper (2013), encounters unforseeable risks that jeopardize the effectiveness of its operations. It is crucial to appropriately address these risks and identify solutions to manage them. Risk analysis is one strategy for dealing with new threats since it allows for the collection and analysis of relevant data to identify the factors that contribute to the risk. The study offers a chance to evaluate the potential outcomes of the rising risk and contribute to the search for solutions to its eradication.

SCM is a challenging undertaking for business, according to the authors Stasytytė and Aleksienė (2015), because the processes that take place there encounter unanticipated difficulties that adversely affect their operations. The authors claim that the following elements aid businesses in controlling SC risks:

1. The atmosphere within. The company‘s personnel takes part in this atmosphere and work to accomplish the company‘s objectives.
2. Making objectives. Companies now need to identify objectives and evaluate potential risks.
3. The identification of an event. At this point, both internal and external elements that affect the company‘s goals are recognized. Influence may be classified as either a danger or a chance for the organization.
4. Risk evaluation. Analyzing risks while taking the company‘s effect into consideration is part of this approach.
5. A reaction to risks. The business must determine how it will respond to the risks that have emerged, including whether it will try to avoid them or opt to embrace and mitigate them.
6. Exercise control. The corporation puts in place a control system with the aim of ensuring that all procedures will be followed in order to fulfill the company‘s objectives.
7. Communication and information. The efficient and trustworthy exchange of information between business managers and their staff is crutial.
8. Watching. The company‘s control system has to be closely reviewed and adjusted as needed.

Based on other literature sources, SCRM employs both proactive and reactive techniques to reduce SC vulnerability. According to infomration processing theory, firms with significant RM capabilities can decide to close the information gap between the information needed and the information possessed for implementing the RM startegies in order to reduce uncertainties and maintain stability (Yang, Xie, Yu & Liu, 2021). This can enable them to prevent unanticipated disruptions, respond to them, and return their systems to their prie-disruption state or even an imporved one with greater performance. A focused company with strong RM capabilities can maintain operations throughout disruptions and continue to produce and deliver high-quality products to consumers (Brusset & Teller, 2017). By avoiding and detecting disruptions before they occur, as well as responding to them and recovering thereafter, a business is also better equipped to predict, respond to, and overcome adverse SC interuptions. SCRM strategies and practices, for the most part, aim to decrease SC vulnerability and mitigate disruption consequences. Firms adopt particular SCRM techniques in response to varied risks and disruptions. And as El Baz and Ruel (2021) stated in their article, these practices comprise four interrelated processes.

2.4.1. Risk Identification

The first step in SCRM is to identify hazards by screening prospective SC issues on a regular basis. Because the severity of disruption consequences depends on early discovery of their likelihood, organizations must use risk identification to precisely identify the sources of SCR (Chowdhury & Quaddus, 2017). Owing to the complexity of supply networks and resource restrictions, organizations

must gather data on essential SC processesm flows, and partners to enhance SCRM efficiency. As a result, risk identification is crtitical in SCRM and determines the results of following procedures.

However, the literature reviews demonstrate that, in the present data-driven world, the conventional methodologies are not the best suitable for risk identification. Reaserchers have to take into account a data-focused approach that uses real-time data to identify risks (Aboutorab, Hussain, Saberi, Hussain & Chang, 2021).

Finding the factors that create disruptions and determining their impact in SC would be made easier by taking into account various risks. According to many reaserches, the following guidelines should be used to identify risks:

1. Brainstorming to generate ideas can assist in uncovering potential risks.
2. SWOT (Streangths, Weaknesses, Opportunities and Threats) evaluation and analysis can also assist in identifying risks by analyzing the internal and external elements affecting the company.
3. By reviewing past cases and examining the risks that were faced, as well as the actions that were taken to mitigate them, companies can identify similar risks that may be present in the current times. Such analysis can provide valuable insights into how similar risks were previously managed and what startegies may be effective in the current situation.
4. By analyzing various situations and considering their likelihood and possible outcomes, companies can identify potential risks that may not be immediately apparent in the current situation.
5. Gathering information from various sources such as industry reports, surveys, and feedback from users can help identify potential hazards and risks that may not be immediately obvious. By collecting and analyzing such information, companies can gain valuable insights into the specific risks.

Decisions in SCM are made while balanding the competing goals of maximising profit and customer responsiveness and loweiring SCR. An optimization models and techniques that may be applied to SC risk identification is provided by multi-criteria decision-making SCM (Khan, Chaabane & Dweiri, 2018). Multi-criteria decision-making (MCDM) approaches are frequently employed in risk assessment and identification because they use a systematic and structured approach to identify the best choices. These approaches include data envelopment analysis (DEA), fuzzy decision-making, analytical hierarchal process (AHP), analytical network process (ANP) and Technique in Order of Preference by Similarity to Ideal Solution (TOPSIS). Abdel-Basset and Mohamed (2020) combined few MCDM techniques to provide more accurate decision-making in order to get over the drawbacks of employing only a single strategy. There was a steady increase in mixing several models to identify risks between 2010 and 2020. The MCDM issues‘ fuzzy transformation made it easier to prioritize and assess the risks.

2.4.2. Risk Assessment

Second step in SCRM is risk assessment. Risk assessment is defined as an evaluation of a risk‘s likelihood of occuring, including an evaluation of the risk‘s potential consequences. With a focus on

the interactions between risk and hazard occurrences, this process seeks to give extensive information on the causes of risk and significant vulnerabilities.

The length of time and the pace of the risk occurrences determine how severe the effects of SC disruptions will be. Risk assessment therefore seeks to appropriately rank detected hazards in accordance with their likelihood. The goal of risk assessment is also to get ready for other SCRM techniques, such as SCR mitigation and control.

Assessment of SCRs must be through, quick, and economical for effective SCRM. Data (if available), expert opinion, and scenarios can all be used to evaluate risks. Hence, assessing risk might be formal or informal, quantitative or qualitative. As each analyst has a unique understanding of what defines a risk and the structure of upstream/downstream linkages, risk assessment is fundamentally subjective. A more robust construction of risks may be produced by fusing factual data with subjective perception, which would enhance the accuracy of risk prediction and assessment (El Baz & Ruel, 2021). The following elements need to be taken into account while determining risks.

SC risk prioritization. As Fan and Stevenson (2018) stated in their article about SCM, organizations can identify the most important risks with the use of risk prioritization. Risks that have a significant impact or that may be rapidly addressed may be assigned high priority. Risk treatment activities need significant expenditure to develop and implement, and it is doubtful that a corporation will be able to address all potential risks. Hence, risk prioritization aids in choosing which risk categories to create countermeasures, enabling a corporation to manage its contrauned risk treatment resources. Prior to now, researchers have mostly tried to prioritize risks by identifying risk interrelationships or by using risk assessment methodologies like failure modes and consequences analysis or the analytical hierarchy process (AHP).

SC risk inter-relationships. Risk events are rarely isolated occurencies; rather, they frequently involve other risks and have an effect on the whole SC. Establishing risk priorities, determining the criticality of SC risks, developing risk treatment plans, and carrying out efficient RM tasks are all aided by an understanding of knock-on effects and interrelations (Chand, Thakkar & Ghosh, 2020). So, the main goal is to identify the risk that has the greatest potential to cascade into hazards and become more serious.

2.4.3. Risk Mitigation

The third step in SCRM is risk mitigation. The main goal of mitigation is to deliberately lower the risk to a manageble level. It relates to both the repercussions and the decrease in the likelihood of a risk occurence. Typically, operational hazards with a high likelihood and low effect are suitable for mitigation techniques. Prior to choosing a risk mitigation approach, organizations should carefully consider the acceptance, avoidance, sharing, and transfer alternatives. The choice of a risk mitigation methor also depends on the kind of risk and the organization's budget. As risks are frequently interrelated, reducing one risk type may also reduce or worsen another (positive vs negative reliance), hence, using mitigation tactics should avoid conflict and pay special attention to risks that have negative dependencies (Can Saglam, Yildiz Çankaya & Sezen, 2021).

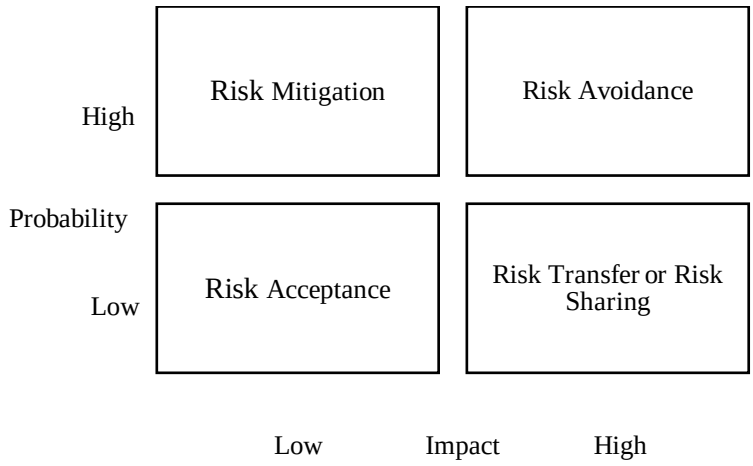

Fig. 7. Risk mitigation strategies for different risk groups (Fan & Stevenson, 2018).

As shown in Fig. 7, different risk clusters may need different RM techniques. A corporation has limited resources, so it is critical to comprehend how effectively use them and when to replace outmoded techniques. For risks with high probabilities and significant impacts, investing in risk avoidance is important to lower the possibility that they will occur, but accepting risk with low probabilities and low impacts may be acceptable. Risk transfer/sharing is most suited for dusruption risks with a low likelihood and large impact, such as natural catastrophies and terrorist attacks, whereas risk mitigation seems more suitable for high probability, low effect threats (Majumdar, Sinha, & Govindan, 2021). So, in order to track the development of the startegies and make sure they remain in line with the threats, the situation must be continuously monitored fore ach risk and across risks, which is the focus of the following part.

2.4.4. Risk Control/Monitoring

To ensure quick risk detection and reaction, it is crucial to determine the risk variables that need to be monitored throughout the risk monitoring and control phase. Since SCs are dynamic and consequently subject to changes (such as policies, guidelines and more), monitoring risks after the implementation of risk response plans is justified in order to assess the success and progression of the taken actions, confirm the corrective actions, and identify deviations from expected performance (El Baz & Ruel, 2021).

Risk is not a constant occurence. It must be constantly examined to see how risk sources are evolving and whether any adjustments to the treatment techniques are required. It is crucial to make sure that risk monitoring is based on both formal processes and judgmental evaluations in order to manage changes, gather new information and keep track of the ongoing development of SCRM. Fan and Stevenson (2018) recommended setting up particular data management systems for risk monitoring, creating monitoring capabilities and early-warning management porcesses, and creating tools to spot patterns. Also, it was noted that managers typically combine monitoring activities into an already-estabilshed management routines, such as combining monitoring with risk assessment and monitoring processes, as well as using key performance indicators and performance measurement systems.

Aside from these four approaches of SCRM and their combining, the key elements that guarantees a company performs well are the procedures and activities carried out throughout the SC. In one way or another, every unforeseen problem that businesses face has an influence on the effectiveness of the SC; in most cases, this impact is detrimental and results in losses for the organizations. It is crucial

for managers to effectively address new issues and decide not to lessen their effects on the firm and its operations. According to Manuj, Esper and stank (2014), increasing capacity, working with independent suppliers, responding more quickly, keeping more inventory on hand, being more flexible, pooling demand overall, and improving operational capabilities are all potential risk-reduction strategies. Table 2 represents all the SCRM methods mentioned.

Table 2. Methods of risk management (derived from Manuj, Esper & Stank, 2014).

Risk Management Method	**Fields of Application of The Method**
Increased capacity	In order to handle unforeseen demand or disruptions, SC must be made more capable. To improve it, a company can spend more money on new manufacturing tools or recruit more personnel.
Work with independent suppliers	Depencence on a single supplier might raise the chance of SC interruptions. Utilizing a variety of independent suppliers may help lower risks by giving an access to different sources of supply.
Quicker response	Rapid action is the face of unforeseen occurrencs can lessen the impact of interruptions. This might entail putting in. place a crisis management plan or spending money on technology that enables real-time monitoring and communication.
Bigger inventory	Keeping a bigger stock of products on hand might can as a safety net in case the SC is disrupted. However, doing so has a price in terms of storage and inventory keeping expenses. Concentration of inventory for valuable and high-quality goods should be considered.
Increased flexibility	The price growth of high-quality item is influenced by the service performance's flexibility. For low-value items, service flexibility is constant and predictable. Concentrating flexibility in many places should be considered.
Combined demand aggregartion	Suppliers may more accurately predict and plan for demand by combining demand from several clients, which lowers the chance of stockouts or other interruptions.
Improved operational capability	High value and quality items are preffered as hey may be more risk averse. Instead of low-quality goods, the capacity is focused on cost-effective solutions.

Effective management of SCR also necessitates information exchange between the organization and its suppliers, according to Moharana, Murity, Senapati and Khunita (2015). A proper information exchange process guarantees that suppliers and corporate executives will discuss all pertinent data on new risks and their repercussions (Fig. 8). Working together to discover, assess, and resolve new risks is possible when there is cooperation.

Fig. 8. Collaboration between business and their suppliers in risk management (derived from Moharana, Murty, Senapati and Khuntia, 2015).

After a literature review, it can be concluded that every organization encounters unforseen risks, which often have a detrimental impact on its operations. The SC and the procedures that take plave inside it are no exception. The SC entails a variety of activities and procedures, all of which have the potential to encounter unforseen difficulties that impair its ability to function successfully. For organizations to secure their resiliency and continuity in the event of unforseen interruptions, SCRM is an essential thing. The internal environment of the bsusiness, including the procedures used for production, control system, and workers can provide a number of obstacles to the SC. Additionally, external risks, such as different natural catastrophes, market risks, political and economic concers, have an impact on how the SC operates. Companies must select and adopt proactive risk mitigation methods and strategies, and improve SC‘s ability to withstand and absorb shocks in order to effectively manage SC risks.

2.5. Framework

The scinentific literature was examined, and it was discovered that businesses may emply a number of strategies to manage the SC effectively. Following a through examination of the proposals made by other authors (Can Saglam, Yildiz Ankaya & Sezen, 2021; Chand, Thakkar & Shosh, 2020; Chu, Park & Kremer, 2020), and a theoretical analysis (El Baz & Ruel, 2021; Majumdar, Sinha & Govindan, 2021; Dagomir, 2019), it can be concluded that the majority tend to highlight RM in several main SCRM processes:

- Risk identification.
- Risk assessment.
- Risk mitigation.
- Risk control/monitoring.

Theoretical research also brought attention to a number of key methods to identify, assess, mitigate and monitor SCR, such as increased capacity to handle high demand, collaboration with independent suppliers to diversify sources of materials, quicker response times to market changes, maintaining a larger inventory to meet customer needs, increased flexibility to adapt to unexpected situations, combined demand aggregaryion to optimize procurement and distribution, and improved operational capability to streamline processes, Businesses may also increase their efficiency and profitability while assuring client loyalty and happiness by putting these fundamental principles into practice.

Based on the importance of these methods and risk management processes, a theoretical framework was developed (Fig. 9).

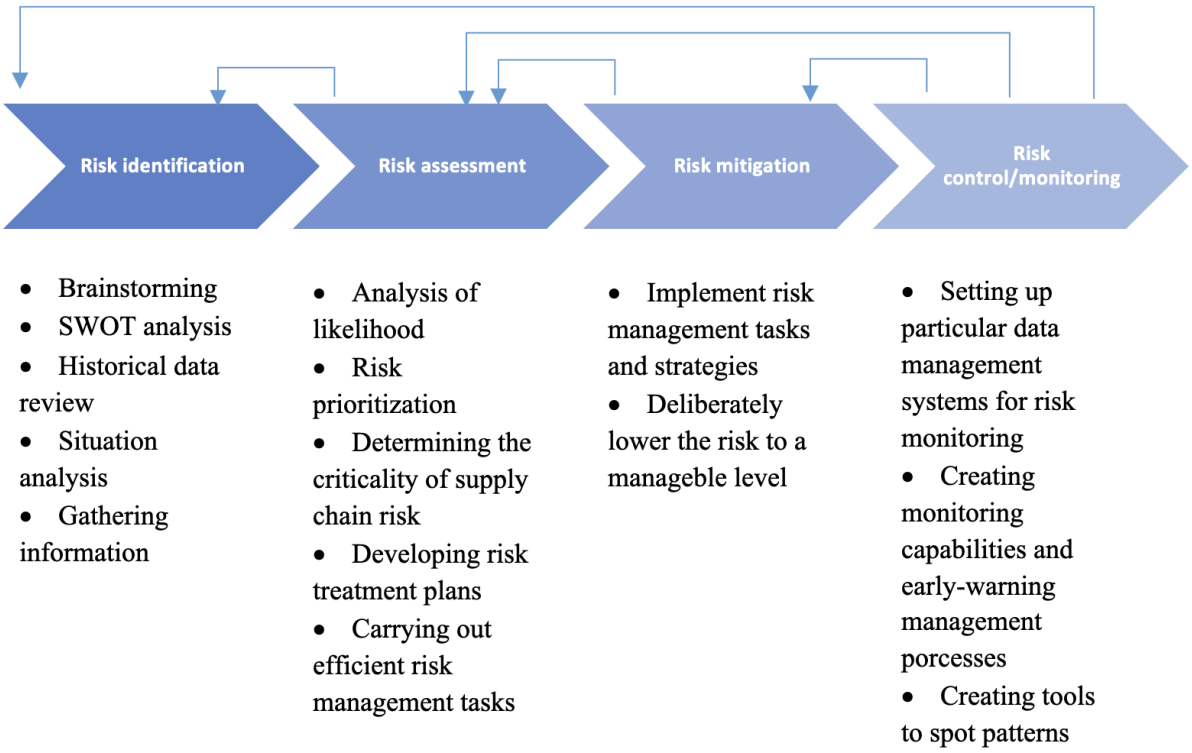

Fig. 9. Framework of SC process risk management (Created by the author of this thesis, 2023).

As provided in the framework above, managing risks in SC involves four main steps. The first step towards a successful RM is risk identification that aims to identify the risks by understanding the situation and gathering all the necessary information, including historical data review to see how risks were handled in the past. The second step is risk assessment by analyzing their probability and prioritizing them. This helps to decide which risks are most important to address and manage with limited resources. Risk reatment plans and efficient tasks are then made fore each of the risk. The third step is risk mitigation, which involves implementing strategies and tasks to lower the risk to a manageble level. This could involve creating new policies, finding alternative suppliers, or changing logistics systems. Finally, the last step in successful RM is risk monitoring and control, which involves tools, such as early-warning and pattern spotting to address any areas where the management plan is not responding effectively. If at any point the RM isn‘t working as expected, the previous steps are reviewed and revised until the risk is reduced to a manageble level again and the systems for monitoring can function and assist properly.

3. Research Methodology

Companies nowadays are required to search for appropriate techniques and means to assure effective performance due to the quicly changing social and economic environment and wising competition. Managing the SC effectively is every company's top priority since it allows the fulfillment of consumer demands, or the creation and delivery of goods that are suitable for their needs. It may be difficult for businesses to manage the SC and the operations that take place inside it because of ferocious competition, unforseen difficulties, and new dangers that pose a threat to the chain's ability to function effectively.

The research process in this section is described in detail, including the methodologies utilized, the aim and objectives, and the instruments and procedures used to gather and analyze data. This data is offered to provide a complete knowledge of the study done and the procedures followed to get the results.

The **aim** of the research is to check the expression of theoretically based risk management solutions for SC processes, to determine what risks the company Tamro faces and what methods it uses to manage these risks.

The empirical research **objectives and tasks** are:

1. To identify risks that the company Tamro is facing.

2. To examine methods the company Tamro is using to manage these risks in SC.

3. To provide solutions and recommendations on how SC process risk management could be improved in company Tamro.

Research method. To examine the challenges faced by the company in managing SCR, a **case analysis** has been chosen as the study methodology. This research technique was chosen in order to gather a larger variety of data that enables to answer the research question by applying the knowledge of the theoretical part and to define the research aim and objectives. The case study seeks to provide an in-depth understanding of the specific subject while also enabling the development of more general theoretical assertions concerning uninformity in the observed issue (Fidel, 1984). Case studies aid in providing clarity into crutial connections that may be expanded in many ways (Gomm, Hammersley & Foster, 2000). To get the core and detailed information, the study is carried out utilizing the **qualitative research** methodology. In general, qualitative research refers to a group of research methodologies that generate results devoid of the use of quantitative measurement or statistical analysis. Participant observation, one-on-one and focus groups interviews, as well as other techniques, are frequently used as qualitative methodologies (Hamilton & Finley, 2019) so a qualitative data gathering approach is highly advised for examining management or decision-making processes.

Semi-structured individual interviews are used in the research. When a researcher wants to learn more about the participant's particular viewpoint rather than a broad grasp of a phenomena, semi-structured interviews are the best option for gathering data. Although, other data collection techniques have a place in qualitative research, the semi-structured interview has the advantage of allowing interviews to be focused while still allowing researcher the freedom to explore any relevant ideas that may arise during the interview. It is possible to customize the response to the individual respondent,

his circumstances, or his experiences. This enables the collection of more pertinent data, supplementing the study with more through data. The interview is conducted in a private, confidential setting with just the responder and interviewer present. During the interview, sound-recording equipment is employed. This method of gathering data during the interviews makes it simplier to transform them into transcripts, which have a structure ideal for analysis (Adeoye-Olatunde & Olenik, 2021).

Sampling. The best way to gain a through grasp of SCRM is to speak with people in various roles inside a SC. In this empirical research information was gathered conducting semi-structured interviews interviewing managers and experts from Tamro, a pharmaceutical wholesale and retail company. The questionnaire with ten questions asked is designed based on the semi-structured interview approach in order to collect data on managers' experiences, perceptions and expertise in relation to SCRM. General information is given to the respondent at the outset of the questionnaire to familiarize them with the goals of the interview, the process of the interview, and the conditions of information gathering, utilizing, and storage.

Managers operating in a certain area of the SC were picked for interviews in order to get as realistic of an experience based on the same activities as feasible. Effective SC process management is the joint responsibility of the SC manager, logistics manager, risk manager and financial manager. Thus, the candidates of these roles received an invitation to take part in the interview. To learn more about SC process risk management at the Tamro firm, a total of four interviews were conducted.

Table 3. Outlined roles for respondents.

Respondent	**Role**
Supply Chain Manager	Responsible for managing their department and assuring the efficiency of the whole SC, ensuring optimal inventory and service level. They may share knowledge how they recognize and reduce SCR as well as how they work with other departments to manage risks, how they work with suppliers to minimize risks and how they assess supplier risks.
Logistics Manager	In charge of organizing the distribution and transportation of commodities. They can shed light on how they control the risks associated with delays, damages and disruptions in transportation and warehousing.
Risk Manager	In charge of locating and evaluating risks inside the company. They may share information on how they assess SCR and create risk management plans.
Finance Manager	Responsible for managing financial parts of the SC. They can shed light on how they handle financial risks including fluctuating currency rates and supplier cretit issues.

Information was gathered in Lithuanian language, and the replies were afterwards translated into English without altering their content inorder to allow respondents to express themselves, as it was also considered that some respondents might not feel comfortable speaking English.

In order to accomplish the goals of the empirical study, research was conducted by looking at interviews utilizing the MAXQDA program as a part of a research instrument. Transcripts of the interviews were reviewed thereafter. In order to achieve the aim, material from the interviews was analyzed and summarized to numerous key data points using the mentioned program MAXQDA.

Such an approach made it possible to assess and review the SCRM experiences. Hence, the most efficient SCRM methods might be identified using MAXQDA.

Table 4. Structure of the research instrument (made by the author of this thesis, 2023).

Question group	Question
Risk identification and assessment	1. What are the key risks that supply chain faces in your company, and how does the company identify and assess these risks?
Risk mitigation measures and effectiveness	2. What measures does the company have in place to mitigate supply chain risks, and how effective these measures are?
Supplier performance monitoring	3. How does the company monitor and manage supplier performance to ensure that supply chain risks are minimized?
Contingency planning	4. What contingency plans does the company have in place to deal with supply chain disruptions or emergencies, and how frequently these plans are tested?
Supplier risk management and assurance	5. How does the company ensure that its suppliers are also managing supply chain risks effectively?
Communication during disruptions	6. how does the company communicate with suppliers and other stakeholders during supply chain disruption or crisis?
Technology's role in risk management	7. What role does technology play in company's supply chain risk management strategy, and what tools or platforms does the company use to monitor and manage risks?
Cost reduction and efficiency balance	8. How does the company balande cost reduction and efficiency with risk management in supply chain operations?
Learning from the past	9. What lessons has the company learned from past supply chain disruptions, and how has it used these lessons to improve its risk management practices?
Staying up to date with emerging risks	10. How does the company stay up-to-dare with emerging supply chain risks and adapt its risk management startegies accordingly?

Question groups:

- *Supply chain risk identification and assessment* question pertains to understanding the risks that the company's SC is facing. So, with this question, it is explored how companies identify and assess these risks.
- *Risk mitigation measures and effectiveness* question explores the measures that the company has in place to minimize risks and how effective those measures are.

- *Supplier performance monitoring* and management for risk minimization question seeks to explore how companies monitor and manage their suppliers to ensure that they are minimizing SCRs.

- *Contingency planning* and testing for SC disruptions or emergencies question pertains to how companies plan for and respond to these situations, including the frequency at which contingency plans are tested.

- *Supplier risk management and assurance* question seeks to explore how companies assure that their suppliers are managing supply risks appropriately.

- *Communication during disruptions* question pertains to how company communicates with its suppliers and other stakeholders during SC disruptions or crises.

- *Technology's role in SCRM* and tools or platforms used plays important role in minimizing risks. This question seeks to explore what tools or platforms the company is using to monitor and manage risks.

- *Cost reduction and efficiency balane* is an important aspect, as while it's important to minimize SC risisk, companies also need to balance this with cost reduction and efficiency. So, this question seeks to analyze how company strikes this balance.

- *Learning from the past* events of SC disrutpions and improving risk management practices can provide valuable lessons for companies. This question explores how a company learns from these experiences and uses them to improve their risk management practices.

- *Staying up to date with emerging SC risks* and adapting risk management strategies accordingly to effectively manage SC is also an important aspect, as the SC landscape is constantly evolving. Tis question aims to discover how a company stays informed of emerging risks and adapt their risk management strategies accordingly.

The empirical research is **ethical** when it is performed responsibly and respectfully with the intention of avoiding damage and increasing benefits for all parties involved. This entails acquiring participants' consent after providing them with all relevant information, safeguarding their privacy and secrecy, and lowering the dangers. Additionally, to guarantee the validity and dependability of the results, empirical research needs to be carried out in a thorough and objective manner. It's crucial to think about the research's potential effects and to share the results in an open and responsible way.

The process of the empirical research is ilustrated in Fig. 10, including all the processes, such as:

1st step: The creation of interview questions based on the framework and theoretical part of the research.

2nd step: Finding informants and getting consent for research participation.

3rd step: Interview conducting.

4th step: The transctriptionf of interviews conducted.

5th step: The analysis of gathere data and systematization using MAXQDA tool.

Fig. 10. Empirical research process.

Regarding the qualitative research and interviewing managers of company Tamro, there are several **limitations** while conducting it. First, the results from a single case study cannot be extrapolated to a broader group due to generalizability issues. Rather than generalizing the population, the emphasis is on the particularities of a specific situation. Another limitation might be the subjectivity. The study may be sewed since the researcher's interpretation of the data is, as with any qualitative research, subjective. Lastly, one person or group is used in a case study, which restricts the research's breadth and might not adequately represent the diversity of people's experiences.

4. Results of Supply Chain Process Risk Management in Company Tamro Empirical Research

The findings of the empirical research, which was based on an analysis of the conducted interviews, are presented in this section of master's thesis. The theoretical and empirical components of this thesis will also be explored and assessed in order to clarify the challenges a company "Tamro" has with SC process risk management. Finally, potential solutions to address SC process risk management issues will be presented based on the analysis of interviews with a number of managers in this company, their knowledge, and a theoretical overview.

4.1. Empirical Research

Four key actions and steps have been identified for an effective SCRM based on the framework presented in the theoretical section. Acoording to these four steps, risk, their identification factors, assessment methods, challenges and monitoring aspects faced by the company were coded on the MAXQDA tool and questions were introduced.

Finally, the information gathered from the semi-structured one-on-one interviews will be divided into two categories – types of SC risks and risk management strategies – and analyzed.

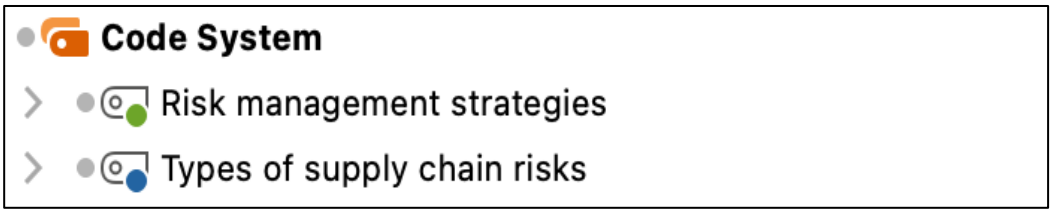

Fig. 11. Categories of codes used for the analysis (prepared by the author of this thesis using MAXQDA tool, 2023).

Each group of codes will be supplemented with subcodes taking into account what risks the company faces, what risk management strategies it uses and what problems it encounters when making risk management decisions. The subsections 4.1.1. and 4.1.2. will examine and graphically illustrate research findings.

4.1.1. Types of Supply Chain Risks

Based on the examination of the risks that the company faces, it can be concluded that the key risks are primarily related to issues such as order calculation, quality issues, market fluctuations, sudden changes in demand, issues with warehouse and logistics, regulatory risks, liquidity risks and credit risks (Fig. 12).

Fig. 12. Identified key risks, according to interviews (created by the author of this thesis using MAXQDA tool, 2023).

Each risk mentioned was placed into a subcode category and marked in each interview in order to see the frequency of appearance in all the interviews. This is supported by the number of encoded segments in the "SUM" column, as well as the size of the symbols. The bigger the size of the circle symbol in the visualization is, the more frequently the identified codes appeared in the responses of the respondents. By examining the frequency of risks faced by each department, it is possible to rank them from the most common to the least common. This helps to analyze the data more effectively and gain a better understanding of the main risks faced by the company.

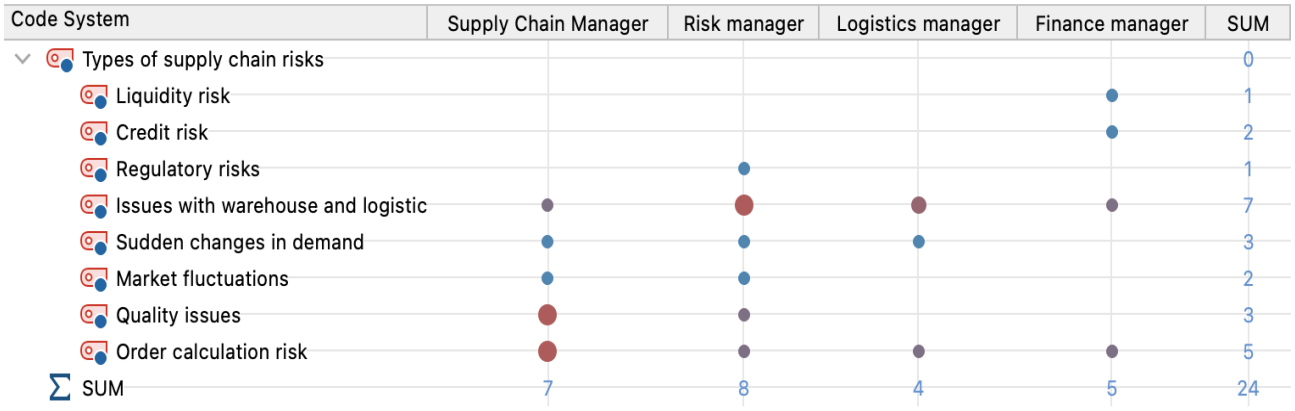

Fig. 13. Distribution of risk frequencies between managers of different parts of the SC (created by the author of this thesis using MAXQDA tool, 2023).

Following the interviews and analysis of each expert's comments, it was discovered that issues with warehouse and logistics is the most typical risk faced by the Tamro company and was mentioned in all the interviews conducted.

Table 5. Warehouse work issues segmentation (created by the author of this thesis usinf MAXQDA tool, 2023).

Position of a Person	Category	Subcategory	Coded quotes
Supply Chain Manager	Types of supply chain risks	Issues with warehouse and logistics	"There are risks such as <…> quality of warehouse work (whether goods are received on time, all goods are found) <…>"
Risk Manager	Types of supply chain risks	Issues with warehouse and logistics	"These risks include <…> logistics and transportation, and inventory management <…>"
			"<…> the risk of stockouts or excess inventory. "
			"<…> lack of personnell in manufactures field and logistical challenges <…>"
Logistics Manager	Types of supply chain risks	Issues with warehouse and logistics	"<…> disruptions in the supply chain, such as transportation delays."
			"<…> disruptions in the supply chain, such as <…> sufficient inventory."
Finance Manager	Types of supply chain risks	Issues with warehouse and logistics	"Another risk is <…> inventory management."

A wholesale distribution company's performance depends heavily on its warehouse and logistics operations. In essence, a wholesale distribution company oversees transporting products from producers to shops, so for a number of reasons an efficient warehouse and logistics management is crucial, as it makes certain that the appropriate goods are offered at the appropriate times in the proper quantities. However, all the respondents, responsible for different parts in SC, mentioned that in one way or another they are facing issues with warehouse and logistics processes - one of the main risks their company is encountering.

Order calculation is another important process of a company's SC as it helps determine how much inventory needs to be ordered and when. This process is critical in ensuring that products are available to meet customer demand. However, the process is not without its challenges, and based on the interviews conducted, company also struggles with managing this process effectively (Table 6). The risk associated with order calculation was identified as the second most prevalent risk facing the company. This underscores the importance of this process in the overall success of company's SC. The accuracy of order calculation is directly linked to the efficiency of warehouse and logistics management and if there are errors or inaccuracies in the order calculation process, it has a significant impact on inventory levels, which in turn cause delays, stockouts, and lost sales.

Table 6. Order calculation risk segmentation (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	Category	Subcategory	Coded Quotes
Supply Chain Manager	Types of supply chain risks	Order calculation risk	"There are risks such as incorrectly calculated orders to suppliers, which affects over stock or out of stock."
			"Order fulfillment is also <…> possible supply disruption."
Risk Manager	Types of supply chain risks	Order calculation risk	"These risks include <…> inadequate order calculations."
Logistics Manager	Types of supply chain risks	Order calculation risk	"Another risk we face is the risk of order calculation, which can arise for various reasons, such as misinterpretation of orders, incorrect product quantities or specifications, system errors."
Finance Manager	Types of supply chain risks	Order calculation risk	"Another risk is the risk of calculating orders <…>"

Another risk, faced by the company, is a sudden change in demand. A SC may be significantly impacted by a sudden shift in demand. If demand spikes unexpectedly, it may be difficult for the SC to keep up, which might result in stock shortages, sluggish delivery, and disgruntled consumers. On the other side, if demand declines unexpectedly, the SC can be left with extra inventory that has to be disposed of or put to other purposes. However, during the interviews, only three out of four managers mentioned that they face such risk (Table 7).

Table 7. Sudden change in demand segmentation (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	Category	Subcategory	Coded Quotes
Supply Chain Manager	Types of supply chain risks	Sudden change in demand	"Another risk is demand - a sudden decrease or increase in demand for the company's products or services, which may disrupt the supply chain."
Risk Manager	Types of supply chain risks	Sudden change in demand	"<…> also, sudden changes of demand <…> as we were effected by COVID-19 pandemic and UA War."
Logistics Manager	Types of supply chain risks	Sudden change in demand	"<…> most painful risk of our company is shortage of medicine products that are crucial for certain patients."

Besides sudden changes in demand, market fluctuations play an important role in SC process management as well. Changes in the market can affect SC process management both favorably and unfavorably, increasing sales revenue and at the same time leading to SC disruptions if the demand exceeds the available supply. However, two out of four respondents who brought this issue up did so in a negative light, identifying it as a risk their company is facing (Table 8).

Table 8. Market fluctuation code segmentation (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	Category	Subcategory	Coded Quotes
Supply Chain Manager	Types of supply chain risks	Market fluctuations	"<…> strongly changing market situation (e.g., covid goods)."
Risk Manager	Types of supply chain risks	Market fluctuations	"<…> and market as we were effected by COVID-19 pandemic and UA War."

The same managers during the interviews mentioned that they are facing quality issues as well (Table 9). Quality problems have a significant impact on SCM, as such risk refers to faults with the goods or services generated by the SC, such as flaws. These problems lead to product recalls, unhappy customers, and damage to the company's reputation.

Table 9. Quality issues segmentation (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	Category	Subcategory	Coded Quotes
Supply Chain Manager	Types of supply chain risks	Quality issues	"<…> we have had suppliers that did not meet our expectations in terms of quality."
			"<…> delays and quality issues affecting our customers."
Risk Manager	Types of supply chain risks	Quality issues	"These risks include issues related to product quality and safety <…>"

Regulatory risks, credit risks and liquidity risks are another three subcategories that were discovered while conducting interviews, however these risks were mentioned fewer times and only in some of the interviews (Table 10).

Table 10. Fewer mentioned risk segmentation (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	Category	Subcategory	Coded Quotes
Finance Manager	Types of supply chain risks	Credit risk	"The biggest risks from the financial side are that customers will not pay money <…>" "<…> meet our solvency guarantees and avoid insolvency risk."
		Liquidity risk	"The biggest risks from the financial side are that <…> sales will stop, that we will be left with large working capital, a lot of money could be frozen in reserves."
Risk Manager	Types of supply chain risks	Regulatory risk	"These risks include <…> regulatory compliance <…>"

In the interview with the finance manager, it was mentioned that the company faces liquidity and credit risk. These risks are more frequently linked to the finance department, which oversees managing the business's financial resources and making sure that it has enough cash flow to satisfy its commitments. Liquidity risk is the risk of not being able to meet short-term financial obligations due to a lack of cash or liquid assets. This usually occurs whenever there is a disruption to the company's cash flow, sudden changes in demand or market fluctuations. On the other hand, credit risk refers to the risk that due to the default or insolvency of the borrower, it is not possible to recover the funds owed to the company. This occurs if a business extends credit to clients who are unable to pay back their debts. And even though credit risk and liquidity risk are more frequently linked to the finance department of the company, they have an impact on the entire SC.

The interview with the risk manager revealed another risk that their company is facing – regulatory risk. Regulatory risk is the possibility that adjustments to laws, rules, or policies will negatively affect a company's business, finances, or reputation. Even though this risk was mentioned in only one interview out of all four conducted, in time of occurrence of this risk, it has an impact on the entire company.

4.1.2. Risk Management Strategies

After examining the risks, the firm is exposed to, it can be said that all of the risks described were, in one way or another, mentioned in theoretical analysis. To control all the risks, company and each department individually has its own SC process risk management strategies, so based on the literature review and theoterical framework, four main risk management steps were included into subcode section in MAXQDA tool to identify what risk identification, assessment, mitigation, and monitoring strategies company is using in order to control arising hazards (Fig. 14).

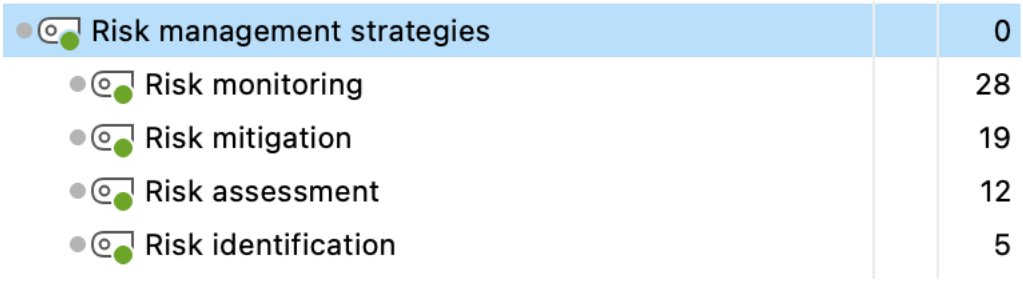

Fig. 14. Main SCM strategies, based on theoretical framework (Fig. 9) (created by the author of this thesis using MAXQDA tool, 2023).

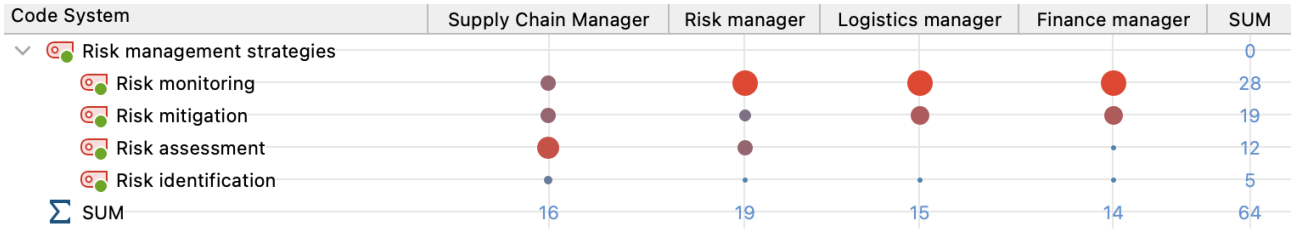

Fig. 15. Distribution of risk management strategies between managers of different parts of the SC (created by the author of this thesis using MAXQDA tool, 2023).

Each risk management strategy was classified into a subcode and tagged in each interview to determine its frequency, just like in the previous analysis of SCR. The larger the symbol, the more

often these risk management strategies occurred in respondents' replies (Fig. 15). It is feasible to rank each risk management strategy from the most common to the least common by looking at how frequently risks are encountered by each department. This makes it easier to assess the data and better identify SCRM strategies.

As it is visible in the Fig. 15, company has many risk monitoring, risk mitigation and risk assessment strategies; these subcodes were the most coded and used while encoding segments in each interview conducted. Based on the frequency of the strategies, the data will be further analyzed, according to the order of the theoretical framework.

The first step in SCM, according to theoretical framework, is risk identification. Risk identification strategies were the least mentioned among all the interviews, as the biggest focus was mostly on mitigation and monitoring strategies that company uses. However, risk identification in SCM is the process of identifying potential risks and uncertainties that could impact a company's SC. These risks could range from natural disasters, political instability, financial issues with suppliers, to technology malfunctions and more. By conducting a risk identification analysis, companies can anticipate potential problems and plan accordingly, as it helps them to develop contingency plans and risk mitigation strategies to minimize the impact of any unexpected events that could disrupt their SC operations. With this, it can be said that risk identification is an important initial step in managing SC risks, because by recognizing possible risks, companies may create strategies and backup plans to reduce the effects of such risks and guarantee the continuation of their SC activities.

Table 11. Risk identification strategies (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	**Category**	**Subcategory**	**Coded quotes**
Supply Chain Manager	Risk management strategies	Risk identification	"The company follows and analyses changes in the situation on the market, communicates with suppliers, manufacturers, hospitals and other medical institutions, follows information in the press, etc."
			"We also work with our suppliers and other stakeholders to understand their views on potential risks and collaborate on risk mitigation strategies."
Risk Manager	Risk management strategies	Risk identification	"<…> we conduct regular assessments of our supply chain to identify potential risks and vulnerabilities."
Logistics Manager	Risk management strategies	Risk identification	"All the risks are being monitored and overviewed regularly."
Finance Manager	Risk management strategies	Risk identification	"<…> continually reviewing and improving processes to identify areas where we can streamline operations and reduce costs without increasing risk."

Even though respondents did not talk much about risk identification strategies, a few of them were noticed during the interview, such as the analysis of market, process overviewing and imporving, communicating with suppliers, manufacturers, hospitals, and other medical institutions, following up with the information in the press.

After risk identification, risk assessment is the next stage in SCRM. Risk assessment entails studying each prospective risk to ascertain its chance of happening and potential effects on the SC. Businesses may use this to organize their risks into priority categories and devote resources to reduce or eliminate them.

Table 12. Risk assessment strategies (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	**Category**	**Subcategory**	**Coded quotes**
Supply Chain Manager	Risk management strategies	Risk assessment	"Quarterly results are discussed with suppliers, future trends and risks are discussed, and appropriate actions are foreseen after the discussion."
			"<…> review the risky assortment and accordingly make decisions about the necessary stock levels to meet the demand, as well as to reduce the risk of staying with over stock."
			"<…> compensation models are being coordinated with suppliers <…>"
			"The company always evaluates whether a certain decision regarding efficiency is financially justified and does not cause supply risks."
			"We discuss the worst-case scenario plan and what protections it should have."
			"<…> solid contingency plans."
Risk Manager	Risk management strategies	Risk assessment	"<…> we prioritize these risks based on their likelihood and potential impact on our operations and customers."
			"<…> we also maintain ongoing communication and collaboration with our suppliers, logistics partners, and regulatory agencies. This allows us to stay informed of any changes or developments that may affect our supply chain and take proactive measures to address any issues. "
			"We have qualification process for new suppliers that includes a review of their quality systems, processes, and compliance with regulatory requirements."
			"We have clear contractual agreements with our suppliers that specify our quality requirements and other important terms. These contracts help to ensure that our suppliers understand our expectations and are held accountable for meeting them."
			"Communication plan is designed to ensure that we can quickly and effectively communicate with our suppliers and other stakeholders during a disruption or crisis, and work together to manage the situation and minimize the impact on our customers and business."

Finance Manager	Risk management strategies	Risk assessment	"<…> invest in technology and data analytics to predict and mitigate potential risks."

Typically, risk assessment entails rating or scoring each risk according to its likelihood of happening and the gravity of its possible effects. Companies design and put into action efficient risk mitigation plans by conducting a risk assessment to better understand the risks they face and the possible effects on their SC processes.

Based on theoretical framework and the interviews conducted, some SCR assessment strategies were noticed while speaking to respondents (Table 12). The company analyzes risk likelihood by prioritizing all the arisen risks based on their potential impact on their processes and customers (*we prioritize these risks based on their likelihood and potential impact on our operations and customers*) as well as discussing quarterly results with suppliers (*quarterly results are discussed with suppliers, future trends and risks are discussed, and appropriate actions are foreseen after the discussion*) and by reviewing and making decisions about stock levels based on risky assortment (*review the risky assortment and accordingly make decisions about the necessary stock levels to meet the demand, as well as to reduce the risk of staying with over stock*). Determining the criticality of SC risks in this company, according to respondents, is carried through discussing worse-case scenarios and protection plans (*we discuss the worst-case scenario plan and what protections it should have*). Risk treatment plan developing includes creating solid contingency plans, compensation models (*compensation models are being coordinated with suppliers*) and investing into technology and data analytics that help predict potential risks (*invest in technology and data analytics to predict and mitigate potential risks*). And finally, after developing treatment plans, risk management tasks are being carried by evaluating certain decision financially (*the company always evaluates whether a certain decision regarding efficiency is financially justified and does not cause supply risks*) and by maintaining ongoing communication with suppliers, logistics partners, and regulatory agencies (*we also maintain ongoing communication and collaboration with our suppliers, logistics partners, and regulatory agencies. This allows us to stay informed of any changes or developments that may affect our supply chain and take proactive measures to address any issues*).

Risk mitigation is the third step in SCRM. Usually, this stage includes implementing strategies to lessen the likelihood and effects of potential risks in the SC. It entails locating possible risks, evaluating their possibility and effect, as well as creating and putting into practice ways to eliminate, reduce, or manage such risks. By making the SC's components less vulnerable to future disruptions, risk mitigation in SCM aims to make the chain more resilient.

Table 13. Risk mitigation strategies (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	**Category**	**Subcategory**	**Coded quotes**
Supply Chain Manager	Risk management strategies	Risk mitigation	"<… >smart demand planning tool is being implemented, which helps to more accurately plan, monitor and maintain optimal stocks."
			"Stock levels in the warehouse are increased for anticipated supply disruptions."

			"The situation in the market is constantly monitored, public communication about possible changes is made and the response is made accordingly."
			"<…> inventory buffering in order to reduce the impact of any supply chain disruptions, as well as alternative transportation routes to reduce the impact of transportation disruptions."
Risk Manager	Risk management strategies	Risk mitigation	"Inventory management: We monitor our inventory levels closely to ensure that we have the right products available at the right time."
			"Supplier management: We work closely with our suppliers to ensure that they also comply with GDP requirements and adhere to our quality standards. We conduct regular qualifications of our suppliers to ensure that they are meeting our requirements and address any issues that may arise."
			"Logistics management: We carefully manage our logistics and transportation processes to ensure that our products are transported safely and securely. This includes monitoring temperature and humidity during transportation and maintaining proper documentation."
			"Regulatory compliance: We maintain strict compliance with all relevant regulations and standards, including GDP requirements, to ensure that our products are safe and meet all necessary quality standards."
Logistics Manager	Risk management strategies	Risk mitigation	"We have measures such as visibility, which provides full visibility of the supply chain, enabling real-time tracking of goods, inventory levels and transportation routes. This visibility helps identify potential risks and allows for timely action to mitigate their impact."
			"Inventory Management ensures that sufficient inventory is available to minimize supply chain disruptions. These include demand forecasting, inventory level monitoring and warehouse operations optimization."
			"<…> security measures to prevent theft, loss, or damage of goods during transportation and storage. These measures include GPS tracking, security cameras and security guards."
			"<…> an outgoing search for new products and new income streams to compensate shortages in the market."
			"<…> each supplier company that we are working with must have certificates of good distribution

			practice. Basically, we must comply, and our suppliers must comply this practice."
Finance Manager	Risk management strategies	Risk mitigation	"<…> we check the customer's solvency. If there is a shortage of money, it is possible to make postponements with buyers."
			"<…> maintain a close relationship with our clients and carry out regular assessments to ensure they meet our solvency guarantees and avoid insolvency risk."
			"<…> maintain a reliable inventory management system. So that we don't go to stockpiles of money, because it will last as a negotiable asset."
			"We also plan cash flows <…>"
			"<…> determining and assessing the impact of a disruption or accident, communication with suppliers, customers and other interested parties, implementation of alternative supply strategies, inventory level and logistics management, constant monitoring of the situation and adjusting any plans if necessary."

The implementation of risk management strategies and tasks to deliberately lower the risks to a manageble level in this company is carried out by various of strategies (Table 13). The most mentioned strategy in all the interviews to mitigate risks was inventory and logistics management (*inventory buffering in order to reduce the impact of any supply chain disruptions, as well as alternative transportation routes to reduce the impact of transportation disruptions*), (*smart demand planning tool is being implemented, which helps to more accurately plan, monitor and maintain optimal stocks*), (*stock levels in the warehouse are increased for anticipated supply disruptions*), (*inventory management: We monitor our inventory levels closely to ensure that we have the right products available at the right time*), (*inventory Management ensures that sufficient inventory is available to minimize supply chain disruptions. These include demand forecasting, inventory level monitoring and warehouse operations optimization*), (*maintain a reliable inventory management system. So that we don't go to stockpiles of money, because it will last as a negotiable asset*), (*logistics management: We carefully manage our logistics and transportation processes to ensure that our products are transported safely and securely. This includes monitoring temperature and humidity during transportation and maintaining proper documentation*), (*we have measures such as visibility, which provides full visibility of the supply chain, enabling real-time tracking of goods, inventory levels and transportation routes. This visibility helps identify potential risks and allows for timely action to mitigate their impact*), (*security measures to prevent theft, loss, or damage of goods during transportation and storage. These measures include GPS tracking, security cameras and security guards*). Since issues with warehousing and logistics were mentioned in all the interviews as the most common risk the company is facing, all the respondents also mentioned how they mitigate such risk, giving broad answers about the implementation of various management tasks. But besides warehousing and logistics, other risk mitigation strategies were also mentioned, such as supplier and customer management (*supplier management: We work closely with our suppliers to ensure that they also comply with GDP requirements and adhere to our quality standards. We conduct regular qualifications of our suppliers to ensure that they are meeting our requirements and address any*

issues that may arise), (*each supplier company that we are working with must have certificates of good distribution practice. Basically, we must comply, and our suppliers must comply this practice*), (*we check the customer's solvency. If there is a shortage of money, it is possible to make postponements with buyers*), (*maintain a close relationship with our clients and carry out regular assessments to ensure they meet our solvency guarantees and avoid insolvency risk*), compliance management (*regulatory compliance: We maintain strict compliance with all relevant regulations and standards, including GDP requirements, to ensure that our products are safe and meet all necessary quality standards*), as well as communication (*determining and assessing the impact of a disruption or accident, communication with suppliers, customers and other interested parties, implementation of alternative supply strategies, inventory level and logistics management, constant monitoring of the situation and adjusting any plans if necessary*). Based on the answers given by respondents, it could be said that the biggest attention is concentrated towards inventory management and logistics management, as these are the most frequent risks that the company is facing.

The last step in SCRM is the risk monitoring. In SC process management, risk monitoring is the continual process of discovering, evaluating, and responding to any risks that might have an impact on the effectiveness, quality, and delivery of goods and services along the SC. In order to maintain the SC's resilience and adaptability to new and emerging risks, it is crucial to regularly monitor and assess risk management measures that have been implemented in place and make necessary modifications accordingly. Based on the theoretical framework, the main goal of analysis is to figure out what management systems and tools for risk monitoring the company is using.

Since risk monitoring strategies were the most mentioned among all the respondents, and the number of coded segments is quite big to be analyzed together, each interview will be presented individually, and the results will be discussed below after the analysis of all four interviws.

Table 14. Risk monitoring strategies from supply chain manager‘s perspective (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	**Category**	**Subcategory**	**Coded Quotes**
Supply Chain Manager	Supply chain management	Risk monitoring	“Order fulfillment is also monitored, and suppliers are communicated with regarding possible supply disruptions.”
			“Company also monitors service level of the supplier, delivery time, expiry date.”
			“RELEX, a flexible inventory planning and management platform, is currently being implemented.”
			“<…>we have implemented stricter supplier monitoring and management practices, including regular performance reviews and audits, to ensure that suppliers meet our expectations and reduce potential risks.”

Aafter analyzing the first interview, it can be said that from the perspective of the first respondent, the emphasis is currently on the newly implemented risk monitoring data management system - RELEX. (*RELEX, a flexible inventory planning and management platform, is currently being implemented*). RELEX is a market-leading SC and retail planning software that aids wholesale and

distribution businesses in streamlining their planning, predicting demand in every channel, and meeting that need with the highest quality of customer service and the most effective use of inventory, capacity, and labor. As for creating capabilities and early-warning management processes, it was mentioned that order fulfillment is monitored and suppliers are being communicated regarding possible disruptions, as well as service level monitoring and the implementation of strictier supplier monitoring and management practices, like regular performance reviews and audits (*we have implemented stricter supplier monitoring and management practices, including regular performance reviews and audits, to ensure that suppliers meet our expectations and reduce potential risks*) (Table 14).

Table 15. Risk monitoring strategies from risk manager‘s perspective (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	Category	Subcategory	Coded Quotes
Risk Manager	Supply chain management	Risk monitoring	“We have established quality management systems that comply with GDP requirements and enable us to track and monitor the quality of our products throughout the supply chain.”
			“We use Inventory days on stock (DOS) and Service level (stock accuracy) to ensure that we maintain appropriate inventory levels and minimize the risk of stockouts or excess inventory.”
			“We have established detailed business continuity plans that outline the steps we will take to maintain our operations in the event of a disruption. These plans cover a range of scenarios, from natural disasters to equipment failures, and include protocols for communication, decision-making, and recovery.”
			“We have a crisis management team that is responsible for overseeing our response to emergencies and ensuring that our plans are executed effectively. This team is comprised of key stakeholders from across our organization and is trained to respond quickly and effectively to unexpected events.”
			“We regularly test and train employees, if there are no crisis or other disasters, during last 3 years company have a real crisis management in relation with COVID-19 situation and UA war.”
			“Enterprise resource planning (ERP) system: Our ERP system allows us to track inventory level and manage logistics and transportation. By integrating these functions into a single platform, we can quickly identify potential risks and take proactive measures to mitigate them.”
			“Our QMS is designed to ensure that our operations comply with GDP requirements and other quality standards. This system includes processes for tracking and reporting quality-related incidents, as well as tools for managing corrective and preventive actions.”
			“We use data analytics tools to identify trends and patterns in our supply chain data, allowing us to proactively identify potential risks and take corrective action before they escalate.”

			"We use supply chain visibility platforms to track the movement of goods across our supply chain, allowing us to quickly identify any disruptions or delays and take appropriate action."

The second interview provided more tools and systems that company is using in order to monitor their risk (Table 15). The respondent mentioned quality management systems (*we have established quality management systems that comply with GDP requirements and enable us to track and monitor the quality of our products throughout the supply chain*), (*our QMS is designed to ensure that our operations comply with GDP requirements and other quality standards. This system includes processes for tracking and reporting quality-related incidents, as well as tools for managing corrective and preventive actions*), inventory management systems (*we use Inventory Days on Stock (DOS) and Service level (stock accuracy) to ensure that we maintain appropriate inventory levels and minimize the risk of stockouts or excess inventory*), (*Enterprise resource planning (ERP) system: Our ERP system allows us to track inventory level and manage logistics and transportation. By integrating these functions into a single platform, we can quickly identify potential risks and take proactive measures to mitigate them*), as well as pattern spotting systems such as data analytics tools and SC visibility platforms to identify patterns, identify disruptions and take actions (*we use data analytics tools to identify trends and patterns in our supply chain data, allowing us to proactively identify potential risks and take corrective action before they escalate*), (*we use supply chain visibility platforms to track the movement of goods across our supply chain, allowing us to quickly identify any disruptions or delays and take appropriate action*).

Table 16. Risk monitoring strategies from logistics manager's perspective (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	**Category**	**Subcategory**	**Coded Quotes**
Logistics Manager	Supply chain management	Risk monitoring	"We monitor service level of the supplier. How do they deliver on time, check, or fulfill the goods according to the quantity. The supplier's non-conformities, defects, excesses, shortages are measured."
			"We also monitor supplier performance over time using data such as delivery time, product quality."
			"We sometimes provide early warning to suppliers and other stakeholders about potential disruptions. This includes sharing information about transportation disruptions, or other factors that may affect operations."
			"<…>status updates with information on transportation status, inventory levels, and any changes to delivery schedules."
			"<…> arisis management team (established during covid and current war situation), they have communication with suppliers and other stakeholders and are ready to provide timely updates."
			"The right tools for planning and monitoring our stock balance allows us to action proactively prior to issue arise. Tools such as build excel sheets, BI reports, more advance will be in the future such as Relex."

			"<…> continuous improvement, to regularly review and update contingency plans and performance indicators."
			"We use data analytics tools to identify trends and patterns in our supply chain data, allowing us to proactively identify potential risks and take corrective action before they escalate."
			"<…> by regularly reviewing and updating strategies based on new information and stakeholder feedback."

From logistic's perspective the answers about risk monitoring were given in more general way, only mentioning a few risk monitoring systems and tools (Table 16). The logistic's part of SC is following the risks by monitoring service level and performance of supplier (*we monitor service level of the supplier. How do they deliver on time, check, or fulfill the goods according to the quantity. The supplier's non-conformities, defects, excesses, shortages are measured*), (*we also monitor supplier performance over time using data such as delivery time, product quality*), sharing the status updates with information on transportation, inventory levels, and changes in delivery schedules, regularly reviewing and updating strategies and continuously improving. The methods that were mentioned included risk management team establishment (*arisis management team (established during covid and current war situation), they have communication with suppliers and other stakeholders and are ready to provide timely updates*), as well as tools, like excel, BI reports and the already mentioned RELEX, for planning and monitoring stock balance (*the right tools for planning and monitoring our stock balance allows us to action proactively prior to issue arise. Tools such as build excel sheets, BI reports, more advance will be in the future such as Relex*). For spotting patterns, the company, as already mentioned in the analysis of previous interview, is using data analytics tools (*we use data analytics tools to identify trends and patterns in our supply chain data, allowing us to proactively identify potential risks and take corrective action before they escalate*).

Table 17. Risk monitoring strategies from finance manager's perspective (created by the author of this thesis using MAXQDA tool, 2023).

Position of a Person	**Category**	**Subcategory**	**Coded Quotes**
Finance Manager	Supply chain management	Risk monitoring	"<…> monitor economic, political and environmental factors that may affect our supply chain and take steps to mitigate these risks before they become significant issues."
			"In order to ensure that our suppliers effectively manage their supply chain risks, we use peer-to-peer leverage."
			"We adapt our communication method to the specific needs and preferences of each stakeholder, depending on the issue."
			"We use several tools such as risk management softwires to identify, assess and manage supply chain risk. It allows to track and analyze risk data, monitor supplier performance and implement risk mitigation strategies."

			"We also use supplier portals to communicate with our suppliers and give them access to important information such as performance metrics, compliance requirements and contract terms."
			"To guarantee that suppliers and customers fulfill our standards and reduce possible risks, the company has put in place tougher supplier monitoring and management methods."
			"We monitor how the clients are doing, so that they do not become insolvent, to take preventive measures in time. For example, to change the prepayment so that there is no unpaid debt."

As it is visible in the Table 17, the finance manager also gave more of a general view of SC risk monitoring, rather than specific systems or tools. However, few tools were still mentioned, such as management softwires (*we use several tools such as risk management softwires to identify, assess and manage supply chain risk. It allows to track and analyze risk data, monitor supplier performance and implement risk mitigation strategies*), supplier portals (*we also use supplier portals to communicate with our suppliers and give them access to important information such as performance metrics, compliance requirements and contract terms*) and peer-to-peer (P2P) system (*in order to ensure that our suppliers effectively manage their supply chain risks, we use peer-to-peer leverage*). Other risk monitoring strategies include the monitoring of economic, political and environmental factors, adaptation of communication depending on the issue, tougher supplier monitoring and management, as well as client monitoring.

To conclude all four interviews, respondents mentioned vaious strategies to monitor SC risks. These include implementing systems and tools such as RELEX, quality management systems, inventory management systems, data analytics tools, and SC visibility platforms. Regular monitoring of service levels, supplier performance, and inventory levels, as well as using a risk management team, peer-to-peer leverage, and supplier portals, were also mentioned. Other strategies mentioned include monitoring economic, political, and environmental factors, adapting communication depending on the issue, and continually improving supplier monitoring and management practices. Overall, respondents emphasized the importance of proactively identifying potential risks and taking corrective action before risks escalate.

4.2. Results Based on the Analysis

While analyzing the interviews conducted with representatives of a wholesale distribution company "Tamro", there were a total of 8 subcategories of risks identified to be interfering with this company's SC's efficient operation. Successful and deliberate SCRM, according to El Baz and Ruel (2021), begins with four interconnected processes: risk identification, risk assessment, risk mitigation, and risk monitoring.

Based on these assertions, an analysis of results will be conducted using the framework created by the author of this thesis with the aid of theoretical results, in order to give corporate insights on deliberate SCRM. All risk management strategies are represented in the theoretical framework, categorized into each risk management process, to provide a clearer view (Fig. 16).

To conclude all the interviews from risk side, ineffective warehouse and logistics management, which is essential to the performance of a wholesale distribution company's SC, was the risk that respondents

mentioned most frequently. The correct items are delivered to the right locations at the right times thanks to the efficient functioning of the logistics and warehousing systems, so delays, stockouts, or mistakes made throughout this procedure have an impact on the whole SC and result in lost revenue.

Closely to warehousing connected risk is order calculation. This risk was the second most often identified risk by all the representatives of the company. This procedure is essential for figuring out how much inventory must be bought and when, ensuring that there are goods on hand to satisfy client demand. All the errors or mistakes in this procedure directly affects the company's SC by causing product shortages, delays, and lost revenues.

Besides these risks, SC can be greatly impacted by rapid fluctuations in demand, which was another most often identified risk. Unexpected demand increases may make it difficult for the SC to keep up, which might result in stock shortages, delayed delivery, and dissatisfied consumers. On the other side, the SC can be left with extra inventory that has to be disposed of or repurposed if demand suddenly decreases.

The fourth most frequent risk was determined to be market volatility. When demand exceeds supply, these fluctuations can have both positive and negative effects on SCM, affecting sales revenue and causing SC disruptions, as for the fifth most often identified risk, it was poor quality. Quality issues with the products or services produced by the SC results in product recalls, dissatisfied consumers, and reputational harm to the business.

All the espondents also noted regulatory concerns, liquidity issues, and credit risks, however these were less often stated. The management of credit and liquidity issues, which have an impact on the whole SC, falls within the purview of the finance department. Regulatory risks, on the other hand, refer to the potential for adverse effects on the business, finances, or reputation of the organization from changes to laws, regulations, or policies. Even if they are less frequent, these risks are also in need to be considered and have backup measures in place in case they materialize.

In conclusion to all the risks, the company pays a lot of attention on resolving the most frequently identified ones, such as poor warehouse and logistics management, difficulties with order calculation, and unforeseen changes in demand. However, to make sure that the SC is robust and can react to changing conditions, company should also be ready to manage less typical risks, such as credit and liquidity risks and regulatory risks.

The four interviews conducted by representatives of the same company offer insightful information on the risks the business faces in its SC and the steps it has taken to reduce those risks. All respondents underlined the value of risk management and the use of technology in reducing SC risks, despite differences in roles and responsibilities.

According to the theoretical framework above in theoretical analysis part (Figure 9), risk management methods and strategies are presented in the same framework format, with each method being assigned to a specific risk management process (Fig. 16).

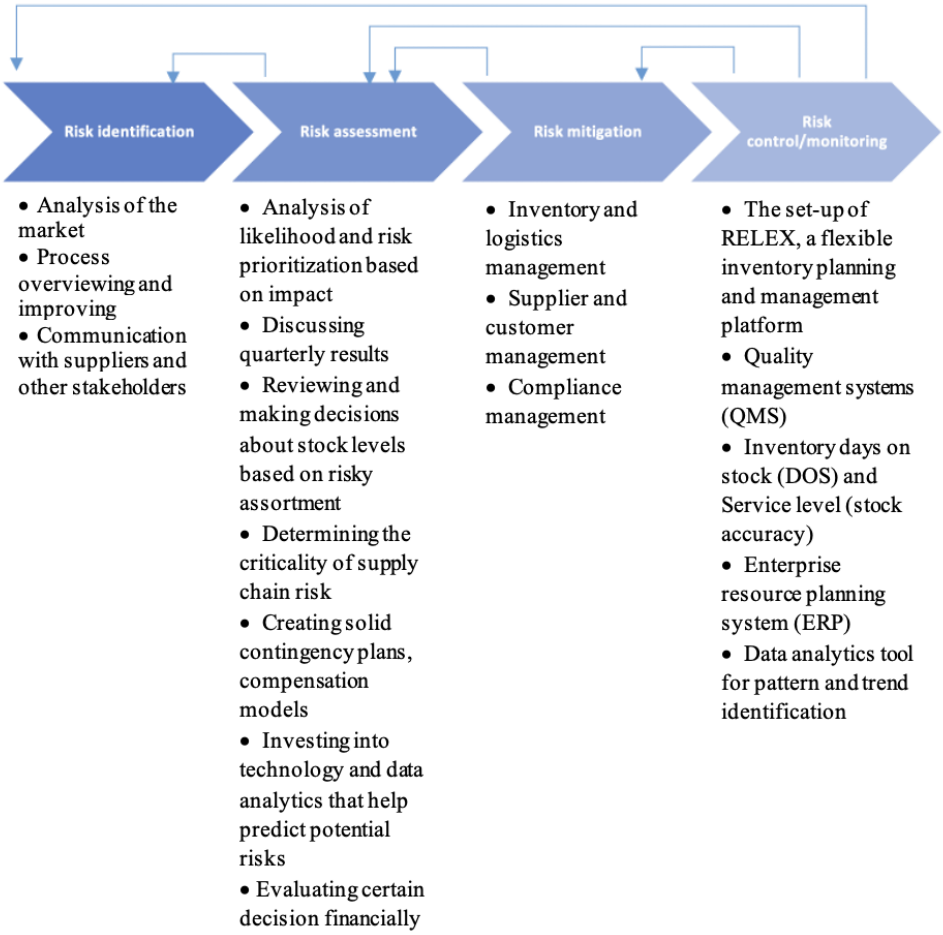

Fig. 16. SCRM in company "Tamro" based on theoretical framework (created by the author of this thesis, 2023).

Risk management methods are shown in the table below (Table 18) for each risk management step adopted in the framework, based on the study of this case and its findings.

Table 18. SC process risk management in company "Tamro" (created by the author of this thesis, 2023)

Risk management step	**Methods used**
Risk identification	Analysis of the market.
	Process overviewing and improving.
	Communication with suppliers and other stakeholders.
Risk assessment	Analysis of likelihood and risk prioritization based on impact.
	Discussing quarterly results.
	Reviewing and making decisions about stock levels based on risky assortment.
	Determining the criticality of SC risk.
	Creating solid contingency plans, compensation models.
	Investing into technology and data analytics that help predict potential risks.

	Evaluating certain decision financially.
Risk mitigation	Inventory and logistics management.
	Supplier and customer management.
	Compliance management.
Risk monitoring	The set-up of RELEX, a flexible inventory planning and management platform.
	Quality management systems (QMS).
	Inventory days on stock (DOS) and Service level (stock accuracy).
	Enterprise resource planning system (ERP).
	Data analytics tool for pattern and trend identification.

As it is visible in the table (Table 18), most of the SCRM methods include risk assessment and risk monitoring strategies. However, effective risk assessment and mitigation methods are also essential for any business, being especially important in the healthcare sector where the stakes are so high.

After the interviews it is quite obvious that the representatives of this company understand the importance of identifying and mitigating risks, and had implemented various measures regarding this matter. Some of the mentioned identification measures include analysis of the market, which involves keeping a close eye on changes in the industry. By staying informed, the company identifies potential risks and vulnerabilities early on and take proactive measures to address them. Regular communication with suppliers and stakeholders is another crucial strategy. Maintaining good communication helps to better understand suppliers' and other stakeholders' perspectives on possible risks by collaborating on risk mitigation methods. This makes it easier to make sure that the SC is safe and that any possible concerns are found and immediately handled. Additionally, company places a lot of emphasis on process overview and improvement while watching out for any rises in risk. The company finds areas where operations may be simplified and expenses can be decreased without compromising quality or raising risk by continuously assessing and optimizing procedures.

Talking about risk assessment, prioritizing risks based on their likelihood and possible effects on operations and clients is one of the primary tactics that respondents mentioned. With this strategy, the company concentrates on the most important risks and takes preventative actions to address them. Another important approach is the quarterly discussion with suppliers, where future trends and risks are discussed, and appropriate actions are taken. This enables the company to collaborate with suppliers and identify potential risks early on, reducing the impact on operations and customers. Additionally, the business regularly assesses risky assortment and decides on stock levels based on this evaluation. By preventing excess of the company's goods, this lowers the possibility of losses. To ensure that suppliers are held responsible for upholding the company's quality standards, compensation models are planned. The possibility of low-quality or non-compliant items entering the SC is reduced thanks to this strategy. To make sure that actions don't put supply at danger, the company carefully assesses them financially. This strategy makes sure that the company is not sacrificing the performance and stability of the SC in the sake of efficiency. Additionally, company keeps close constant contact and cooperation with suppliers, logistics partners, and regulatory bodies to keep a track of any modifications or advancements that may have an impact on the SC and take

preventative action to deal with any problems. In order to anticipate and reduce possible risks, company also makes investments in technology and data analytics. With this strategy, it is possible to spot hazards before they materialize and take preventative action to mitigate them.

Regarding risk mitigation process, “Tamro” company has implemented various risk management strategies to mitigate potential risks and maintain a manageable level of risk. The most commonly mentioned strategy in all interviews was inventory and logistics management. This includes implementing a smart demand planning tools, monitoring inventory levels closely, increasing stock levels in the warehouse for anticipated supply disruptions, demand forecasting, inventory level monitoring, warehouse operations optimization, and alternative transportation routes. Supplier and customer management were also mentioned as risk mitigation strategies, which involve working closely with suppliers to ensure compliance with GDP requirements, conducting regular qualifications of suppliers, and maintaining a close relationship with clients to avoid insolvency risk. Compliance management is also a significant aspect, which includes maintaining strict compliance with all relevant regulations and standards, including the already mentioned GDP. Overall, the company's risk management strategies aim to lower the risks to a manageable level, with a focus on inventory and logistics management, supplier and customer management, compliance management and security measures.

Lastly, for risk monitoring, the company has many different platforms and tools in action to monitor each arising risk. For inventory planning and management, the new RELEX platform is being currently implemented with a huge potential and expectations to assist company with risk monitoring in the future. Quality management systems (QMS) act as a help to track and monitor the quality of our products throughout the whole SC. Inventory days on stock (DOS) monitors inventory levels closely to ensure that company has the right products available at the right time. The ERP (enterprise resource planning) system implemented in one program allows company to track inventory level and manage logistics and transportation, as well as quickly identify potential risks and take proactive measures to mitigate them. For trend and pattern identification, company uses data analytics tools, allowing to proactively identify potential risks and take corrective actions before they escalate.

Recommendations. All the mentioned SCRM steps and strategies play a huge role in the day-to-day operations of “Tamro” company. And even if a company already implements quite useful tools, to improve SCRM even more company could consider investing in more sophisticated and intelligent SCRM technologies to improve the ability to identify, evaluate, and monitor risks. This could include exploring options like artificial intelligence, machine learning, and predictive analytics to assist potential threats. Another way to improve SCRM is to encourage employees to embrace innovation and to be receptive to fresh perspectives. Establishing a culture that values risk preparation and awareness could be very ebnefitial to the organization and would allow to respond rapidly to changing conditions and new hazards. This might also entail creating clear and precise plans to make sure that RM strategies are well-defined and communicated to all SC players. A common knowledge and dedication to RM may be cultivated by clearly defining the roles, responsibilities, and activities necessary to manage risks successfully.

As risk identification process had the least mentioned strategies during the interviews, the company could also conduct more detailed and comprehensive risk identification, taking into account interdependencies and prioritizing risks based on their likelihood and potential impact on operations and customers. Multi-criteria decision-making techniques such as data envelopment analysis (DEA),

fuzzy decision-making and analytic hierarchy process (AHP) could be used to improve the accuracy and efficiency of risk assessment.

However, after the analysis of the company “Tamro”, it is important to note that all the indentified methods that work for this company, will not necessarily work for the other. Some of the mentioned strategies may have a completely different impact regarding RM. Thus, recognizing risk identification, assessment, mitigation and monitoring plans and strategies is essential to lessen the probability of facing huge disruptive and operational risks in the future.

Conclusions

1. After analyzing the problem, it can be said that the perception and management of risks in everyday life depends on various factors, including the individuals involved, the activities they engage in, and the general external environment. The scale of day-to-day risks is different from the risks that arise in SC, so understanding and mitigation are critical. There are many different types of risk that can disrupt an SC, including operational risk arising from normal activities and processes, as well as disruption risk, which can cause widespread disruption and is often beyond the control of the organization. Natural disasters, political instability, transportation disruptions, cyber-attacks, sudden market changes, as well as recent disruption that have affected different industries in different ways – the COVID-19 pandemic – were all presented to illustrate potential sources of disruption. Risk management is essential in SC because it enables proactive planning, minimizing disruption, building resilience, making informed decisions, fostering collaboration, and ensuring compliance. However, not much research has been done in the healthcare wholesale distribution sector, especially considering the case study of a company such as Tamro, thus the need for this study to investigate SCR risks and their management methods in such a company arises.

2. The literature review highlighted the main findings of the SCRM literature review. Various strategies and techniques have been identified to effectively manage risk in the SC. The literature emphasizes four main SCRM processes: risk identification, risk assessment, risk mitigation, and risk control/monitoring. Theoretical studies have also highlighted important methods for identifying, assessing, mitigating, and monitoring SCR. These techniques included capacity management, collaboration with independent suppliers, responsive market strategies, inventory management, flexibility, demand aggregation and operational improvements. Implementing these techniques can increase efficiency, profitability, customer loyalty and satisfaction. Based on the significance of these methods and processes, a theoretical framework was developed. The framework outlined four key steps for successful risk management: risk identification, risk assessment, risk mitigation and risk monitoring/control. Risk identification involves gathering information and understanding the situation, while risk assessment prioritizes risks based on likelihood and importance. Risk mitigation includes the implementation of risk mitigation strategies and tasks, while risk monitoring/control includes the use of measures to address deficiencies in the risk management plan. If the risk management process is not working effectively, the previous steps should be revisited and revised until the risk is reduced to a manageable level. Continuous monitoring ensures that the risk management system is functioning properly.

3. The empirical research methodology was developed. Semi-structured individual interviews with four representatives of company “Tamro” were used in the case study research to get in-depth data on the risks that the company "Tamro" is experiencing and the strategies it employs to manage them. The research's findings might not be relevant to other institutions or nations due to the particulars of the case, the technique chosen, and the sample size. Interviews were performed on the basis of confidentiality guidelines.

4. The resulfs of the empirical part were analysed.

1) The interviews conducted with representatives of the wholesale distribution company "Tamro" has provided valuable insights into the risks faced by the company's SC. Total of 8 risks were identified: ineffective warehouse and logistics management, order calculation errors, rapid fluctuations in demand, market volatility, and poor quality. The company has recognized these risks as critical and has developed specific risk management methods and strategies to address them.

2) In terms of RM, analysis was based on the theoretical framework, analysing identification, assessment, mitigation and monitoring strategies that the company is using. For identification, the company relies on market analysis, process overview, communication with suppliers and stakeholders, and continuous improvement efforts to identify potential risks early on. Regular communication with suppliers and stakeholders helps in understanding their perspectives on risks and collaborating on mitigation methods. For risk assessment, the company prioritizes risks based on likelihood and potential impact, engages in quarterly discussions with suppliers to identify future trends and risks, and evaluates decisions financially to ensure they do not compromise the performance and stability of the SC. To mitigate risks, "Tamro" has implemented various strategies such as inventory and logistics management, supplier and customer management, and compliance management. These strategies involve smart demand planning, close monitoring of inventory levels, maintaining strong relationships with suppliers and customers, and strict compliance with regulations and standards. In terms of risk monitoring, the company utilizes tools and platforms such as the RELEX inventory planning and management platform, quality management systems, enterprise resource planning systems, and data analytics tools. These technologies help in monitoring inventory levels, tracking product quality, identifying trends and patterns, and taking proactive measures to mitigate potential risks.

3) To provide recommendations and solutions on enhancing SCRM, offers as investing in advanced technologies, fostering a culture of innovation, creating clear plans and responsibilities, and tailoring risk management strategies to their specific context were suggested, based on theoretical framework and literature analysis.

By continuously improving risk management practices, organization can strengthen its ability to mitigate and respond to potential disruptions, safeguarding their SC and ensuring smooth operations.

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