



Vaasan yliopisto
UNIVERSITY OF VAASA

Jenni Ala-Lipasti

Strategic Supply Chain Risk Management in Finland's Forestry Industry in Response to the Russia-Ukraine War

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UNIVERSITY OF VAASA**School of Innovation and Technology****Author:** Jenni Ala-Lipasti**Title of the thesis:** Strategic Supply Chain Risk Management in Finland's Forestry Industry in Response to the Russia-Ukraine War**Degree:** Master of Science in Economics and Business Administration**Degree Programme:** Industrial management**Supervisor:** Petri Helo**Year:** 2026 **Pages:** 64

ABSTRACT:

Supply chain management (SCM) refers to the actions used to manage the supply chain from inside the company. It focuses on how materials move through the global supply chain to support efficient production. Both, supply chain management and global supply chain management (GSC), aim to improve the efficiency of global supply chain.

Future consequences of an activity that leads to uncertainty creates a risk. Risks are something that can lead away from optimal path and ideal results. Geopolitical risk refers to potential threat that can disrupt the normal harmony of international relations. Geopolitical risks are caused by events such as terrorism, political tensions and wars. This thesis examines how the Russia-Ukraine war has affected Finnish forestry companies and how efficient supply chain management can help to mitigate the effects of the risk. The companies selected for observation are UPM and Metsä Group.

The Russia-Ukraine war increased energy prices significantly since Russia is one of the largest energy producers in the world. High energy prices increased pulp prices and production costs for UPM and Metsä Group. Due to sanctions imposed on Russia, UPM and Metsä Group had to shift their wood procurement to alternative sources, shut down mills, and reduce production in order to match the current market situation.

This thesis analyses pulp and energy prices during the years of 2021 to 2024. This shows how the geopolitical risk affected production costs and if there is a correlation between energy and pulp price in comparison to the war starting. It was found that in 2021 before the Russia-Ukraine war started, both energy and pulp prices were lower. In 2022 both prices increased and pulp price was especially high in October 2022. A positive correlation was found between energy and pulp prices especially in 2021 and 2022, indicating that the war affected these prices causing production costs to increase significantly and disrupting supply chains.

The problems arising from geopolitical risk can be mitigated through efficient supply chain management. This can be achieved by successful supplier selection, reducing production temporarily to match the markets, and procuring raw materials from multiple sources.

KEYWORDS: geopolitical risk, risk management, war, supply chain management

Vaasan Yliopisto**School of Innovation and Technology****Tekijä:** Jenni Ala-Lipasti**Tutkielman nimi:** Strategic Supply Chain Risk Management in Finland's Forestry Industry in Response to the Russia-Ukraine War**Tutkinto:** Kauppatieteiden maisteri**Opintosuunta:** Tuotantotalous**Työn ohjaaja:** Petri Helo**Vuosi:** 2026 **Sivumäärä:** 64

Toimitusketjun hallinta tarkoittaa toimia, joilla toimitusketjua hallitaan yrityksen sisällä. Se keskittyy siihen, miten materiaalit liikkuvat maailmanlaajuisessa toimitusketjussa tehokkaan tuotannon tukemiseksi. Sekä toimitusketjun hallinnan että globaalin toimitusketjun hallinnan tavoitteena on parantaa globaalin toimitusketjun tehokkuutta.

Epävarmuutta aiheuttavat tapahtumat muodostavat riskin. Riskit voivat johtaa pois optimaaliselta polulta ja estää ihanteellisten tulosten saavuttamisen. Geopoliittisella riskillä tarkoitetaan mahdollista uhkaa, joka voi häiritä kansainvälisten suhteiden normaalia tasapainoa. Geopoliittisia riskejä aiheuttavat esimerkiksi terrorismi, poliittiset jännitteet ja sodat. Tässä opinnäytetyössä tarkastellaan, miten Venäjän ja Ukrainan välinen sota on vaikuttanut suomalaisiin metsäteollisuusyrityksiin ja miten tehokas toimitusketjun hallinta voi auttaa lieventämään riskin vaikutuksia. Tarkasteluun valitut yritykset ovat UPM ja Metsä Group.

Venäjän ja Ukrainan välinen sota nosti energian hintoja merkittävästi, koska Venäjä on yksi maailman suurimmista energiantuottajista. Energian korkeat hinnat nostivat sellun hintoja ja UPM:n sekä Metsä Groupin tuotantokustannuksia. Venäjälle asetettujen pakotteiden vuoksi UPM ja Metsä Group joutuivat siirtämään puun hankintansa vaihtoehtoihin lähteisiin, sulkemaan tehtaita ja vähentämään tuotantoa vastatakseen vallitsevaan markkinatilanteeseen.

Tässä opinnäytetyössä analysoidaan sellun ja energian hintoja vuosina 2021–2024. Tämän avulla tarkastellaan, miten geopoliittinen riski vaikutti tuotantokustannuksiin ja oliko energian ja sellun hintojen välillä yhteyttä sodan alkamiseen nähden. Tulokset osoittivat, että vuonna 2021, ennen Venäjän ja Ukrainan sodan alkamista, sekä energian että sellun hinnat olivat alhaisempia. Vuonna 2022 molempien hinnat nousivat ja sellun hinta oli erityisen korkea lokakuussa 2022. Energian ja sellun hintojen välillä havaittiin positiivinen korrelaatio erityisesti vuosina 2021 ja 2022. Tämä viittaa siihen, että sota vaikutti näihin hintoihin, mikä johti tuotantokustannusten merkittävään kasvuun ja toimitusketjujen häiriintymiseen.

Geopoliittisesta riskistä aiheutuvia ongelmia voidaan lieventää tehokkaan toimitusketjun hallinnan avulla. Tämä voidaan saavuttaa onnistuneella toimittajien valinnalla, tuotannon väliaikaisella vähentämisellä markkinatilanteen mukaisesti sekä hankkimalla raaka-aineita useista eri lähteistä.

KEYWORDS: geopoliittinen riski, riskienhallinta, sota, toimitusketjun hallinta

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Abbreviations

SCM = Supply Chain Management

NATO = North Atlantic Treaty Organization

JCPOA = Joint Comprehensive Plan of Action

IAEA = International Atomic Energy Agency

UNSN = United Nations Security Council

GSC = Global Supply Chain Management

LIHF = Low-Impact-High-Frequency

HILF = High-Impact-Low-Frequency

1 Introduction

The purpose of this research is to study how different forestry companies in Finland have managed to mitigate risks that Russia-Ukraine war has caused via strategic supply chain management. This thesis will be concentrating on UPM and Metsä Group. I will also study what risk management strategies these companies have adopted since the war started and how forestry companies can build resilient supply chains. Before the war, Finland's forestry companies sourced quite a lot of wood from Russia but that is no longer possible. This study aims to show how these companies have changed the sourcing of materials needed in their production process. This study also discusses how rising energy and pulp prices have affected companies' turnover and how these companies were able to manage the effects of this geopolitical risk.

1.1 Relevance

This research is relevant topic due to today's geopolitical situations. A large part of Finland's wood supply has been coming from Russia, but due to the war, it is no longer possible for Finnish companies to use Russian wood supply. This research also shows how sanctions are used today and if they have worked in previous cases. This study goes through sanctions that were imposed on Iran in order to restrict their nuclear program as an example of how geopolitical crises and sanctions effect on global supply chains.

1.2 Purpose of thesis

Research questions:

1. How did the Russia-Ukraine war affect Finnish forestry companies supply chains?
2. How can strategic supply chain management mitigate the effect of geopolitical risks?

1.3 Thesis structure

This thesis is divided into different sections that provide a comprehensive overview of the research topic, present the theoretical background, describe methodology, and analyse findings.

Chapter 1: Introduction gives an overview on what this thesis is about, what are the research questions and why this thesis is relevant.

Chapter 2: Literature review introduces the key concepts relevant to this thesis such as, geopolitical risk, sanctions, supply chain management and risk management. It provides the reader with the necessary background and understanding to follow the research.

Chapter 3: Research methodology describes the research methods used in this thesis and explains how the data was collected, analysed, and used.

Chapter 4: Findings present the results of the analysis and highlights the main findings of the study. It shows how the companies under observation have managed geopolitical risks. It summarizes the information on pulp and energy prices in relation to the revenue of the companies. This chapter also provides information on where the companies procured wood, after Russia-Ukraine war started.

Chapter 5: Conclusions bring together the key findings of the thesis and discusses potential areas for future research.

2 Literature review

This section covers what is supply chain management and what are the different supply chain management strategies that can help companies to mitigate risks. This literature review covers the advantages that companies gain from properly operating supply chains. It will use studies about different supply chain management methods and risk mitigation strategies in the supply chain. This literature review also goes through geopolitical risks and more precisely the Russia-Ukraine war. These topics are discussed so that reader can understand how supply chain management can help mitigating risks that are caused by geopolitical crises. Russia-Ukraine war is explained more in depth to make the timeline clear and to show how much impact the war has on supply chains and companies.

2.1 Russia-Ukraine war

The political Russia-Ukraine crisis began in 2014 in the end of the cold war when Russia annexed Crimea (Nguyen et al., 2022, p. 633). This increased unstable environment in the eastern region of Donbass. In 2021 the situation escalated due to Russia submitting a security proposal to the United States and the North Atlantic Treaty Organization (NATO). Russia demanded that NATO should return to the point in 1997 before it expanded to the east and admitted three Baltic Republics and the Eastern European countries to be part of NATO. Russia considered these countries to be a serious threat to its security and strategic interests (Nguyen et al., 2022, p. 633). Russia also demanded that NATO should not continue expanding to the east and that Ukraine is not to be a member of NATO (Nguyen et al., 2022, p. 633).

Russia received a response stating that Ukraine is a sovereign state that has the ability to apply to join NATO and other organisations that are aligned with its national interests (Nguyen et al., 2022). Large military forces were deployed to the border region of Ukraine in November 2021, and on February 2022, Russia started a war in Ukraine (Nguyen et al., 2022, p. 634). The bottlenecks that disrupted global supply chains in 2021 started to ease briefly, but the war and a blockade order in China to prevent the Covid-

19 pandemic from spreading further made them tighten again (Nguyen et al., 2022, p. 634).

2.2 Geopolitical risks

Geopolitical risk refers to potential threat that can disrupt the normal harmony of international relations (Gong & Xu, 2022). Geopolitical risks are caused by events such as terrorism, political tensions and wars (Gong & Xu, 2022). According to Gong and Xu (2022), geopolitical risks have become more common and are usually taking place in areas that possess large quantities of mineral and energy resources, and this can be seen with the latest Ukraine and Russia conflict. Since the conflict began, gold, silver, oil and gas prices have increased because of Russia being one of the top energy producers in the world (Gong & Xu, 2022).

2.3 Previous geopolitical risk and the effect of sanctions

This chapter will go over sanctions that were imposed on Iran with the aim of restricting its nuclear program. This case provides a previous example that helps to understand how broad economic sanctions can affect global supply chains, the procurement of raw materials, energy prices, and international trade. Based on this example, it is easier to analyse the effects of sanctions against Russia during the war and to assess whether sanctions have had positive effects in the past and whether they have succeeded in achieving their intended goals.

Different sanctions were imposed on Iran to force a change on its policies on developing its nuclear program (Isaac & Fouda, 2025, p. 4). Iran insisted that the program was only for peaceful purposes (Khajehpour et al., 2013, p. 82). The sanctions targeted Iran's vital economic sectors, such as banking and oil sectors, by restricting its possibilities to import and export different products (Isaac & Fouda, 2025, p. 4). The United States and European Union targeted specifically natural gas and oil sector, because it consisted 25% of

Iran's GDP, 80% of Iran's exchange earnings and 65% of its state budget revenues in 2008 and 2009 (Isaac & Fouda, 2025, p. 8).

This led to increased costs and dissatisfaction against the government of Iran (Isaac & Fouda, 2025, p. 4). Iran was prevented from getting materials needed to develop the nuclear program by restricting targeted trade and implementing military sanctions (Isaac & Fouda, 2025, p. 4). First sanctions to Iran were imposed in 1979 as a response to the hostage crisis in Iran when diplomats were held hostage in the United State embassy in Tehran for over a year (Khajehpour et al., 2013, p. 82).

The efficiency of sanctions set on Iran remained controversial from the beginning of the nuclear issue in August 2002 until January 2016 when the Joint Comprehensive Plan of Action (JCPOA) was implemented (Isaac & Fouda, 2025, p. 1). Some analysts say that these sanctions caused major pressure on Iran, so Iran adjusted its negotiation view with the goal of reaching a peaceful agreement (Isaac & Fouda, 2025, p. 1). Others however, see that these sanctions did not achieve intended results since leaders of Iran were not convinced that their goals would be met by abandoning their nuclear targets or policies (Isaac & Fouda, 2025, p. 1).

In 2003 Iran and E3 countries that include the UK, France and Germany, started diplomatic negotiations after a report was submitted by the International Atomic Energy Agency (IAEA) stating that Iran had not complied with its nuclear safety measure agreement (Isaac & Fouda, 2025, p. 2). E3 countries imposing these sanctions aimed to restrict Iran's ability to source essential materials and thus slow down progress in Iran's nuclear project (Isaac & Fouda, 2025, p. 4). This was intended to lead Iran to make concessions and to reach an agreement preventing it from obtaining fissile material for nuclear weapons as well as allowing International Atomic Energy Agency (IAEA) to perform regular inspections to Iran's facilities (Isaac & Fouda, 2025, p. 4). These sanctions would also signal that the international community does not believe that Iran has violated the nuclear non-proliferation obligation (Isaac & Fouda, 2025, p. 4). Another aims were to

improve Iran's respect for human rights and force it to quit funding and supporting militias in the Middle East and reduce its support for the government of Syria as well as restrict Iran's ability to produce cruise and ballistic missiles and other military gear (Isaac & Fouda, 2025, p. 4).

The E3 group was able to create a large alliance of nations opposing Iran's nuclear program (Isaac & Fouda, 2025, p. 5). Tensions caused by Iran's nuclear program increased prices due to supply disruptions (Isaac & Fouda, 2025, p. 6). The sanctions impacting Iran's finance and oil sectors cut Tehran's oil income approximately by 50 percent from 2011 to 2012 (Khajehpour et al., 2013, p. 84). Oil prices increased from 55.70 USD up to 120 USD during the years from 2008 to 2012 after Iranian government stated that all cooperation with the IAEA would come to an end (Isaac & Fouda, 2025, p. 6). The sanctions impacting Iran's finance and oil sectors cut Tehran's oil income approximately by 50 percent from 2011 to 2012 (Khajehpour et al., 2013, p. 84).

In order for Washington to increase its control over Tehran, it implemented multilateral and unilateral sanctions (Khajehpour et al., 2013, p. 82). In 2010 American president signed a law that increased sanctions against Iran (Khajehpour et al., 2013, p. 84). These sanctions include prohibiting the sale of services and equipment that could help Iran produce more gasoline and banning gasoline and other fuel sales to Iran (Khajehpour et al., 2013, p. 84). These sanctions decreased Iran's imports and created fuel shortages. Due to this, Iran produced gasoline domestically and caused its pollution levels to increase (Khajehpour et al., 2013, p. 84). The sanctions also increased Iran's unemployment rate and increased poverty rate to reach 8% (Isaac & Fouda, 2025, p. 7).

More sanctions were set that limited foreign banks from using the United States financial system if they handle oil transactions with the central bank of Iran (Khajehpour et al., 2013, p. 85). The president of the United States signed Iran Threat Reduction and Syria Human Rights Act that freeze the United States assets of insurers, lenders, and people that help Iran receive money from its oil sales or work with the National Iranian Tanker

Company and the National Iranian Oil Company (Khajehpour et al., 2013, p. 85). This agreement also prevents companies that work with Iran's energy sector from doing business in the U.S. market (Khajehpour et al., 2013, p. 85).

The European Union and the United States imposed strict sanctions after IAEA stated that Iran was expanding its nuclear program further (Isaac & Fouda, 2025, p. 5). Unilateral sanctions were used to create pressure on Tehran because China and Russia opposed the implementation of more sanctions created by United Nations Security Council (UNSN) (Isaac & Fouda, 2025, p. 5). These sanctions made it difficult for Iran to meet the increasing demand for natural gas globally and western companies did not want to be involved in this natural gas production anymore (Isaac & Fouda, 2025, p. 7). This also made banks to stop business with Iran, companies to remove investments from Iran, and many countries to drastically reduce their oil imports from Iran as well as restrict business affairs with Tehran (Isaac & Fouda, 2025, p. 9).

Sanctions implemented on Iran were a primary tool to increase the costs of their nuclear program so that it would be impossible for Tehran to continue its plans (Khajehpour et al., 2013, p. 85). A Change in Iran's nuclear program was expected to help bring Tehran back to negotiations and to make Tehran understand that negotiations would be the only way to end the pressure on Iran's priorities (Khajehpour et al., 2013, p. 86). The sanctions imposed by the European Union and the United States had a more severe effects on Iran than the multilateral sanctions imposed by United Nations Security Council (Isaac & Fouda, 2025, p. 9).

Multiple parties have stated that the sanctions had a major negative impact on the economy of Iran. However, Iran's economic decline is also blamed on mismanagement, corruption, subsidy reforms, and overall failed economic policies (Khajehpour et al., 2013, p. 87). Sanctions were able to put major pressure on Iranian economy but that did not stop Iran from proceeding its nuclear program completely (Khajehpour et al., 2013, p. 95 ; Isaac & Fouda, 2025, p. 12). Even though sanctions had negative effects, Iran did not

follow the UNSC resolutions and the IAEA rules concerning uranium enrichment (Isaac & Fouda, 2025, p. 12).

The Joint Comprehensive Plan of Action took effect in January 2016, after the director-general of IAEA reported that Iran took the required steps and carried out its commitments to execute this agreement (Isaac & Fouda, 2025, p. 2).

2.4 Sanctions

Economic and political sanctions as well as military penalties are used for multiple purposes (Haass, 1997, p. 1). These sanctions are aimed at states and other parties in order to change unacceptable political acts (Haass, 1997, p. 1). Sanctions can be used to prevent human rights violations, protect the environment, prevent the spread of missiles and weapons of mass destruction, stop support for terrorism, prevent drug trafficking, protect civilians, and to stop funding conflicts with criminal activities (Ronzitti, 2016, p. 10; Haass, 1997, p.1). Sanctions do not always mean that the target country has committed international misconduct (Ronzitti, 2016, p. 9). If a situation is a threat to peace, it is not stated that the country is responsible for committing a violation of international law. Rather, a political judgement is made (Ronzitti, 2016, p. 9).

Sanctions are motivated by political reasons, and they are not implemented for commercial reasons (Ronzitti, 2016, p. 10). Sanctions are bound by the limits of jus cogens norms (Ronzitti, 2016, p. 10). This practice means that some restrictions are created with consideration for human rights and humanitarian law and new sanctions have also been adapted accordingly (Ronzitti, 2016, p. 10). Conflicting constitutional law principles or principles of an international organization can prevent the implementation of sanctions (Ronzitti, 2016, p. 10).

Sanctions can be cutoffs of foreign assistance, boycotts, diplomatic relations withdrawal, import and export limitations, visa denials, weapon embargoes, asset freezes, increased tariffs, financial restrictions, interruption of sea, air, rail, postal, radio and telegraphic

communication, lower import quotas, interruption of economic relations, technology transfer bans, investment bans, and suspension or eviction from an organization to which a state or country belongs to (Haass, 1997, p. 1; Isaac & Fouda, 2025, p. 2; Ronzitti, 2016, p. 9-10).

According to Haass (1997), the increasing use of economic sanctions in promoting foreign policy goals is unfortunate. Sanctions are expensive, can be counterproductive and do not necessarily contribute to wanted foreign policy goals (Haass, 1997, p. 1). The costs compared to the benefits is one major determinant of sanctions effectiveness. Sanctions are seen more successful if the costs stay lower than in other alternative approaches and any sanction is unsuccessful if the costs are excessive (Isaac & Fouda, 2025, p. 3). According to Haass (1997), it is difficult to get international support for sanctions, since some governments favour minimal sanctions or do not support sanctions at all.

Sanctions appear to give balanced responses to challenges where the interests involved are less important hence these sanctions remain popular (Haass, 1997, p. 1). Sanctions also signal disapproval of a certain action and fulfil a political need to take action in order to support a norm, such as prevent weapons proliferation or support human rights (Haass, 1997, p. 2). Sanctions are a nonmilitary alternative, so they can be used to avoid resorting to war (Haass, 1997, p. 2). In right conditions, sanctions can help to reach many foreign policy targets, but on their own sanctions do not achieve desired results if the goal is too big or timeframe is too short (Haass, 1997, p. 2).

Preventative sanctions are implemented in order to prevent illegal act from happening and the purpose of a punitive sanction is to have a detrimental effect on the target in response to its political decisions, either through broad or targeted actions (Isaac & Fouda, 2025, p. 2). The use of sanctions is a way to demonstrate opposition to the target's policies to a broad audience (Isaac & Fouda, 2025, p. 2).

Despite the benefits, sanctions can also create unintended consequences (Haass, 1997, p. 3). A good example of this is Haiti where sanctions increased the island's economic troubles (Haass, 1997, p. 3). This led to a vast emigration of Haitians to the US. The emigration was life-threatening for the Haitians and disruptive as well as expensive for Florida (Haass, 1997, p. 3).

There have also been situations where sanctions were effective. After the Persian Gulf War, sanctions against Iraq increased Iraq to follow United Nations decisions to eliminate its mass destruction weapons (Haass, 1997, p. 3). The sanctions also decreased Iraq's possibilities to import weapons and other technology linked to that (Haass, 1997, p. 3). Haass (1997) states that these sanctions made Iraq significantly weaker economically and militarily.

Most sanctions affect the whole country (Haass, 1997, p. 3). The reason for this is that goods and funds can easily be relocated, and governments can take control of resources from others (Haass, 1997, p. 3). The problem with sanctions is that even though military and government can avoid the effects of them, sanctions usually affect the general population the most (Haass, 1997, p. 3). Even though sanctions are a powerful form of intervention, they also have moral and practical problems (Haass, 1997, p. 3). Sanctions cause innocent people to suffer and can lead to large-scale emigration, stronger administration, and slower emerge of civil society (Haass, 1997, p. 3).

Sanction should be implemented progressively. They should be temporary and lifted immediately after the political goal is reached (Ronzitti, 2016, p. 11). Economic sanctions should be used only after serious consideration and they should focus on those who are responsible for the unwanted action (Haass, 1997, p. 4). Limited sanctions would prevent risking other benefits and relationships (Haass, 1997, p. 4). This would make getting multinational support easier and decrease the collateral damage to innocents (Haass, 1997, p. 4). And when it comes to political sanctions, they should not break diplomatic connections (Haass, 1997, p. 4).

Innocents should not suffer more than is necessary and this is why humanitarian exemptions need to be included in any extensive sanctions (Haass, 1997, p. 5). It is also much easier to get support for sanctions allowing medicine and food supply (Haass, 1997, p. 5).

2.5 Supply chain

Supply chain affects company's production and business operations. It is also an important part of business development. When supply chain operates properly, the company will receive competitive advantage and establish a firm presence in both domestic and foreign markets and grow its possibility to expand even further (Nguyen et al., 2022, p. 635).

The supply chain must be aligned with the company goals and strategies. It needs to follow the markets, resources, and the company's strengths (Nguyen et al., 2022, p. 635). Before reaching the consumer, a product has to pass multiple processes that will transform raw materials into final product. These finished products will then be sent to distributors that transport them to retail locations (Nguyen et al., 2022, p. 635). These processes are all part of the supply chain and therefore, supply chains have a key role in delivering products and services to consumers efficiently (Nguyen et al., 2022, p. 635). When a company has steadily increasing profits and high product sales it means that it has a well operating supply chain (Nguyen et al., 2022, p. 635).

Effective supply chain includes well created products that are suitable for the target markets of the business (Nguyen et al., 2022, p. 635). Fast and efficient delivery is also a vital part of a good supply chain. Depending on company's position, it will have different choices of suppliers and customers (Nguyen et al., 2022, p. 635). Companies need to be able to share and receive information and adapt according to the changing markets (Nguyen et al., 2022, p. 635). Having an efficient supply chain requires companies to

react quickly to customer needs, market conditions and competitors (Nguyen et al., 2022, p. 635).

2.6 Supply chain management

Supply chain management (SCM) refers to the actions used to manage the supply chain from inside the company (Nguyen et al., 2022, p. 636). It focuses on how materials move through the global supply chain to support efficient production (Nguyen et al., 2022, p. 636). Both, supply chain management and global supply chain management (GSC), aim to improve the efficiency of global supply chain, but supply chain management focuses on products in the system and how efficiently they move through it (Nguyen et al., 2022, p. 636). Global supply chain management on the other hand focuses on the whole system and how companies interact with each other (Nguyen et al., 2022, p. 636).

2.6.1 Global supply chain management

The term global supply chain management has originated in the mid-2000s (Nguyen et al., 2022, p. 636). Its main goal is to make supply chains work more efficiently. Global supply chain management refers to the rules, structures and institutions that are used to guide, manage, lead and control supply chains through different regulations across countries (Nguyen et al., 2022, p. 636). Operating systems in the global supply chain are created by different actors, such as individual companies and international organisations (Nguyen et al., 2022, p. 636). International finance and globalization have expanded global supply chain processes and created a need for a management system that is able to guide global supply chains to work more efficiently (Nguyen et al., 2022, p. 636).

A global supply chain is a process where raw material is transformed into a final product across different countries and the products and services are delivered from producers to consumers (Nguyen et al., 2022, p. 636).

2.7 Supplier selection

Supplier selection process is done when a buyer needs to identify, evaluate and eventually establish a contract with a new supplier (Beil, 2011, p. 1). In order to avoid suppliers that do not perform on a required level, companies take proactive measures to make sure that the supplier is qualified before making a contract with them (Beil, 2011, p. 3). This reduces the chances of non-delivery, late delivery, or delivery of faulty goods (Beil, 2011, p. 3). Secondary objective is to make sure that the supplier will be reliable partner in business (Beil, 2011, p. 3).

2.7.1 Identifying suppliers

The first step is to identify potential suppliers (Beil, 2011, p. 1). Since the global economy is very competitive, it is important for companies to not only strengthen their relationship between existing supplier but to also find new suppliers (Beil, 2011, p. 2). New suppliers are important because they can be significantly better than the suppliers that the company already has (Beil, 2011, p. 2). New suppliers may, for example have more advanced production technology that enables cost reductions, or they may have lower costs than existing suppliers due to better trade regulations and inexpensive labour in their country (Beil, 2011, p. 2). It is also important to take into consideration that existing suppliers can increase their costs or even go out of business (Beil, 2011, p. 2). Having multiple suppliers can help company to meet their business targets, decrease the risk of supply disruption, and it is good for the competition (Beil, 2011, p. 2).

It is difficult to find a new qualified supplier since they need to be able to meet all of the buyer's requirements and if a supplier does not perform at the required level, it can cause serious consequences for the buyer (Beil, 2011, p. 2). Production delays caused by product recalls and part shortages from unreliable suppliers can cost buyer companies millions of dollars through warranty costs, inventory adjustments, and recalls, as well as harm the company's reputation and have a negative effect on future sales (Beil, 2011, p.

2). After potential suppliers are identified, suppliers are formally requested to share more information about the goods and services that they provide (Beil, 2011, p. 4).

2.7.2 Supplier evaluation

Second step is to evaluate the suppliers (Beil, 2011, p. 1). This begins when the buyer formally requests information from supplier and supplier provides offers for the contract. These offers include information about lead time, price, and quality (Beil, 2011, p. 1). In supplier evaluation, the buyer ranks potential suppliers based on their suitability and chooses which supplier will be awarded a contract (Beil, 2011, p. 6). After this, the buyer can monitor the supplier's performance and utilize this information with future selection processes (Beil, 2011, p. 6).

Most common supplier evaluation dimensions are quality, price, and delivery (Beil, 2011, p. 7). Other commonly used dimensions are technical support and capabilities, financial status, production flexibility and capacity, information systems, and innovations (Beil, 2011, p. 7). Other dimensions also include personnel training, terrorism risk, social and environmental responsibility, quality systems, performance history, reputation, labour relations record, handling ability and packaging, geological location, claim policies and warranties, and strategic fit (Beil, 2011, p. 7). After the suitable dimensions are identified, the ability to rank suppliers is essential for making an informed selection decision. This becomes easy when suppliers differ in only one factor, such as price (Beil, 2011, p. 7). However, when bids have to be evaluated across several dimensions, ranking becomes more complex (Beil, 2011, p. 7).

Supplier qualification screening includes reference checks and financial status checks. Reference check means that the buyer contacts previous customer to find out if the supplier's delivery performance was good and if there were any problems that needed to be solved (Beil, 2011, p. 3). Financial status checks means that the buyer determines the supplier's financial state and viability by using published supplier ratings (Beil, 2011, p.

3). This way the buyer can see if the supplier has, for example, substantial debt (Beil, 2011, p. 3).

The buyer also must take into consideration the supplier's surge capacity availability which means how capable the supplier is to increase delivery quantities when needed even within short lead times (Beil, 2011, p. 3). This becomes important if the buyer company is not completely sure about their quantity needs during the contract (Beil, 2011, p. 3). The uncertainty of quantity needs is common when the contract is during a long period of time, and the demand of the buyer's product is tied to unexpected market events (Beil, 2011, p. 3).

The buyer can also require certifications from the supplier showing that supplier follows correct procedures, documentation, policies, and trainings that ensure devotion to high quality and standards (Beil, 2011, p. 3). To make sure that the supplier is reliable, the buyer might need to investigate the supplier's organization on a deeper level (Beil, 2011, p. 3). Some ways a buyer can verify that a supplier is suitable include sample requests of a product and visits at the supplier's production site to make sure that employees and production follow the buyer's requirements (Beil, 2011, p. 3). So, supplier qualification processes require time and financial resources (Beil, 2011, p. 4).

2.7.3 Choosing a supplier

Lastly, the buyer chooses a supplier or multiple suppliers that they want to make a contract with (Beil, 2011, p. 1). Once the buyer has chosen a way to evaluate suppliers, it can start the contract award process and a final suppliers are chosen (Beil, 2011, p. 7). If the suppliers are too similar, the buyer might only choose one if the work is best done by a single supplier and to cut costs (Beil, 2011, p. 7). The buyer can also use multiple-award contracting if it is needed to diversify the supply sources to decrease the chance of disruption risks (Beil, 2011, p. 8). Multi-sourcing also prevents suppliers from becoming a monopolist (Beil, 2011, p. 8). When a buyer faces a monopoly supplier, it cannot benefit from competition (Beil, 2011, p. 8). The buyer should also take into consideration

that when suppliers are located in the same region, the buyer is exposed to cost risks, such as increases in transportation costs between the supplier region and the buyer's location, for example, due to a port strike (Beil, 2011, p. 11). Selecting suppliers from different regions can reduce these risks by not depending on a single area (Beil, 2011, p. 11).

The supplier selection process concludes with a contract between the buyer and selected supplier or suppliers (Beil, 2011, p. 5). At this stage, the information received from the suppliers is converted into formal contract terms before the agreement is finalized (Beil, 2011, p. 5). The contract specifies what is expected from the supplier and how they will be paid (Beil, 2011, p. 5). When choosing a supplier, the buyer considers both the supplier's qualifications and the contract terms (Beil, 2011, p. 5). Qualifications, such as reputation, is based on past performance and cannot be changed quickly. However, contract terms can be negotiated between the buyer and the supplier (Beil, 2011, p. 5). After the contract is made, buyer usually monitors supplier's performance throughout the duration of the contract because it supports cost containment and quality (Beil, 2011, p. 8). This also helps buyer to make informed decisions in the future regarding supplier selection (Beil, 2011, p. 8).

2.8 Definition of a risk

Future consequences of an activity that leads to uncertainty creates a risk (Aven, 2015, p. 13). Risk means that the activity leads to consequences and these consequences are uncertain (Aven, 2015, p. 13). Risks are caused by uncertain events and are something that can lead away from optimal path and ideal results (Manuj & Mentzer, 2008b). Two risk components are: potential losses including the magnitude of these losses, and the possibility of an occurrence that would end up with losses (Manuj & Mentzer, 2008b). When it comes to the speed of a risk, there are three points to take into consideration: how quickly the risky event occurs, how soon the risk is detected, and how fast losses happen (Manuj & Mentzer, 2008b). When speed is combined with supply chains

decreased control, longer lead time, and increased distance from the source of the risk, problems increase (Manuj & Mentzer, 2008b).

Supply chain risks can lead to decrease in profitability, sales and asset utilisation by damaging the firm's financial performance (Hendricks & Singhal, 2005). Risks and disruptions lead to lower operational performance as well as lower supply chain performance and companies that face supply chain risks usually experience poor supplier quality, late deliveries and imbalance between demand and supply (Hendricks & Singhal, 2005; Wagner & Neshat, 2012) .

2.9 Vulnerability

Vulnerability is closely related to risks (Aven, 2015, p. 19). It basically is a risk that happens if a hazard or threat occurs (Aven, 2015, p. 19). Aven (2015) compares vulnerability to a human catching an illness. If a person gets sick, so a hazard occurs, the consequences will depend on the vulnerability of that person (Aven, 2015, p. 19). If the person is young and in a good shape physically, the vulnerability is low. However, if the person is old and already in a weakened state prior to catching the illness, vulnerability is high and the probability of that person dying is high (Aven, 2015, p. 19). The concept of vulnerability is used when the consequences are concerning after a threat has occurred (Aven, 2015, p. 19). It is understood as the combination of associated uncertainty and consequences (Aven, 2015, p. 19).

2.10 Risk management and mitigation

There are five main steps in risk management: risk identification, risk assessment, selecting the best risk management strategy, implementing chosen strategy and supply chain risk mitigation (Manuj & Mentzer, 2008a, p. 144).

Manuj and Mentzer (2008a), created a model for risk management and mitigation. First step in managing and mitigating risks is to identify the risk (Manuj & Mentzer, 2008a, p.

144). It is important to identify risks before conducting risk assessment and initiating risk mitigation strategies (Narasimhan & Talluri, 2009, p. 115). First step in risk management should be identifying companies' goals and the risks related to them (Narasimhan & Talluri, 2009, p. 115). Identifying risks increases their visibility in the performance assessment process leading to risk mitigation strategies that are able to aid performance improvements (Narasimhan & Talluri, 2009, p. 115).

Risks such as supply, demand, macro, security, operational, resource, and competitive risks are identified at domestic and global levels (Manuj & Mentzer, 2008a, p. 144). Global supply chains include many partners in different countries and the interaction between these environments and the focal firm's home country (Manuj & Mentzer, 2008a, p. 144). If a company operates globally, it needs multiple supply chain partners and that can increase risks compared to a company that only operates domestically (Manuj & Mentzer, 2008a). So, in the first step the goal is to create a "profile" for the identified risks. Manuj and Mentzer (2008a) state that the risk profile shows if the risk is atomistic or holistic and if it is qualitative or quantitative. It also shows if the risk has domestic or global effects.

The second step is to assess and evaluate the risks (Manuj & Mentzer, 2008a, p. 145). In this step it is evaluated if the risks identified are harmful for the supply chain (Manuj & Mentzer, 2008a, p. 145). A company's supply chain can be vulnerable to some risks, but it is also secured from other risks. So, not all risks are a threat to the supply chain (Manuj & Mentzer, 2008a, p. 145). This is why in step two it is important to determine which risks found in step one are critical (Manuj & Mentzer, 2008a, p. 145). Some minor risks can also disappear when major risks are taken care of (Manuj & Mentzer, 2008a, p. 147).

The third step is to select a suitable strategy to manage these critical risks listed in step two (Manuj & Mentzer, 2008a, p. 146). Risk management strategies need to be aligned with the supply chain strategy and the company's corporate strategy (Manuj & Mentzer, 2008a, p. 146). Some risk management strategies that Manuj and Mentzer (2008a) mention are Focusing on cost efficiency, postponement, single sourcing, focusing on pooling

and sharing risks, multiple sourcing, transferring risk, and hedging. Risk management strategies help to mitigate possible losses that can come from different risk events (Manuj & Mentzer, 2008a).

Step four is implementing supply chain risk management strategy (Manuj & Mentzer, 2008a, p. 147). In order to be successful in strategy implementation a company needs to clearly communicate its strategy, align organization accordingly, drive planning according to the strategy, reduce complexity and install a problem resolution system (Freedman, 2003, p. 29). The company might have to be reorganised in order for it to align with strategic requirements and Strategy must guide planning (Freedman, 2003). Strategy has to be ready first and planning will be part of strategy implementation (Freedman, 2003). Implementation requires structural and procedural changes that are coherent with globalisation and product customisation (Manuj & Mentzer, 2008a, p. 147). Freedman (2003) states that strategy implementation requires creativity, discipline, commitment, leadership and amazing execution skills.

It is not possible to avoid all possible risks, but companies need to have a plan for situations where the worst-case scenario could happen (Manuj & Mentzer, 2008a, p. 148). Risk mitigation planning helps companies to make better decisions when facing unexpected events and possible losses (Manuj & Mentzer, 2008a, p. 148). The main thing in risk mitigation is to identify and be aware of the possible losses that can be caused by an unexpected incident (Manuj & Mentzer, 2008a, p. 148). In risk mitigation, various scenarios are considered, and a plan of action is prepared for the most damaging cases (Manuj & Mentzer, 2008a, p. 148).

2.11 Supply chain risk management strategies

Supply chain risk management can be seen as a strategic action for companies because it influences firms financial, operational and market performance (Narasimhan & Talluri, 2009, p. 114).

2.11.1 Sourcing

Companies use outsourcing for strategic agility, responding more quickly to changing customer demands, innovation and to reduce costs (Narasimhan & Talluri, 2009, p. 115). When outsourcing is used to support innovation, in order to achieve business goals, companies must use integrative supply chain management practises such as knowledge, design and information integration (Narasimhan & Talluri, 2009, p. 115).

A company can either divide work between several suppliers (multiple sourcing) or just work with one supplier (single sourcing) (Namdar et al., 2018, p. 2344). Single sourcing has benefits such as smaller inventories and improved quality, lower production costs because one supplier produces larger quantities and becomes more efficient over time and lastly it also helps to create a stronger relationship with the chosen supplier (Namdar et al., 2018, p. 2344). Single sourcing can also be more secure because sensitive information is shared through only one channel, between one buyer and one supplier (Namdar et al., 2018, p. 2344). This is why companies have reduced the number of suppliers they use and have one main supplier that they rely on instead (Namdar et al., 2018, p. 2344). The down side of single sourcing is that it majorly increases disruption risks (Namdar et al., 2018 p. 2344).

Multiple sourcing can help mitigate risks such as strikes, shortages and natural disasters (Namdar et al., 2018 p. 2344). Multiple sourcing practice creates strong competition between suppliers and that can create better offers for the buyer (Berger & Zeng, 2006, p. 250). However, working with multiple suppliers can require more time for negotiations and this can cause delays or problems in production schedules (Berger & Zeng, 2006, p. 250). In order for suppliers to stay competitive, they have to invest in expertise, forecasting, technology, quality, cost, and delivery performance (Berger & Zeng, 2006, p. 250).

According to Berger and Zeng (2006) multiple successful business are building long-term partnership with fewer number of suppliers. This can help them achieve the benefits of competition while reducing the number of suppliers (Berger & Zeng, 2006, p. 250). With

this way of operating, companies can form strong partnerships with those that can provide high quality and low costs (Berger & Zeng, 2006, p. 250). This is why reducing the number of suppliers is an important purchasing strategy (Berger & Zeng, 2006, p. 250).

In Namdar and others (2018) article, risks are divided into two categories: low-impact-high-frequency risks (LIHF) and high-impact-low-frequency risks (HILF). Low-impact-high-frequency risks are operational risks that are caused by inadequate coordination between supply chain parties (Namdar et al., 2018, p. 2340). These are for example machine breakdowns, uncertainties in lead times, imbalance between demand and supply, and power outages (Namdar et al., 2018, p. 2340). High-impact-low-frequency risks on the other hand cause serious long-term effects and require a long recovery time. For example, political instability and terrorism and natural hazards are HILF risks (Namdar et al., 2018, p. 2340).

For high-impact-low-frequency risk the findings show that for low and medium risk aversion, single-sourcing and multiple-sourcing are basically identical strategies (Namdar et al., 2018, p. 2355). However, when a company uses single sourcing for high level risk aversion, it chooses the most reliable and possibly the most expensive main supplier and on top of that signs a contract with a backup supplier to reduce risks (Namdar et al., 2018, p. 2355). And when a company uses multiple sourcing for this situation, it does not choose the most expensive supplier, but spreads orders between cheaper but reliable suppliers (Namdar et al., 2018, p. 2355). On top of this the company uses backup supplier contracts to reduce risks. For both single and multiple sourcing, spot purchasing and backup supplier contracts are recommended when risk aversion is high (Namdar et al., 2018, p. 2355).

For low-impact-high-frequency risks the finding show that when using single sourcing at low risk aversion levels, the company chooses the cheapest main supplier (Namdar et al., 2018, p. 2355). Risk of disruption is mitigated by investing on supplier's recovery rate and improving the company's own ability to detect problems early (Namdar et al., 2018,

p. 2355). But for medium level risk aversion, company selects quite expensive and reliable supplier and mitigates disruption risks by investing on supplier's recovery rate (Namdar et al., 2018, p. 2355).

And for high risk aversion level, reliable and relatively expensive supplier is also chosen, but risk mitigation is done by signing contracts with backup suppliers and by utilizing spot purchasing (Namdar et al., 2018, p. 2355). When it comes to multiple sourcing, diversification strategy works well regardless of the level of risk averseness (Namdar et al., 2018, p. 2355). For LIHF disruptions, the cheapest suppliers are chosen for multiple sourcing unlike for HILF disruptions. In multiple sourcing, using backup supplier contract together with spot purchasing is not an effective strategy, no matter the level of risk aversion (Namdar et al., 2018, p. 2355).

When risk aversion level is low or moderate, single sourcing is always better than multiple sourcing with HILF disruptions. And increasing risk aversion makes multiple sourcing a better option than single sourcing (Namdar et al., 2018, p. 2355). When viewing LIHF disruptions, multiple sourcing strategy is more effective than single sourcing strategy in every level of risk aversion (Namdar et al., 2018, p. 2355). Spot purchasing strategy and backup purchasing strategy can be used when risk averse level is high for both type of risks but especially for HILF (Namdar et al., 2018, p. 2355).

It is important that the ability to detect disruptions early is on a good level. It is more important than recovery rate (Namdar et al., 2018, p. 2356). According to Namdar and others (2018), redundancy helps companies to reduce risks. However, a truly resilient supply chain must be able to foresee unexpected disruptions, maintain operations, recover fast and achieve a competitive advantage (Namdar et al., 2018, p. 2356).

2.11.2 Risk transfer

Risk transfer happens when one party shifts the responsibility for negative outcome of a risky action to another party, usually for a fee (Abdullah, 2013, p. 282). So, risk transfer

is basically selling a risk. The party that transfers the risk must have been exposed to it, even for only a short period of time (Abdullah, 2013, p. 282).

On top of selling a loan to other parties, another way to transfer risk is to buy a credit default swap, which works like insurance on a loan (Abdullah, 2013, p. 283). Credit default swaps are usually sold by insurance companies and investment banks (Abdullah, 2013, p. 283). The seller agrees to insure the buyer from losing money in exchange for the buyer paying an agreed amount of money in advance (Abdullah, 2013, p. 283).

Risks can be transferred or shared in a supply chain by off-shoring, outsourcing and contracting (Manuj & Mentzer, 2008a, p. 143). Outsourcing in a global supply chain means sourcing products and services internationally or domestically. "Off-shoring" usually means sourcing globally when talking about a global supply chain (Manuj & Mentzer, 2008a, p. 143). When a company is off-shoring or outsourcing, some of the risks shift to suppliers, but companies need to balance with how much control they want to keep and how big of a risk they are willing to take (Manuj & Mentzer, 2008a, p. 143).

Risk transfer also has some problems. The problem in risk transfer is the assumption that the best way to manage a risk is to transfer it to someone else (Abdullah, 2013, p. 284). Even though someone else is willing to bear someone else's risks, does not mean that they are able to do that (Abdullah, 2013, p. 284). Normally risk transfer can mitigate risks for individual parties but on the other hand it also increases systemic risks (Abdullah, 2013, p. 284).

Risk transfer is basically a sale of responsibility, and this is quite problematic. Risk transferring breaks the connection between an action and responsibility (Abdullah, 2013, p. 284). It undermines the individual responsibility principle and poses injustice by passing the responsibility to someone who did not perform the given act (Abdullah, 2013, p. 284). By shifting responsibility for a particular act to someone other than the perpetrator, risk transfer encourages irresponsible or risky behaviour (Abdullah, 2013, p. 284).

While risk transfer can work in normal conditions, it generally does not work in exceptional conditions (Abdullah, 2013, p. 285). In exceptional times, parties that are willing to take on risks from other parties often are unable to meet their obligations and this can lead to systemic collapse (Abdullah, 2013, p. 285). Risk transfer does not protect investors in a time of crisis when the need for protection is highest (Abdullah, 2013, p. 285). The difference between risk sharing and risk transfer is that risk sharing creates good relationships and cooperation, but risk transfer creates a win-lose situation between the parties (Abdullah, 2013, p. 286).

2.11.3 Risk sharing

Sharing a risk mitigates the size of risk faced by one party (Abdullah, 2013, p. 287). The more partners there are sharing a risk, the lower the impact of the risk is for each partner is (Abdullah, 2013, p. 287). Partners can also give advice to each other on the most efficient ways to reduce risks (Abdullah, 2013, p. 287).

Risk sharing happens for example, when people make a partnership agreement (Abdullah, 2013, p. 288). In that case, capital suppliers share both the risks and the profits with entrepreneurs. The terms depend on the type of partnership chosen (Abdullah, 2013, p. 288). A partnership can be passive or active, and partners share profits based on an agreed percentage (Abdullah, 2013, p. 288). But for losses, each partner shares the loss according to how much they invested (Abdullah, 2013, p. 288). Partnerships do not create a win-lose situation like risk transfer strategies do (Abdullah, 2013, p. 290). Where risk transfer can weaken systemic stability, risk sharing improves it (Abdullah, 2013, p. 290).

2.11.4 Production hedging

Production hedging means producing less than the total demand (Park et al., 2017, p. 1299). It is an effective risk mitigation strategy (Park et al., 2017, p. 1299). By producing

less than total demand, a company preserves flexibility to sell more globally when the exchange rate goes up, and more in domestic markets when the exchange rate goes down (Park et al., 2017, p. 1300). Such flexibility is absent if the company must fully meet total demand (Park et al., 2017, p. 1300). Also, with production hedging, the domestic market helps to protect the company from losses without taking away the chance to make higher profits (Park et al., 2017, p. 1300). By producing less than total demand, when the exchange rate is low, the company can reduce losses by selling less in the foreign market and more in the domestic market (Park et al., 2017, p. 1300). In this way, with production hedging, the domestic market works like a currency option seen in financial hedging (Park et al., 2017, p. 1300).

Production hedging reduces the company's exposure to risks (Park et al., 2017, p. 1313). By producing less than total demand, the company is able to keep its flexibility to sell its limited output across markets in a way that maximizes revenue depending on the realized exchange rate (Park et al., 2017, p. 1313). According to Park and others (2017), Production hedging strategy leads to lower risk exposure compared to the conventional policy of manufacturing enough to meet the total demand. Production hedging becomes increasingly desirable when demand uncertainty, unit production costs, exchange uncertainty and risk aversion rises (Park et al., 2017, p. 1313)

2.11.5 Postponement

Postponement means delaying distribution or processing tasks until exact details of the customer's order is available (Yang & Yang, 2010, p. 1902). Companies can save money in inventory costs and transportation by handling and storing products in bulk before they know the exact order of one customer (Yang & Yang, 2010, p. 1902). An important factor in implementing postponement is to understand that operations should focus more on the customer (Yang & Yang, 2010, p. 1902).

Studies show that after seeing just 20% of the initial sales of an item, companies can predict future demand much more accurately (Ogawa & Piller, 2006, p. 67). Businesses

can delay their production until they have a better understanding of the market. In this case, manufacturing is divided into two parts. First, standard components are made and stored and once more information about demand is received, the parts are assembled in order to create the final product (Ogawa & Piller, 2006, p. 67). Companies can change product designs not only to respond to changes in customer demand, but also to handle supply problems, such as unexpected changes from suppliers in early production cycle (Yang & Yang, 2010, p. 1904). Postponement allows a company to adjust the product at the last possible moment if a needed component is not available (Yang & Yang, 2010, p. 1904).

It is known that forecasts made at the finished product level are not as accurate as the ones made at the component level (Yang & Yang, 2010, p. 1905). With manufacturing postponement, risk is reduced by combining demand for all variations of the undifferentiated products (Yang & Yang, 2010, p. 1905). Logistic postponement mitigates risk by delaying inventory location changes until the final customer or destination is known (Yang & Yang, 2010, p. 1905). This reduces unnecessary shipments as demand changes. Postponement helps companies handle big changes in technology, customer needs and competitors' actions by waiting for the adequate information before making decisions (Yang & Yang, 2010, p. 1905).

Global supply chains face many risks; thus, postponement becomes more valuable when a product contains more off-shore parts (Manuj & Mentzer, 2008b, p. 207). The more off-shore components a final product has, the more likely a supply chain is to invest in postponement (Manuj & Mentzer, 2008b, p. 207). In this situation, different links connected in a large network are prone to breakdowns, disruptions, political or economic changes and disasters that can lead to increased amount of risks making risk management harder (Yang & Yang, 2010, p. 1902).

3 Research methodology

This research uses quantitative research approach. This research uses numerical data on energy and pulp prices, inventory sizes and companies' quarterly turnover. This study focuses on two forestry companies, UPM and Metsä Group.

The time period that this study focuses on is the years between 2021 to 2024. This is because the Russia-Ukraine war started in February 2022 so, this study aims to examine how forestry companies in Finland adapted to the new situation that this geopolitical risk caused. In order to observe how the war affected the companies and prices, it is essential to first assess the situation in 2021 before the outbreak of the war.

3.1 Data collection methods

As a primary data this study uses interim reports and annual reports from selected companies. Companies reports are utilized in multiple studies regarding supply chains and risks and are generally seen as reliable source of information (Zhong et al., 2024; Zhuo et al., 2025). Secondary data such as energy and pulp prices are collected from Datastream database. This study will utilize Datastream as it is used by previous studies addressing risks and war (Çatık ym., 2025; Wang et al., 2024).

Data for pulp prices are collected from Wood Pulp Northern Bleached Softwood Kraft Benchmark Spot Finland Helsinki Monthly Average Euro Per Metric Tonne index. Symbol HWWIWDE. Data was collected from years 2021 to 2024. Prices are separated by month so it can be seen how the prices change throughout each year.

Data for energy prices was collected from Finland, Industry Producer Prices Index (Producer Price Index), Producer Prices Index (Producer Price Index) - Domestic Market, Industry Producer Prices Index, Domestic Market - Monthly Data (Nace Rev 2), Domestic Producer Prices, Current Prices, Index, 2021 = 100. Symbol: FNESR5HGF. This data is available in Datastream starting from 2005. However, since this study focuses on the

period immediately before and during the Russia-Ukraine war, the data was collected from years 2021-2024. The Data is separated by month for easy observation of the prices.

3.2 Overview of case companies

This chapter provides a brief overview of the case companies selected for this study. It includes information on the companies' market positions, founding years, the industries in which they operate and the most significant events throughout the years from 2021 to 2024.

3.3 UPM

UPM-Kymmene Corporation is a material solutions company that holds strong global market positions across several business areas (UPM, 2026b). The corporation was established in 1995 through the merger of Kymmene Corporation, Repola Ltd., and United Paper Mills Ltd (UPM, 2026a). The Group's first paper mills, pulp mill and sawmills began operations in 1870s (UPM, 2026a). Production of pulp started in the 1880s and paper converting began in the 1920s (UPM, 2026a). Plywood production started during the next decade (UPM, 2026a).

UPM supports the sustainable transformation of society by providing resource-efficient material solutions produced from renewable materials (UPM, 2026b). It operates in 46 countries and has production in 10 countries (UPM, 2026b). UPM supports extensive range of industries by providing advanced materials, renewable fibres, communication papers, and decarbonization solutions (UPM, 2026b). UPM globally collaborates with different brands and industries (UPM, 2026b). The company's roots are in the forest and paper industries, but it also aims to grow by expanding its high-value material science businesses (UPM, 2026b).

UPM's main business functions are UPM fibre, UPM raflatac, UPM specialty papers, UPM plywood, UPM energy, UPM biochemicals, UPM biofuels, UPM communication papers, UPM biomedical, and UPM forest (UPM, 2025a).

UPM fibres consist of timber and pulp businesses (UPM, 2025a). UPM pulp offers a versatile portfolio of pulp products for a wide range of end users, including packaging papers and packaging board, tissue and speciality papers, and graphic papers (UPM, 2025a). UPM timber supplies certified sawn timber for example for furniture manufacturing, construction, and packaging industries (UPM, 2025a). UPM Raflatac provides film products and self-adhesive paper that includes labelling materials for graphic marketing, communication, and labelling, as well as self-adhesive products (UPM, 2025a).

UPM Specialty papers offer specialty packaging materials for labels, flexible packaging, and industrial release papers, as well as graphic and office papers (UPM, 2025a). UPM Plywood on the other hand provides high-quality WISA plywood and veneer products for vehicle flooring, construction, LNG shipbuilding, and other industrial applications (UPM, 2025). While UPM Energy produces carbon-free electricity at its own and jointly owned power plants. Its operations also include trading in physical electricity and related derivatives. UPM Energy is Finland's second largest electricity producer (UPM, 2025a).

UPM Biochemicals offers renewable wood-based biochemicals designed to replace fossil-based raw materials in a wide range of applications, including PET bottles, textiles, cosmetics, packaging, detergents, rubber, and pharmaceuticals (UPM, 2025a). And UPM Biofuels produces renewable wood-based diesel suitable for all diesel engines, as well as naphtha that can be used as a biocomponent in gasoline or as a substitute for fossil-based raw materials in the petrochemical industry (UPM, 2025a).

3.3.1 UPM risk management

At UPM risk management means proactive and systematic approach to identify, manage, and analyse threats and opportunities that are related to business operations (UPM,

2025a). It also includes risks that can be avoided with careful planning evaluation of future business environments and projects (UPM, 2025a). The risk management group in UPM is responsible for giving risk profiles and risk tolerances to the strategy group. The strategy group on the other hand is responsible for aligning risk management priorities and strategies with business goals (UPM, 2025a). The board views the efficiency of the company's risk management systems and the risks assessment related to the company strategy (UPM, 2025a). The audit committee makes sure that the risk management tools are aligned with risk management policies (UPM, 2025a).

In cases where the magnitude of the risk is larger than UPM's risk tolerance, the company seeks to transfer the risk away from its own responsibility (UPM, 2025a). UPM mitigates risks through trainings, monitoring and regular risk assessments (UPM, 2025a). Most of the uncertainty factors that UPM faces are related to regional, global, and local political and economic conditions. Especially political changes create uncertainty in the global economy (UPM, 2025a).

Geopolitical tensions can lead to economic sanctions, military conflicts, import and export restrictions and blockades that limit UPM's operations in a specific region or country (UPM, 2025a). These tensions also have a negative impact on logistics, energy, and other key input costs for UPM's production like the price and availability of Wood (UPM, 2025a).

3.3.2 Key events at UPM

This chapter will go through the most important events at UPM from years 2021 to 2024. This provides essential information on how the company has performed during the geopolitical risk and what strategic decisions it has made.

In January of 2021, UPM shut down its papermill in Kaipola. This was a strategic decision that was needed due to demand changes (UPM, 2022). Many global supply chains had disruptions due to Covid-19 pandemic and the 2020 recession. These disruptions increased costs and uncertainty in the availability of energy and raw materials (UPM, 2022).

In Finland, the price of electricity was at a record high, especially towards the end of the year of 2021 (UPM, 2022). This was caused by commodity prices and the lack of water resources in the Nordic markets (UPM, 2022). UPM's input costs were significantly higher in 2021 compared to the previous year (UPM, 2022). In addition, the sharp rise in energy prices affected investments and consumption (UPM, 2022).

In 2022 key forest certification organisations, such as, FSC and PEFC, excluded Russian and Belarusian wood from their certification systems (UPM, 2023b). UPM suspended deliveries to Russia, purchases of wood in Russia and operations at the UPM Chudovo plywood mill (UPM, 2023b). Due to uncertainties, UPM wrote down all business assets and unsecured receivables that were located in or related to operations in Russia or Ukraine (UPM, 2023b). UPM's pulp terminal at Montevideo deep sea port was completed and a direct rail connection from the mill to deep sea port created an efficient supply chain to global markets (UPM, 2023b). The port also provided benefits in ocean transport for UPM's existing operations (UPM, 2023b). In 2022 UPM's energy costs increased significantly due to tight energy market situation in China and Europe.

In 2022, UPM achieved record results and was prepared for significant growth and expected 2023 to be a strong year (UPM, 2023b). UPM was about to start production in UPM Paso de los Toros pulp mill and predicted that this combined with the start-up of Olkiluoto 3 nuclear power unit would increase delivery volumes (UPM, 2023b).

UPM's new world class pulp mill in Uruguay, UPM Paso de los Toros, started operating in April 2023 (UPM, 2024b). The OL3 nuclear power plant unit started commercial production in April 2023. The nuclear power plant increased UPM Energy's electricity generation capacity (UPM, 2024b). UPM participated in OL3 through its shareholding in Pohjola Voima Oyj, as it is the largest shareholder of the developer of OL3 (UPM, 2024b). Shareholders were supplied with electricity and heat in proportion to their ownership shares. In the first quarter of 2023, UPM completed the complete withdrawal of its operations from Russia by selling all of its Russian operations, including the Chudovo plywood mill

(UPM, 2024b). UPM updated the start-up schedule and cost estimate for the biorefinery project since it had been affected by the insolvency of a key equipment supplier, poor contractor availability and the negative impact of the geopolitical situation on material availability and prices (UPM, 2024b). In 2023, the business environment for UPM's products, especially in Europe, was unprecedented due to low economic activity (UPM, 2024b). Product deliveries to the market were slowed down by inventory destocking in most product value chains (UPM, 2024b).

In 2024, UPM initiated the start-up of the Leuna biorefinery which mostly made a good progress despite the geopolitical uncertainties and material shortages that impacted the project (UPM, 2025b). In August 2024, UPM shut down production at its Hurth newsprint mill and in December it also closed production at Norland Papier fine paper machine (UPM, 2025b). UPM also announced that it will temporarily adjust production at the UPM Kaukas and UPM Kymi pulp mills to reflect the market situation (UPM, 2025b). Overall in 2024, global demand for pulp was strong and UPM deliveries increased significantly with the completion of the ramp-up of the Paso de los Toros pulp mill in Uruguay (UPM, 2025b). Russia's ongoing war in Ukraine continued to affect world politics and the international community tried to respond to Russia's actions (UPM, 2025b). The number and intensity of sanctions increased, focusing on key sectors and preventing sanctions evasion (UPM, 2025b).

3.3.3 Changes in UPM's wood procurement

About 10% of UPM's wood used in Finland previously came from Russia, especially birch (UPM, 2023). After the end of Russian imports, more wood was sourced from Finland and imported from the Baltic region and Sweden (UPM, 2023). UPM also emphasized wood traceability, certification and biodiversity supporting measures (UPM, 2023).

3.4 Metsä Group

Metsä Group is a company that is divided into five different business areas that develop alternatives to fossil materials (Metsä Group, 2026a). It manufactures fossil free products from renewable wood (Metsä Group, 2026a). Metsä Group invests in a fossil free future and in the development of new bioproducts (Metsä Group, 2026a).

Metsä Group was established when the forest owners wanted to gain a stronger negotiation position in timber market and started to cooperate (Metsä Group, 2026b). The operations began with joint sales, and Metsäliitto Oy, founded in 1934, initially continued with wood exports (Metsä Group, 2026b). Since 1947 the company has been a cooperative and in 1949 the first sawmills were established (Metsä Group, 2026b). In 1950, operations expanded into the chemical forest industry (Metsä Group, 2026b).

Metsäliitto Cooperative's operations expanded significantly from the 1960s onwards, and in the 1980s and 1990s the company grew strongly, investing both in Finland and abroad (Metsä Group, 2026b). By the 2000s, Metsäliitto Group had become an international forest industry group employing over 25 000 people. Between 2005 and 2012, they carried out a significant transformation process and renamed themselves to Metsä Group in 2012 (Metsä Group, 2026b). These changes completed a strong structural change based on Metsä Group's strategy to build a unified and competitive forest industry group (Metsä Group, 2026b).

3.4.1 Key events at Metsä Group

At the of 2021, exports of round softwood from Russia stopped (Metsä Group, 2022). In February 2021, Metsä Fibre made an investment decision to build a bioproduct mill in Kemi. This is the largest domestic investment in the history of the Finnish forest industry. The estimated cost of the investment was approximately 1.85 billion euros (Metsä Group, 2022). In 2021, Metsä Group had four significant factory investments in the implementation phase (Metsä Group, 2022). Logistical challenges strengthened the market

position of European paper manufacturers in Europe and correspondingly weakened the position of Chinese paper manufacturers in the global market (Metsä Group, 2022). However, rising process for raw materials, energy and logistics, as well as challenges in availability, had a negative impact on profitability (Metsä Group, 2022).

In 2022, Metsä Group closed its operations in Russia and implemented measures to open new raw material sources and product markets (Metsä Group, 2023). The end of Russian wood imports led to a shortage of raw materials and production restrictions at the Punkaharju and Suolahti mills (Metsä Group, 2023). Metsä Tissue announced temporary production shutdowns at its Central European mills due to energy price spikes (Metsä Group, 2023). Metsä Wood's profitability was weakened by rising raw material, energy and logistics prices, as well as challenges in the availability of birch logs (Metsä Group, 2023). A new generation sawmill has been launched in Rauma, utilizing new technologies in operational and quality control (Metsä Group, 2023). The sawmill was integrated into the pulp mill, bringing significant benefits in energy use and logistics efficiency (Metsä Group, 2023).

The new Kemi bioproduct mill began operations in September 2023, with customer deliveries starting in October 2023. At the same time, the old pulp mill was permanently closed (Metsä Group, 2024). The financial effects of the discontinuation of Russian operations continued in 2023, primarily due to the sale of land in Konstancin, Poland, and the end of lease agreements related to the Russian operations (Metsä Group, 2024). In 2023, higher wood prices increased revenue, but lower delivery volumes and weaker raw material availability significantly reduced financial performance (Metsä Group, 2024). Wood delivery volumes in the last quarter of the year were clearly lower than in the corresponding period of the previous year, as product markets remained quiet (Metsä Group, 2024). Limited availability of birch logs and weaker construction activity in Europe led to production restrictions in the wood products industry, affecting birch plywood, softwood plywood, and Kerto LVL production (Metsä Group, 2024).

Geopolitical uncertainty and the end of imports from Russia reduced the availability of fertilizers and prevented forest fertilization activities in 2023 (Metsä Group, 2024).

Weak economic growth in Europe and China reduced Metsä Group's sales volumes in 2024 and high wood costs affected negatively on profitability (Metsä Group, 2025). Demand for the mechanical forest industry was weakened by the recession in the European construction industry and strong growth did not begin in 2024 as expected after economically weak 2023 (Metsä Group, 2025). The year of 2024 was a time of weak economic growth globally (Metsä Group, 2025). Weak demand in China affected pulp markets and unusually high imports of Chinese paperboard complicated the market situation in the paperboard industry (Metsä Group, 2025). In 2024, Metsä Group made investments, the largest of which were a new generation tissue production line in Mariestad and an advanced Kerto LVL mill in Äänekoski (Metsä Group, 2025). These investments made Metsä Group's market position stronger in these product segments (Metsä Group, 2025). In 2024, Metsä Group also published development programs for the renovation of the Simpele board mill and the Mänttä tissue mill (Metsä Group, 2025).

3.4.2 Changes in Metsä Group's wood procurement

In 2022, Metsä group supplied 60% of its wood from Finland, 32% from Sweden, 7% from Baltic countries and 1% from Russia before it stopped wood supply from Russia completely (Metsä Board, 2023). Metsä Board discontinued sales and wood procurement from Russia in March 2022 (Metsä Board, 2023). Folding boxboard volumes previously sold to Russia were redirected mainly to Europe and North America, while wood procurement shifted to Finland and Sweden (Metsä Board, 2023). Russian wood had accounted for approximately 9% of Metsä Board's wood supply, mainly consisting of birch. In 2021, 5.6% of Metsä Board's sales came from Russia and 0.7% from Ukraine (Metsä Board, 2023).

4 Findings

Figure 1 shows the energy and pulp prices and how they change during the years of 2021 to 2024. Figure 1 shows energy price (indexed, 2021 = 100) and pulp price (EUR/mt) of each month from 2021 to 2024. The green line indicates when the Russia-Ukraine war started. On the left y-axis there are energy prices and on the secondary y-axis on the right side there are pulp prices.

When looking at the average price in energy and pulp during years 2021 to 2024, it can be seen that in 2021 both, energy and pulp price increased quite a lot. In 2023 the prices went down and energy price did not increase after that. However, pulp price increased again between the years of 2023 and 2024.

It can be seen that in 2021 before the Russia-Ukraine war started, both energy and pulp prices were lower. In 2022 both prices increased and pulp price was especially high in October 2022. The highest point of energy price in 2022 was in September.

At the start of 2023, energy price was high but then started to decrease. Overall, it was much lower than it was in 2022. Energy price in 2024 decreased even further. Pulp price in 2023 descended but then got back up in 2024 almost as high as what it was in 2022 September.

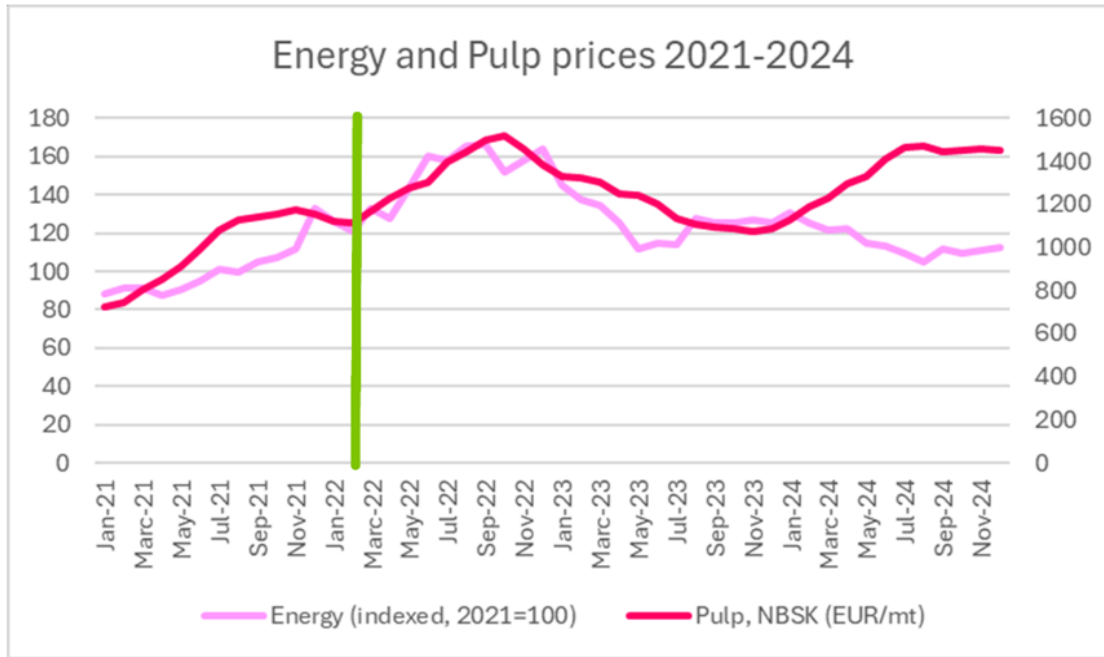


Figure 1. Energy and pulp prices in 2021-2024.

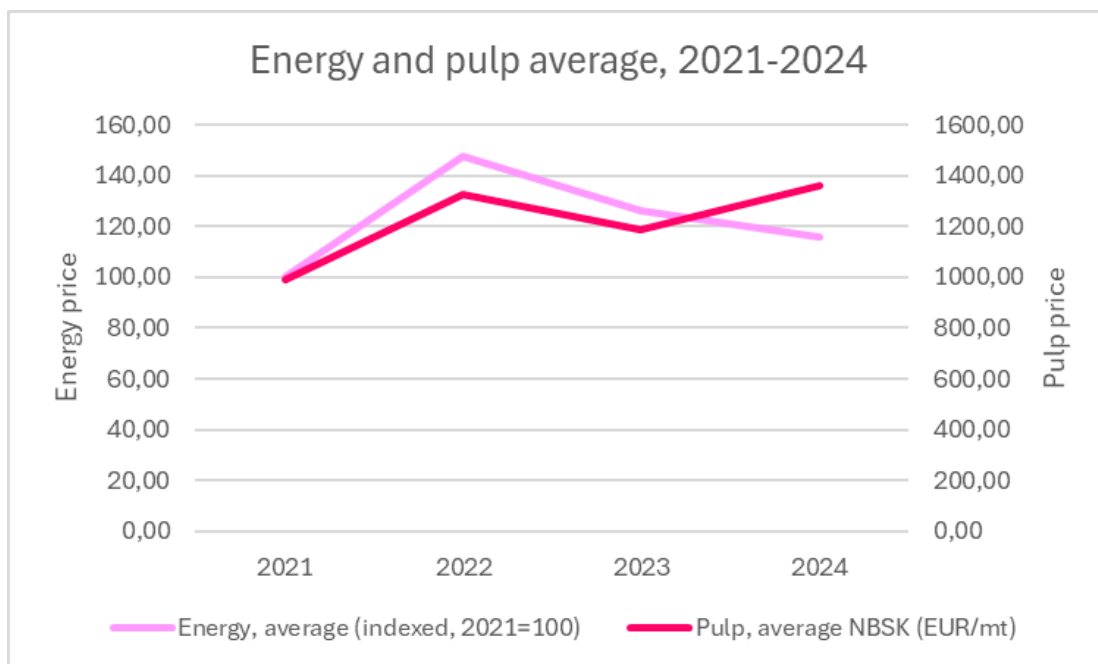


Figure 2. Energy and pulp average in 2021–2024.

Figure 2 shows average energy price and average pulp price from years 2021 to 2024. This figure provides a clear overview of how energy and pulp prices have changed over time and it allows for an analysis of whether the two price trends have moved in parallel. Figure 2 shows that the prices have peaked during the same time period and started to decrease around the same time period. However, when energy prices were still decreasing, pulp prices increased in 2023.

Table 1 shows the average energy price and pulp price per year.

Year	Energy, average	Pulp, average
2021	100.01	988.72
2022	147.81	325.37
2023	126.28	1186.95
2024	115.56	1359.13

Table 1. Average energy and pulp price per year

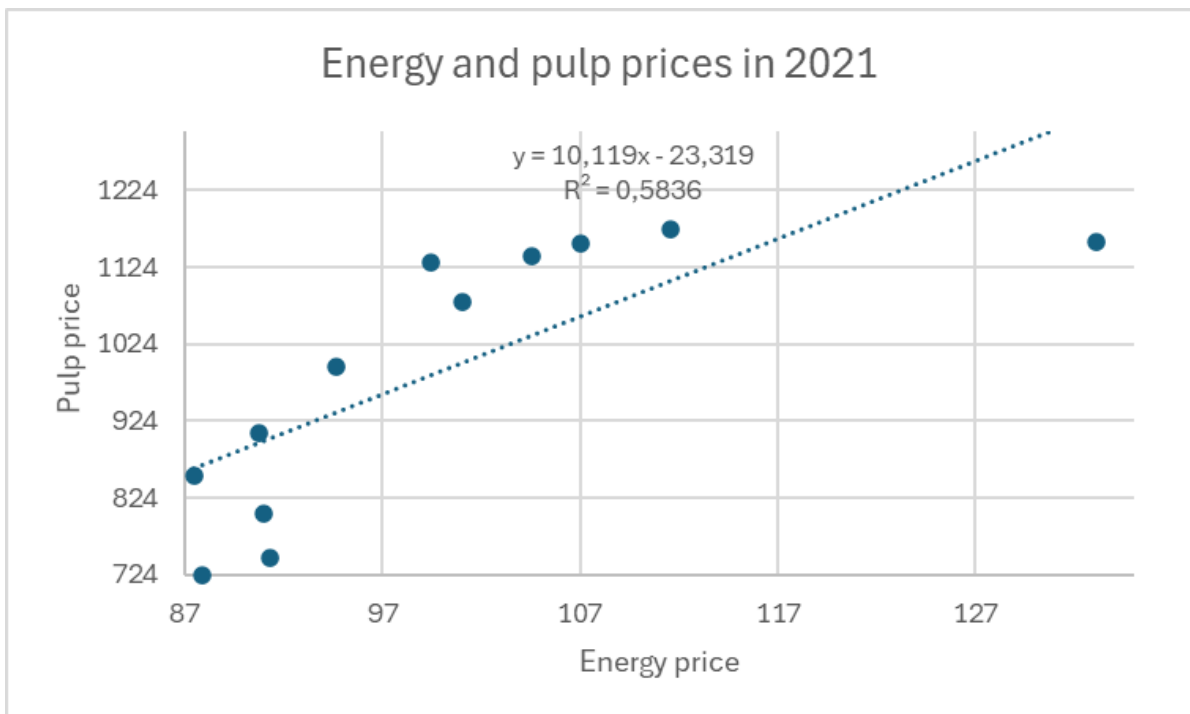


Figure 3. Scatter plot trend line, pulp and energy 2021

In figure 3 there is a linear regression line that shows energy and pulp prices in 2021. It can be seen that some of the points deviate quite a bit from the regression line, meaning that the points do not form a perfect linear connection. The prices do not change together but there is a clear linear connection between them. Correlation with energy price in 2021 and pulp price in 2021 was 0.76 so, the positive correlation is strong. This means that when energy price went up by one index point, pulp price also went up by 76% of the index point.

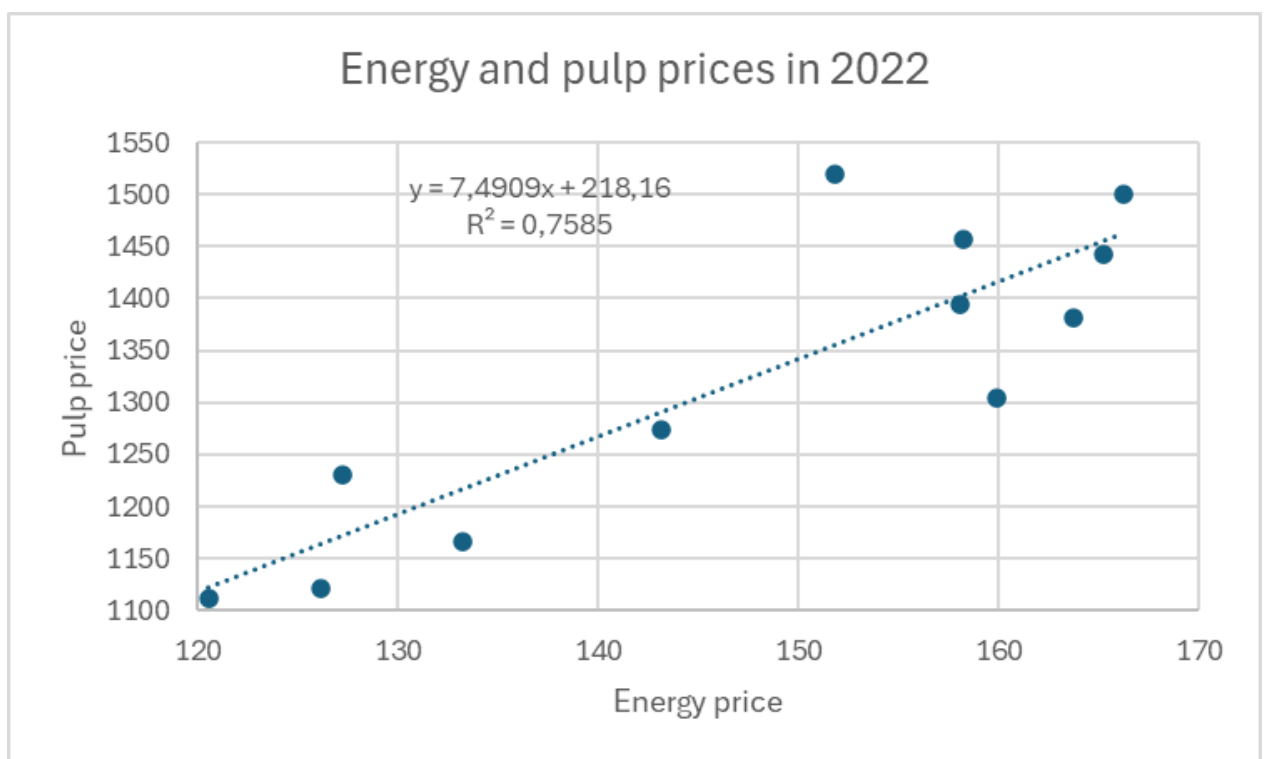


Figure 4. Scatter plot trend line, pulp and energy 2022

Figure 4 shows a linear regression line of energy and pulp prices in 2022. The figure shows that most of the points are close to the line and this indicates stronger linear connection. In 2022 correlation with energy and pulp price is 0.87 so it is even stronger than in previous year. This is when the war started and both, energy and pulp prices started to increase more rapidly. The shock in energy prices directly affected the price of pulp since pulp production requires a lot of energy (UPM, 2024a).

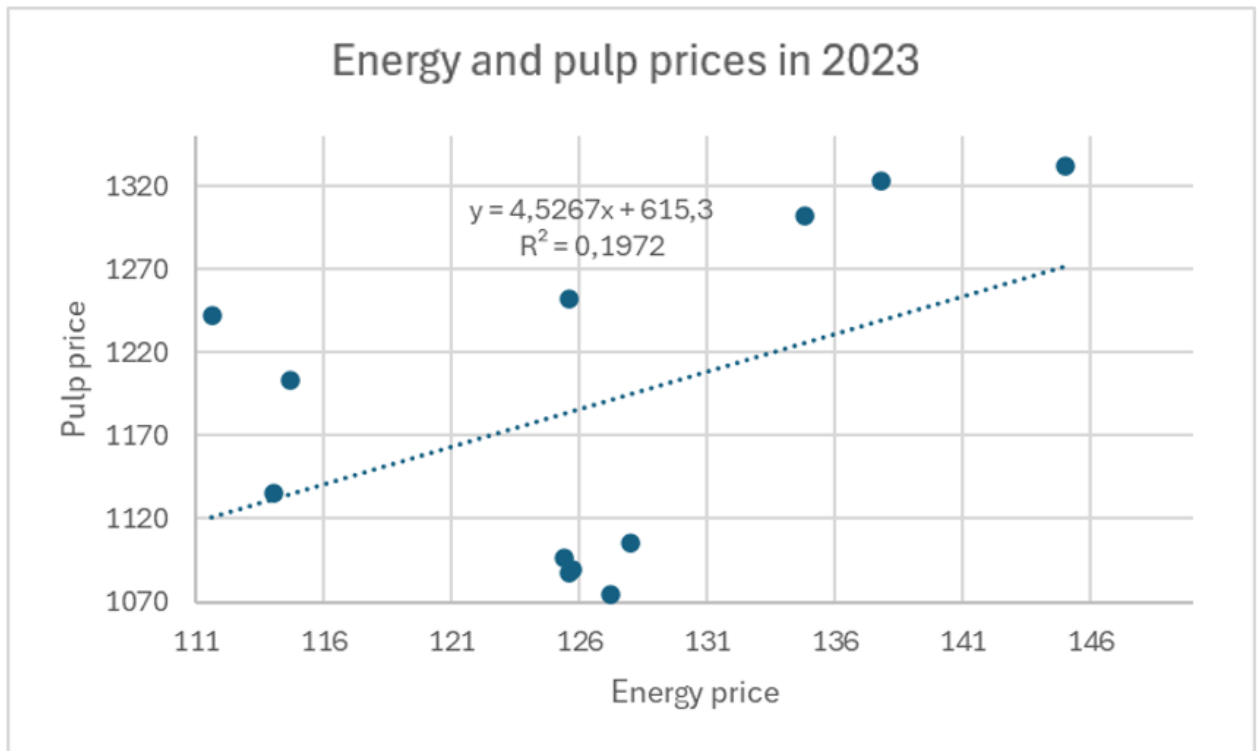


Figure 5. Scatter plot trend line, pulp and energy 2023

In figure 5 there is a linear regression line of energy and pulp prices in 2023. This is when the correlation fell to 0.44 and the points are not close to the line. This means that the correlation seemed to weaken quite significantly, so energy price and pulp price were less related in 2023.

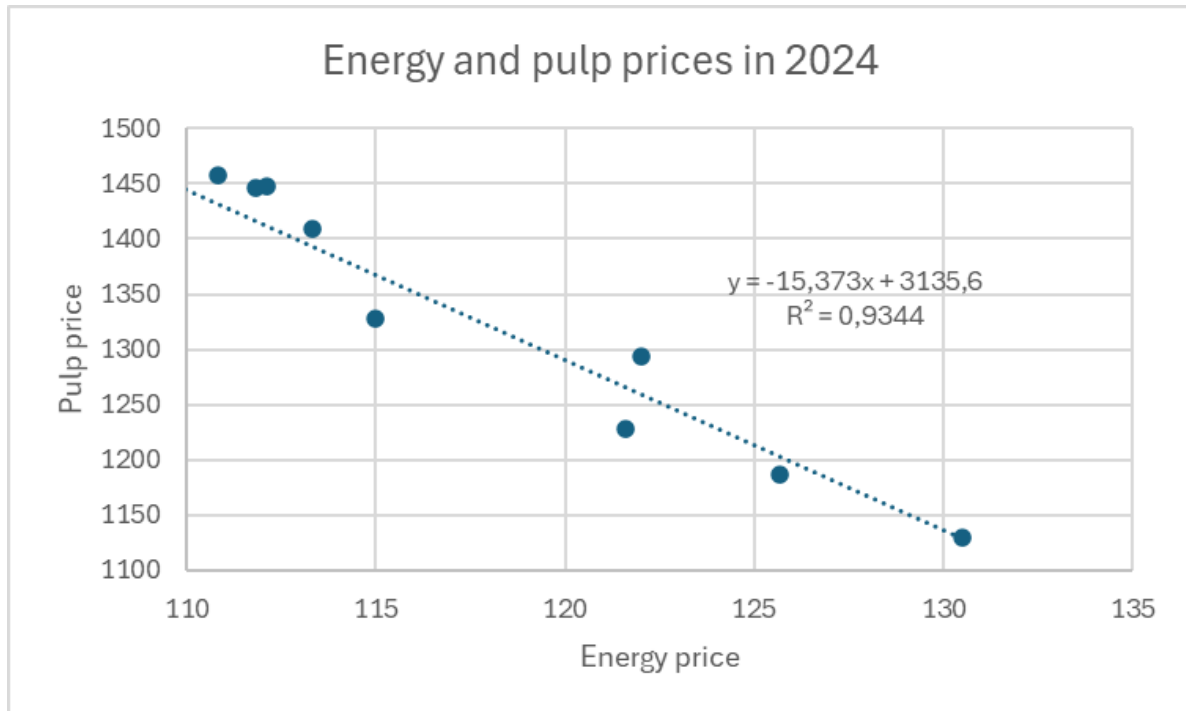


Figure 6. Scatter plot trend line, pulp and energy 2024

And lastly, when looking at energy and pulp prices in 2024, it is shown that the correlation is -0.96. Figure 6 also shows that the points are close to the line and the line is descending. So, this means that, when energy price increased, the pulp price decreased the same amount.

According to the data, during these years from 2021 to 2024, energy price and pulp price correlations swung from significant positive correlation to almost perfect negative correlation. These correlations are calculated in excel using the command =correl(range1; range2).

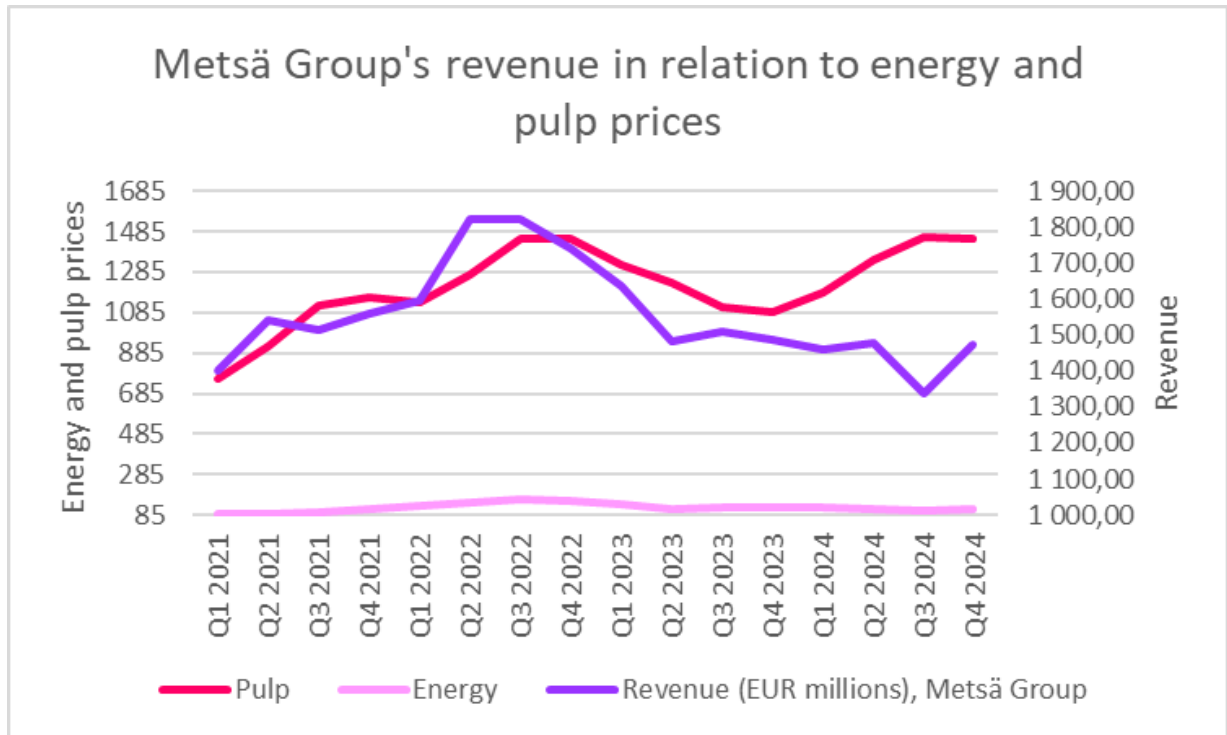


Figure 7. Metsä Group's revenue in relation to energy and pulp prices

Figure 7 shows Metsä Group's revenue in relation to energy and pulp prices the same figure, making it easier to examine how changes in these prices correspond with changes in the company's revenue over time. Pulp price had more significant changes compared to energy price. However, both energy and pulp price trends followed a similar pattern to revenue.

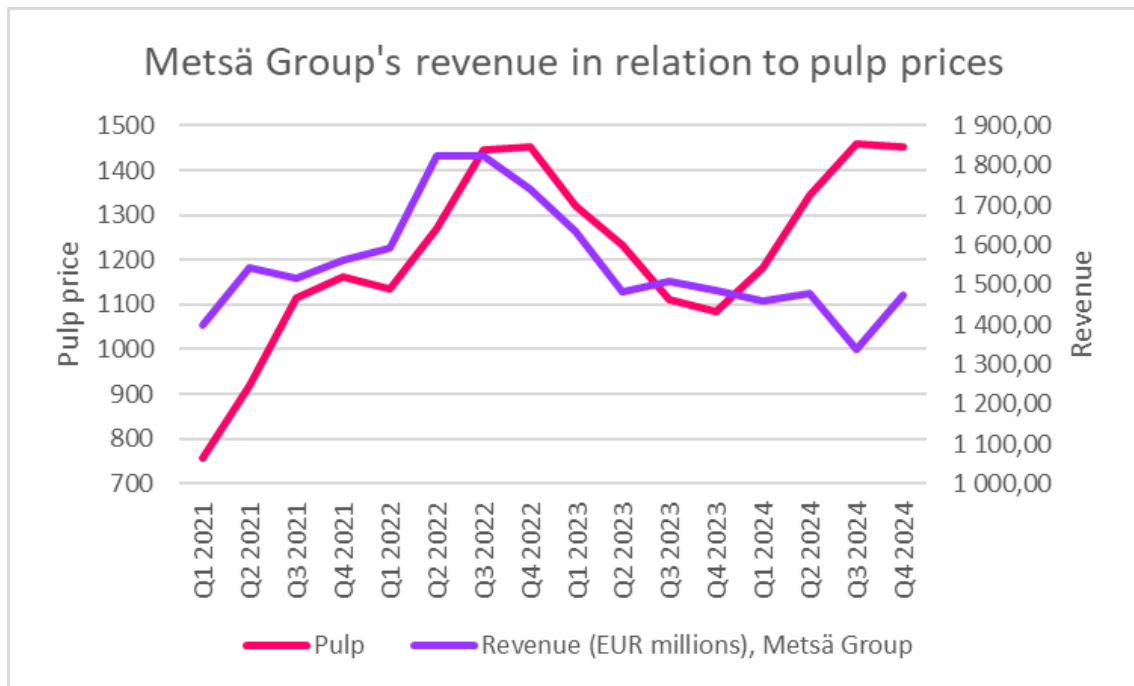


Figure 8. Metsä Group's revenue in relation to pulp prices

Figure 8 provides a closer look on how Metsä Group's revenue has changed compared to pulp price changes. In 2022 when pulp price peaked, Metsä Group's revenue also peaked. After that, the revenue started to decrease again when pulp price decreased. In 2024, pulp price started to rise again but the revenue stayed quite stable.

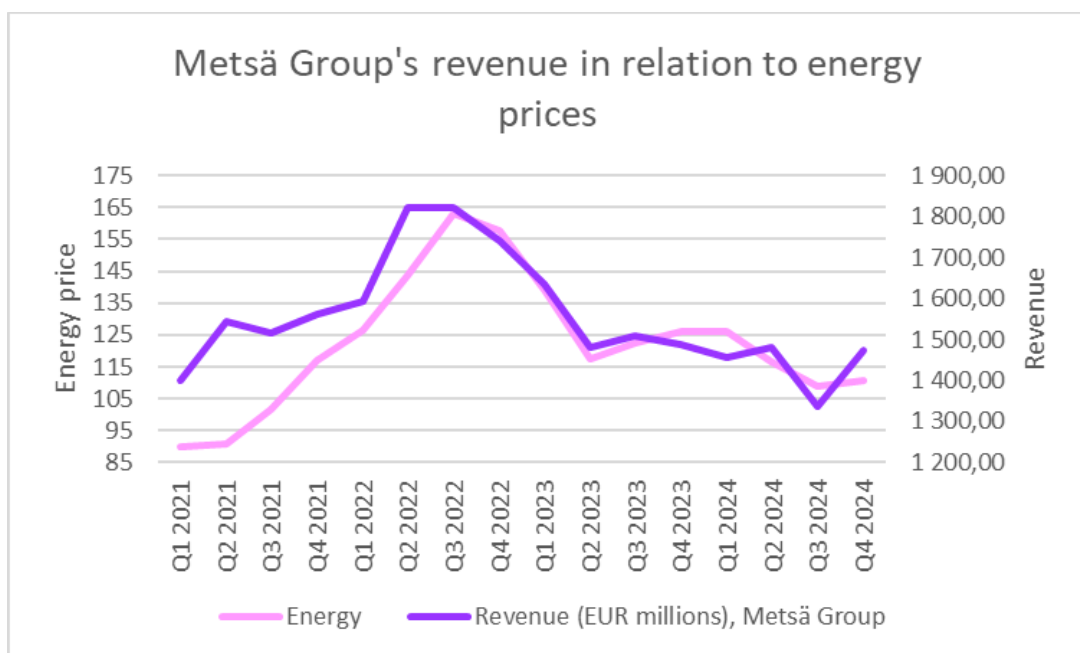


Figure 9. Metsä Group's revenue in relation to energy prices

Figure 9 compares Metsä Group's revenue to energy prices during every quarter of a year from 2021 to 2024. It shows that when energy prices started to rise more in 2022, Metsä Group's revenue increased. After that, the revenue followed energy price changes very similarly.

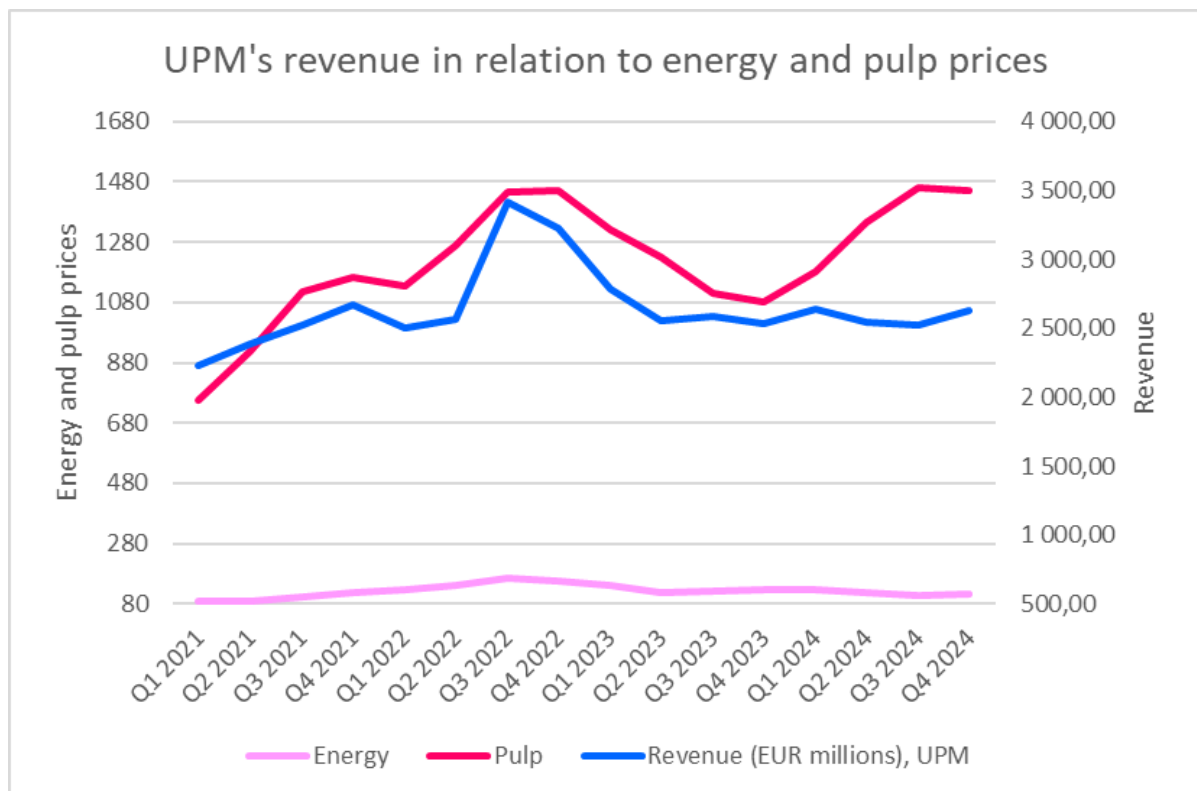


Figure 10. UPM's revenue in relation to energy and pulp prices

Figure 10 gives an overview of energy and pulp prices in comparison to UPM's revenue. It can be seen that pulp price changes are clearer than energy price changes, but energy prices still followed a same kind of pattern with energy prices and UPM's revenue. The revenue peaked with energy and pulp prices and decreased when the prices decreased. UPM's revenue also stayed moderate like Metsä Group's revenue, even though pulp prices increased again in 2024.

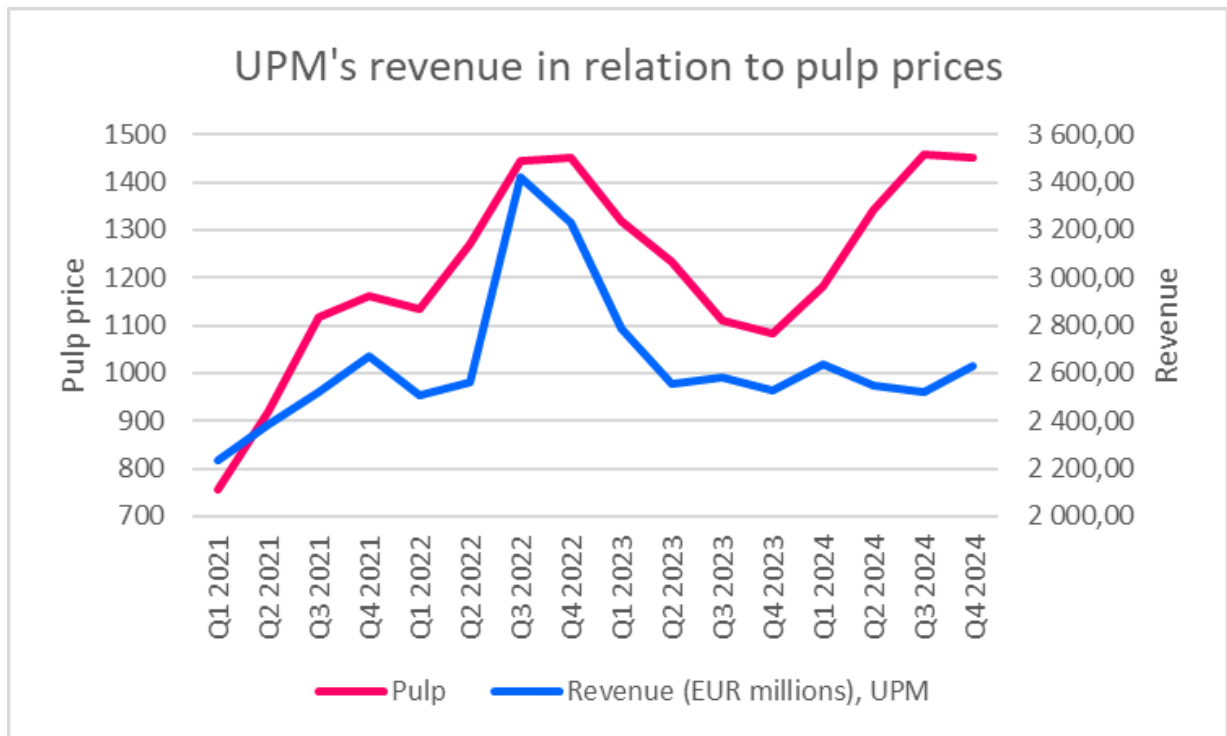


Figure 11. UPM's revenue in relation to energy prices

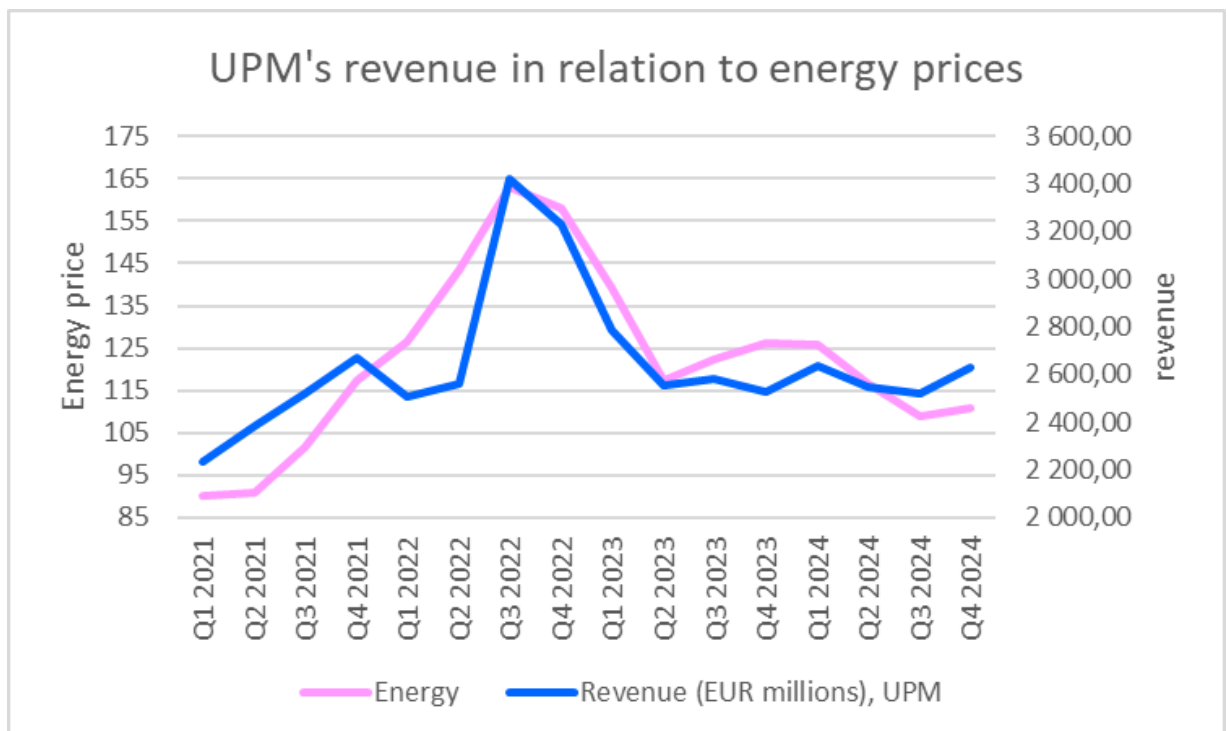


Figure 12. UPM's revenue in relation to pulp prices

Figure 11 shows UPM's revenue in relation to pulp prices. When analysing this figure, it can be seen that when pulp prices started to rise, UPM's revenue started to increase. Both pulp and energy prices peaked around Q3 2022. This is when UPM's revenue was also at its highest. Energy prices in relation to UPM's revenue can be seen in figure 12.

When pulp and energy prices increased, the companies had to sell their products at a higher cost since they had to pay more production costs. This is why their revenue increased noticeably during that time. When energy and pulp prices went down, the revenue of these companies also decreased.

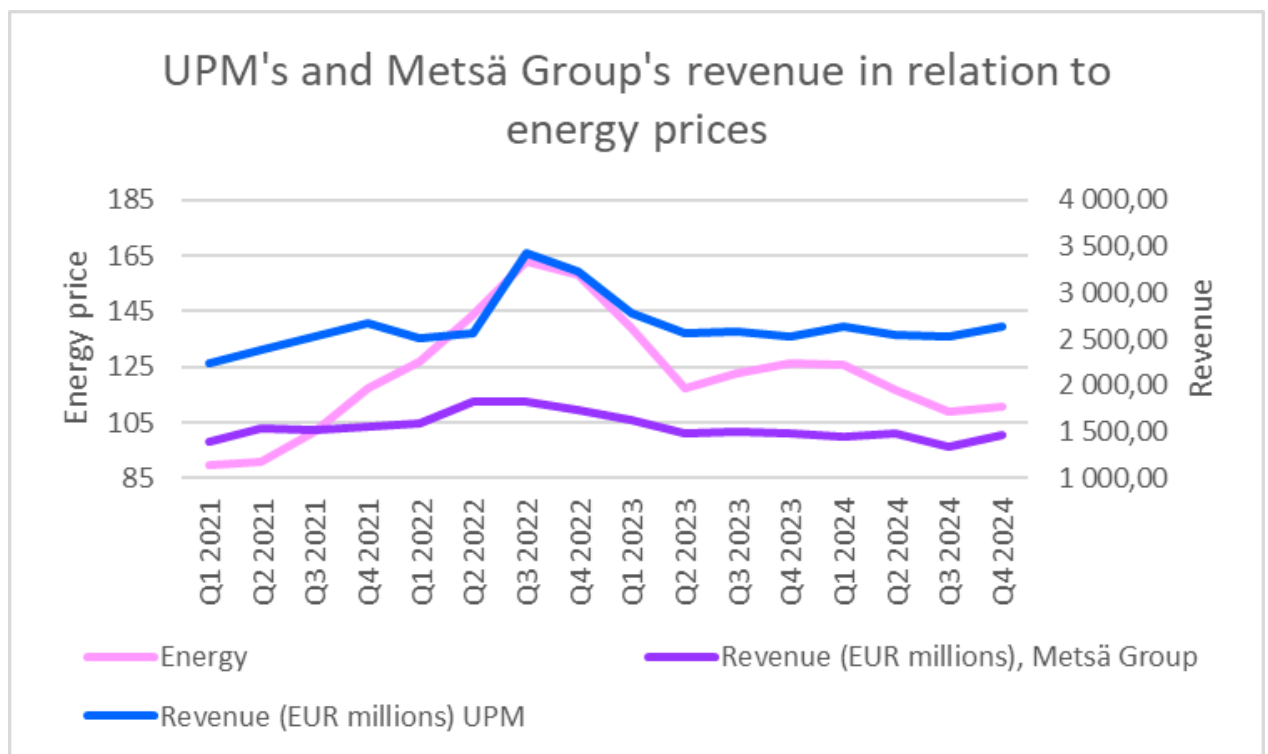


Figure 13. UPM's and Metsä Group's revenue in relation to energy prices

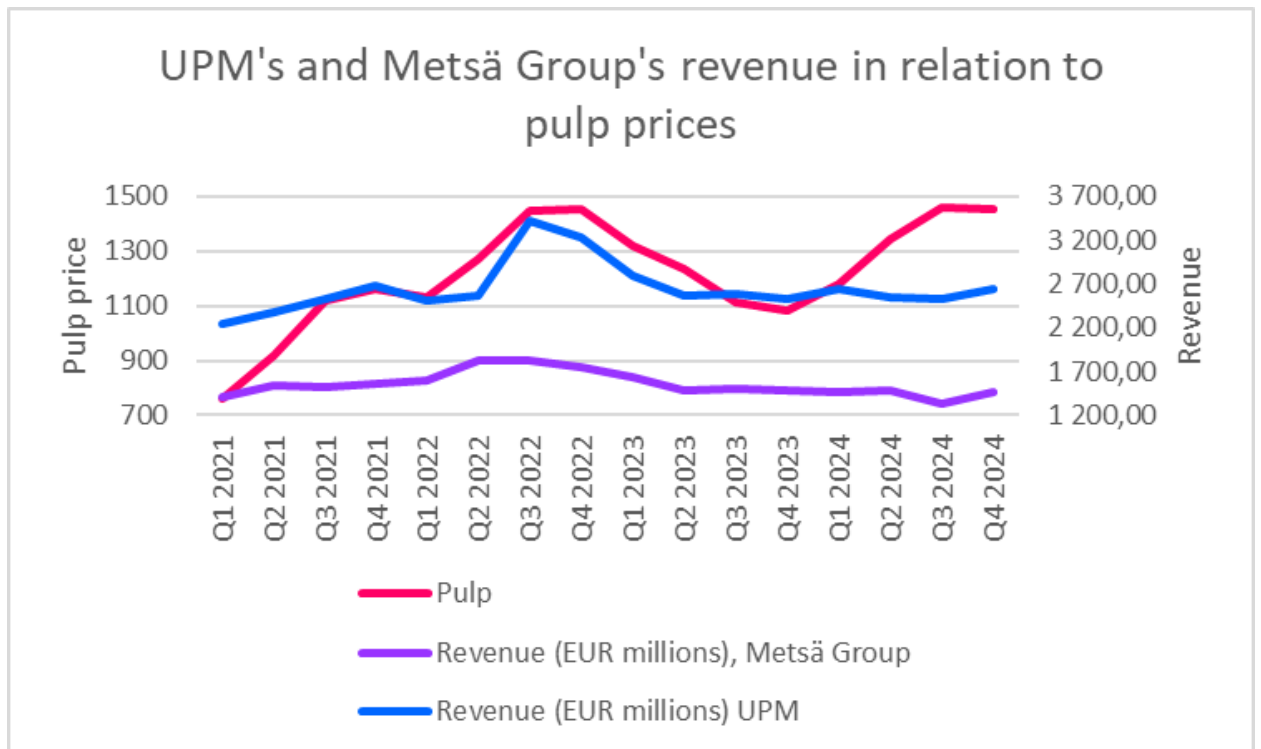


Figure 14. UPM's and Metsä Group's revenue in relation to pulp prices

It can be seen from figures 13 and 14 that when pulp and energy prices started to rise, UPM's revenue increased more rapidly compared to Metsä Group. The difference may be related to the companies' different business structures and exposure to pulp and energy markets. UPM has a separate energy business and large pulp operations (UPM, 2023). Metsä Group on the other hand, operates across a broader range of forest industry businesses (Metsä Group, 2023).

4.1 Wood import to Finland

In 2022, Russia's share of wood imports to Finland fell by 27% and due to sanctions, wood imports from Russia stopped completely in July (Natural Resources Institute Finland, 2023). Estonia's share of wood imports to Finland increased to 23% and Latvia's to 21%, and the share of wood imported from Sweden was 18% (Natural Resources Institute Finland, 2023).

4.2 Companies' responses to geopolitical risks

When the war started, UPM and Metsä Group were both affected and rising energy and pulp prices complicated the production processes of these companies (Metsä Group, 2022; UPM, 2022).

When sanctions against Russia started in 2022, energy and pulp prices increased significantly, causing increased production cost for both UPM and Metsä Group (Metsä Group, 2023; UPM, 2025a). Due to this, the companies had to increase prices due to high wood prices which increased their revenue (Metsä Group, 2024). This was one main response to the geopolitical risk. By increasing prices, the companies were able mitigate the impact of rising costs.

Both companies changed and expanded their wood procurement sources after imports from Russia ended (Metsä Board, 2023; UPM, 2023a). This is when a supplier selection process is needed. As previously mentioned, in order for the companies to avoid inadequate suppliers, they have to make sure that the supplier is qualified (Beil, 2011, p. 3). It is said in UPM's annual report (2023a) that UPM concentrated on certification, biodiversity supporting measures and wood traceability. This helped UPM to ensure reliable and responsibly sourced wood when procurement had to be shifted away from Russia.

Both companies used risk management steps that are identification of a risk, assessing the risk, selecting the best risk management strategy and implementing it (Manuj & Mentzer, 2008a, p. 144). In 2021 UPM and Metsä Group identified the geopolitical risk and assessed the possible consequences (Metsä Group, 2022; UPM, 2022).

Risk management strategies that UPM used were shutting down unnecessary mill in 2021, suspending deliveries to Russia and stopping wood purchases from Russia, and also stopping operations at the UPM Chudovo plywood mill in 2022 (UPM, 2022). UPM also wrote down all business assets and receivables in Russia due to significant uncertainties surrounding its operations in Russia as a part of risk management (UPM, 2023b).

One main risk management strategy from UPM was to completely withdraw operations from Russia by selling its Russia operations in 2023 (UPM, 2024b). In 2024, UPM shut down production at Hurth newsprint mill and Norland papier fine paper machine in order to handle the risks of declining demand (UPM, 2025b). On top of this, UPM adjusted production at Kaukas and Kymi pulp mills so that it would be better aligned with the prevailing market situation (UPM, 2025b). One main risk management strategy was to procure wood from other regions since it could not be sourced from Russia. The companies compensated for the loss of Russian wood by increasing procurement from other sources (Metsä Board, 2023; UPM, 2023a).

On top of procuring wood from other sources than Russia, Metsä Group's risk management strategies included closing its operations in Russia in 2022, opening new raw material sources and product markets, and temporarily shutting down production at its central European mills (Metsä Group, 2023). Metsä Group launched a new generation sawmill that utilized new technologies to improve operational and quality control (Metsä Group, 2023). This helped the company to reduce operational risks, improve production efficiency, and maintain consistent product quality (Metsä Group, 2023). By integrating the sawmill into pulp mill, Metsä Group was able to get significant benefits in energy use and logistic efficiency which was a great way to manage risks caused by the Russia-Ukraine war (Metsä Group, 2023). Metsä Group also sold its and in Poland, and ended lease agreements related to Russian operations as a risk management strategy.

Metsä Group strengthened its market position by investing in a new generation tissue production line in Mariestad (Metsä Group, 2025). This helped Metsä Group to increase production efficiency and improve competitiveness (Metsä Group, 2025). Metsä Group also renovated its board mill in Simpele and tissue mill in Mänttä.

5 Conclusions

Supply chain is an important part of business development, and it has to operate efficiently in order for the company to receive competitive advantage (Nguyen et al., 2022, p. 635). Company's strategies must be aligned with the supply chain, and it needs to follow resources, markets and the company's strengths (Nguyen et al., 2022, p. 635). A well operating and successful company does not exist without a reliable supply chain (Nguyen et al., 2022, p. 635). Supply chain management is actions taken to manage the supply chain from within the company focusing on movement of the goods and supporting efficient production (Nguyen et al., 2022, p. 636). Global supply chain management takes a broader approach and focuses on the whole system (Nguyen et al., 2022, p. 636).

Russia started war in Ukraine on February 2022 (Nguyen et al., 2022, p. 634). This created a global geopolitical risk that affected multiple industries worldwide. One of these were forestry industry that suffered from increasing production costs and supply chain disruptions due to the war.

Activity that causes uncertain outcomes creates a risk (Aven, 2015, p. 13). Risk can push away from ideal outcomes (Manuj & Mentzer, 2008b). Risk in supply chain can lead to decrease in sales, profitability and asset utilization hence damaging the company's performance (Hendricks & Singhal, 2005). Companies with supply chain risks usually encounter late deliveries, poor supplier quality, and imbalance between supply and demand (Hendricks & Singhal, 2005; Wagner & Neshat, 2012). UPM aimed to reduce risks that came from the imbalance of demand and production by shutting down its papermill in Kaipola (UPM, 2022). UPM also closed production at Norland Papier fine paper machine, shut down production at Hurth newsprint mill, and adjusted production at the UPM Kaukas and UPM Kymi pulp mills. These decisions were made in order to optimise the supply chain and reflect market changes (UPM, 2025b). For the same reasons, Metsä Group had production restrictions at the Punkaharju and Suolahti mills and temporary production shutdowns at Metsä Tissues Central European mills (Metsä Group, 2023).

Geopolitical risk is a threat that can disrupt normal international relations (Gong & Xu, 2022). It is caused by events like political tensions, terrorism and wars (Gong & Xu, 2022). In order to manage geopolitical risks, sanctions can be imposed on countries that engage in harmful actions (Haass, 1997, p. 1). Sanctions can protect human rights, civilians, and environment. They can also prevent mass destruction and terrorism (Ronzitti, 2016, p. 10; Haass, 1997, p.1). The sanctions against Russia made it impossible for forestry companies to continue sourcing wood from Russia (Metsä Board, 2023; UPM, 2023a). UPM and Metsä Group had to shift their wood procurement operations completely to Finland, Sweden, and Baltic region (Metsä Board, 2023; UPM, 2023). This is when supplier selection is important. A company that needs a supplier will perform supplier selection process that identifies, evaluates and establishes a contract with a reliable supplier (Beil, 2011, p. 1). When supplier selection process is done well, it reduces the chance of late delivery, non-delivery, or delivery of faulty goods (Beil, 2011, p. 3).

When choosing a supplier, the company has to decide whether it wants to use single supplier or multiple suppliers (Beil, 2011, p. 1). Companies might choose only one supplier to cut costs but this creates a higher risk for supply disruptions (Beil, 2011, p. 7). When using multiple suppliers, supply sources are more diversified and supply disruption risks are lower (Beil, 2011, p. 8). UPM and Metsä Group both had sourced wood from other countries on top of Russia. After the war started, they increased sourcing from other countries and stopped operating in Russia (Metsä Board, 2023; UPM, 2023). This was one of the main points how they have survived during this geopolitical risk. Choosing suppliers from different regions reduces risks by not relying on a single area or country (Beil, 2011, p. 11).

To answer the first research question: How did the Russia-Ukraine war affect Finnish forestry companies supply chains? Since Russia is one of the top energy producers in the world, energy prices increased significantly which difficulted UPM's and Metsä Group's production (Gong & Xu, 2022; Metsä Board, 2023; UPM, 2023a; UPM, 2025b). High

energy prices also increased pulp prices due to pulp production consuming a lot of energy (UPM, 2024a). The Russia-Ukraine war affected Finnish forestry companies supply chain by making it impossible to continue sourcing wood from Russia (Metsä Board, 2023; UPM, 2023a; UPM, 2025b). Due to this reason, the companies had to increase sourcing wood from Finland, Sweden, and Baltic region in order to compensate for the wood supply that could no longer be sourced from Russia (Metsä Board, 2023; UPM, 2023). The companies also needed to shut down mills due to significantly increased energy prices (Metsä Board, 2023; UPM, 2023).

To answer the second research question: How can strategic supply chain management mitigate the effect of geopolitical risks? Strategic supply chain management mitigates the effect of geopolitical risks by offering an alternative way to procure raw materials, making sure that there are no supply disruptions, and keeping costs under control (Beil, 2011; Isaac & Fouda, 2025; Metsä Board, 2023; UPM, 2023a)

Decision makers should focus on building a resilient and flexible supply chain by ensuring reliable suppliers and avoid depending on single supplier. Multiple suppliers can reduce the impact of disruptions since other supplier is able to compensate for lost supply if one source becomes unavailable (Beil, 2011, p. 8). During challenging market conditions, companies should also consider reducing activities and resources that are no longer economically reasonable. Metsä Group and UPM closed some of their production facilities in response to changing market demand (Metsä Group, 2023; UPM, 2022). This helped them to adjust their operations to current conditions. Investment decisions should also be made carefully and based on thorough consideration of whether or not it would bring long-term benefits for the company. During a challenging time, Metsä Group made major investments on a new generation tissue production line and an advanced Kerto LVL mill (Metsä Group, 2025). This was a well thought out plan that strengthened Metsä Groups market position and helped the company to survive in difficult conditions.

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