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Risk management in the procurement of critical raw materials during geopolitical crises

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ABSTRACT:

This thesis explores how companies can manage procurement risks of critical raw materials during geopolitical crises to ensure supply chain resilience. The aim is to understand how disruptions in critical raw material supply chains arise and how procurement strategies are able to mitigate their impact. As global supply chains become increasingly complex and exposed to geopolitical tensions, understanding how to maintain stable material flows becomes vital for organisations operating under uncertain conditions.

This study was carried out as a narrative literature review. A wide range of sources and articles concentrating on critical raw materials, procurement and supply chain risks, and resilience are used in this thesis. This study primarily uses research published after 2020 on these subjects.

The findings from the literature review suggest that procurement risks that arise during geopolitical crises are supply disruptions, trade barriers imposed by governments and compounding risks. These risks lead to supply disruptions, increased costs and reduced supply chain performance. The literature indicates that procurement strategies such as diversifying suppliers, spot market sourcing, long-term relationships with suppliers, and improved transparency reduce these risks. In addition, supply chain risk management practices support the ability to anticipate and respond to disruptions, which strengthens resilience.

KEYWORDS: Procurement, critical raw materials, resilience, supply chain risk management, geopolitical crisis

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Tiivistelmä:

Tutkielmassa tarkastellaan kriittisten raaka-aineiden hankintaan liittyvien riskien hallintaa geopoliittisten kriisien aikana toimitusketjujen resilienssin varmistamiseksi. Tavoitteena on ymmärtää miten häiriöt kriittisten raaka-aineiden toimitusketjuissa syntyvät ja miten hankintastrategioilla voidaan vähentää niiden vaikutuksia. Globaalien toimitusketjujen muuttuessa yhä monimutkaisemmiksi ja alttiimmiksi geopoliittisille jännitteille on tärkeää ymmärtää, miten materiaalivirtojen vakaus voidaan turvata epävarmoissa toimintaketjuissa.

Tutkielma on toteutettu narratiivisena kirjallisuuskatsauksena. Aineistoina on käytetty laajasti lähteitä ja artikkeleita, jotka käsittelevät kriittisiä raaka-aineita, hankintaa, toimitusketjujen riskejä sekä resilienssiä. Tutkimus perustuu pääasiassa 2020-luvulla julkaistuun tutkimusaineistoon näistä aiheista.

Kirjallisuuskatsauksen tulokset osoittavat, että geopoliittisten kriisien aikana syntyviä harkintariskejä ovat toimitushäiriöt, valtioiden asettamat kauppaesteet sekä kumuloituvat riskit. Nämä riskit johtavat toimistuskatkoksiin, kustannusten kasvuun ja toimitusketjun suorituskyvyn heikkenemiseen. Kirjallisuuden perusteella hankintastrategiat, kuten toimittajien hajauttaminen, spot-hankinnat, pitkäaikaiset suhteet toimittajiin sekä toimitusketjun läpinäkyvyyden parantaminen, voivat vähentää näitä riskejä. Lisäksi toimitusketjun riskienhallintakäytännöt tukevat kykyä ennakoida ja hallita häiriöitä, mikä vahvistaa resilienssiä.

AVAINSANAT: Hankinta, kriittiset raaka-aineet, resilienssi, toimitusketjujen riskienhallinta, geopoliittinen kriisi

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Abbreviations

- **CRM** – Critical Raw Material
- **CRMA** – Critical Raw Materials Act

1 Introduction

Critical raw materials have a central role in modern industries such as renewable energy, electronics and defence (Nwaila, 2024, p. 8). This importance gives them a strong strategic role. However, critical raw material supply chains are complex, often have geographical concentrations and governmental actors (Månberger, 2023, pp. 75–76). These characteristics increase exposure to risks and make the supply chain more vulnerable to external disruptions.

In recent years, critical raw material supply chains are increasingly exposed to geopolitical risks, which have made their procurement risks an important area of study. Events such as natural disasters and human-induced threats including war, political unrest and terrorism are major risks to these supply chains (Ho et al., 2015, p.4). The recent Russian invasion to Ukraine has brought global attention to the risks geopolitical tensions pose to supply chains (Dietrich & Melcher, 2022, p. 595).

The effects of supply chain disruptions on the procurement of critical raw material is important to study, as material shortages can disturb production lines, which negatively impact profitability (Li, 2025, p. 865). As companies become more dependent on these global supply chains, understanding how to manage these risks becomes increasingly important.

1.1 Theoretical framework

Various risks can impact supply chains, potentially disrupting operations and reducing performance. Within supply chain management, risk is defined as the possibility of an event which can prevent processes from working as planned or disrupt material flows (Waters, 2009, p. 474). According to Waters (2009, p. 474-475), risks may arise from external factors such as supply shortages or geopolitical tensions, or from internal operations. Disruptions can lead to delays, shortages of materials or increased costs, all of which harm procurement and the company as a whole.

Procurement strategies are crucial in mitigating supply chain risks by ensuring the availability of materials. Procurement strategies such as supplier diversification, supplier risk assessments and long-term supplier relationships are used to mitigate supply risks (Li, 2025, pp. 870–874). Supplier diversification decreases dependency on individual suppliers, while long-term relationships with suppliers help secure a stable supply. Supplier risk assessments can be conducted to make more informed sourcing decisions and anticipate potential risks. Procurement strategies mitigate disruptions and help reduce supply risks.

Supply chain risk management framework provides a structured approach to address risks in supply chains. It consists of several key stages such as risk identification, assessment, management and monitoring (Ho et al., 2015, pp. 7–18; Rangel et al., 2015, p. 6870). Risk identification consists of recognising risks and potential sources of disruption. Ho et al. (2015, pp. 7–18) introduce risk assessment, then evaluates the likelihood of the risk happening and how it could impact supply chains. Risk management or mitigation focuses on reducing and controlling the impact of the disruptions (Rangel et al., 2015, p. 6870). According to Rangel et al. (2015, p.6870), risk monitoring is continuous and results in decision-making as the risk profiles change. The goal of the framework is to anticipate and prepare for disruptions and to minimize their effects on supply chain performance.

Resource dependence theory proposes that a company's resources can be classified as internal and external. The theory explains how being reliant on a small amount of suppliers for external resources increases vulnerability to supply risks (Zhou & Mei, 2025, pp. 3–4). This shows the need for companies to reduce the risks and dependencies that were created, by diversifying their suppliers and focusing on their sourcing strategy.

Risk management is a systematic process focused on identifying, analysing and responding to risks (Waters, 2009, pp. 476–477). The goal of risk management is to anticipate disruptions, respond effectively and recover from the impacts. Risk management is an integral part of creating resilience. Supply chain resilience is the capability to maintain the performance at sufficient levels during and after disruptions (Manners-Bell, 2024, pp. 33–34). Through proactive risk management, supply chains can better endure and recover from disruptions, which makes them more resilient.

Supply chain resilience theory describes how supply chains manage to withstand disruptions, respond to them and recover after adverse events (Guo et al., 2025, p. 1). Supply chains have the ability to adjust to changing conditions and can return to optimal function after disruptions. A resilient supply chain should be capable of minimising the impact of disruptions, reduce recovery time and return to original or enhanced performance levels after disturbances (Christopher & Peck, 2004, p. 4). The theory emphasises how adaptability along with flexibility help companies manage and recover from disruptions effectively.

1.2 Objectives and research questions

The objective of the thesis is to analyse how risks in critical raw material procurement are addressed in the literature in the context of geopolitical crises. The thesis aims to identify the main risk factors affecting critical raw material procurement, examine strategies to mitigate these risks and explore how these strategies contribute to resilient supply chains during geopolitical crises.

To achieve the objective, this thesis aims to address the following research questions:

Main research question:

> How can companies manage procurement risks of critical raw materials during geopolitical crises to ensure supply chain resilience?

Sub-questions:

1. What types of procurement risks arise during geopolitical crises?
2. What strategies are used to prevent or mitigate supply disruptions?
3. How do these strategies contribute to supply chain resilience?

1.3 Research methodology

1.3.1 Research design

To achieve the objectives of this study, a narrative literature review is conducted. It is conducted as a narrative literature review as this method is deemed the most appropriate for this study. The aim of a narrative literature review is to produce a critical comprehensive analysis of a given subject (Uchendu et al., 2023). This method fits the topic well as procurement risks, risk management strategies, geopolitical disruptions and critical raw materials have been studied in numerous articles, but the topics have not been studied together. This thesis aims to provide an overview of this topic by collecting and analysing earlier articles.

1.3.2 Data collection

The articles in this were collected from multiple different databases such as ABI Inform Complete (ProQuest), ScienceDirect (Elsevier), Academic Search Elite (EBSCO), Emerald and Springer Nature Link. Appropriate keywords are used in order to find articles suitable for this thesis. Keywords that are often used in different combinations are “critical raw materials”, “procurement”, “supply chain disruption”, “risk management” and “geopolitical crisis”. These keywords and variations of them were used with Boolean operators to find suitable and relevant articles.

1.3.3 Selection criteria

The selection criteria for the articles are academic, English language, peer-reviewed, full text available, published 2000-2026, with preference given to articles published between 2020-2026, relevant to the topic of the thesis and supporting the research

questions. The criteria used in a search depended on the search terms and the criteria that the database allows the user to set. Below Table 1. Shows how many articles were found using different search terms and criteria in different databases.

Table 1. Search results

Database	Keywords	Criteria used	Number of articles found
ProQuest	“critical raw material” AND (procurement OR sourcing)	Peer-reviewed, Full text, published 2020-2026	143
EBSCO	("critical raw material" OR CRM) AND (“supply chain disruption” OR “supply disruption” OR “procurement disruption”) AND (geopolitics OR war or "geopolitical crisis")	Peer reviewed, full text, published 2020-2026	47
ScienceDirect	"critical raw material" AND "risk management" AND (procurement OR sourcing)	Research articles, published 2020-2026	195
Emerald	“critical raw material” AND “risk management”	Published 2020-2026, open access	11
Springer Nature Link	“geopolitical crisis” AND (“supply chain resilience”) AND disruption	Published 2020-2026, open access, research article	26

1.3.4 Data analysis

Thematic analysis was used to examine the selected articles. Thematic analysis is a research method used to find, analyse and examine recurring themes and meanings in the selected data (Clarke & Braun, 2016, p. 197). This method helps find and understand the key concepts related to the research topic and research questions.

During the data analysis process, the abstracts and titles of articles were reviewed to make sure they matched what was searched for and the criteria set. Based on this step, it was decided which articles were considered for deeper analysis. The selected articles were then reviewed carefully, categorised into three themes: procurement of critical raw materials, supply chain and procurement risks, and supply chain resilience, and incorporated into the literature review presented in chapter 2. After the analysis process, 23 articles were selected to be used in this study, a list of which is provided in Appendix 1.

1.4 Scope and de-limitations

This study focuses on procurement risks in critical raw material supply chains, particularly in the context of geopolitical crises. The scope of the thesis is limited to analysing how procurement strategies and supply chain risk management practices can be applied to mitigate disruptions and improve supply chain resilience.

The study is limited to a general supply chain perspective and does not focus on a specific industry or company. Critical raw materials are considered as a broad category rather than examining individual materials in detail. The thesis focuses on external risks, particularly geopolitical risks, that affect critical raw material supply chains. Many fields of study can analyse these risks, but this study is conducted from the perspective of industrial management.

1.5 Reliability and validity

To ensure reliability and validity, this study uses selection criteria such as: published in an academic journal, English language and peer reviewed. Another criterion was that the selected articles were published recently. This ensures that the selected research is not outdated and has current value, which ensures the validity of this research. Earlier studies were considered if they were deemed relevant to the topic and provided

additional value. The JUFO rating of the publishing journals of these articles was also checked and journals with a rating between 1 and 3 were given priority.

A systematic approach was used on the selections and analytical processes to ensure consistency and transparency. The use of thematic analysis strengthens the study's validity by helping to identify repeat patterns within the data.

1.5.1 Ethical considerations

In order to maintain fair practice in research, all sources in this study are properly cited. Zotero was used as a tool for organizing sources during the writing process. All figures and tables included in this study are either taken from or based on other publications, which are appropriately acknowledged. Artificial intelligence has not been used to produce any text or materials for this thesis, and a statement regarding its use is provided in Appendix 2.

1.6 Structure of the thesis

This thesis is a narrative literature review organised into five main sections: an introduction, theoretical chapters on critical raw material procurement, procurement and supply chain risks, risk management and resilience, and finally a chapter presenting discussion and conclusions which are based on prior literature and theoretical frameworks.

2 Procurement of critical raw materials

2.1 Critical Raw Materials

To understand the importance of procurement strategies in managing supply risks, we must examine what are considered critical raw materials. There are multiple approaches to define, list and rank which materials are considered critical raw materials. According to Nwaila (2024, p. 2) different countries have different considerations and criteria that they use to compile lists, which then result in different materials being listed as critical. The most common criteria are economic importance, national security, and supply risk (Nwaila, 2024, p. 3). These criteria highlight the strategic value of these materials as well as their vulnerability to supply disruptions and supply chain risks.

In the European Union, critical raw materials are defined according to their supply risk and economic importance. As a result, the European Union identified 34 different critical raw materials in their most recent assessment (Nwaila, 2024, p. 2). The European Union published the Critical Raw Materials Act (CRMA) to set regulations and tackle supply challenges with these materials (Hool et al., 2024, pp. 662–663). The CRMA highlights the strategic importance as well as the governmental influence on critical raw material supplies. According to Hool et al. (2024, p.662), one of the key problems CRMA attempts to tackle is the anticipation and mitigation of supply risks of critical raw materials. This highlights the importance of risk management in the critical raw material supply chain as it is noted on the policy level.

Critical raw materials get their strategic significance from the industries that use them. These materials are vital for many modern technologies such as magnets and batteries, which are used in renewable energy technologies, electric vehicles and defence technologies (Nwaila, 2024, p. 8). The demand for critical raw materials has been growing rapidly in recent years and is expected to keep increasing rapidly in the future. According to Maisel et al. (2023) the growth green energy and electric vehicle

industries is a key driver in the increased demand for these materials. It is estimated that the current production capacity of critical raw materials including cobalt and lithium would need to increase significantly to meet the future demand (Maisel et al., 2023). The process of opening new production plants is slow, and demand is growing fast, which may cause increased competition for these materials in the future.

2.1.1 Geographical concentrations and dependencies

Industries around the globe are highly dependent on critical raw materials, but they are geographically concentrated in specific regions. These concentrations create complex global supply chains that are exposed to disruptions. As Maisel et al. (2023) note, these concentrations create dependencies, which then create supply risks. This supports the resource dependence theory, which argues that reliance on a limited number of suppliers increases vulnerability to supply risks (Zhou & Mei, 2025, pp. 3–4).

The extraction of critical raw materials is concentrated in a small number of countries. According to Maisel et al. (2023), several critical raw materials are mined almost exclusively in specific geographical regions, which creates global dependencies on a small number of countries. These geographical concentrations are illustrated in Figure 1, which shows the countries which hold the largest shares of the global critical raw material supply. As Figure 1 shows, certain countries account for significant shares of the supply of certain critical raw materials. For example, cobalt mining is heavily centered in the Democratic Republic of Congo (European Commission, 2023, p. 47). This concentration of supply creates large-scale dependencies to specific regions, increasing the vulnerability to regional disruptions.

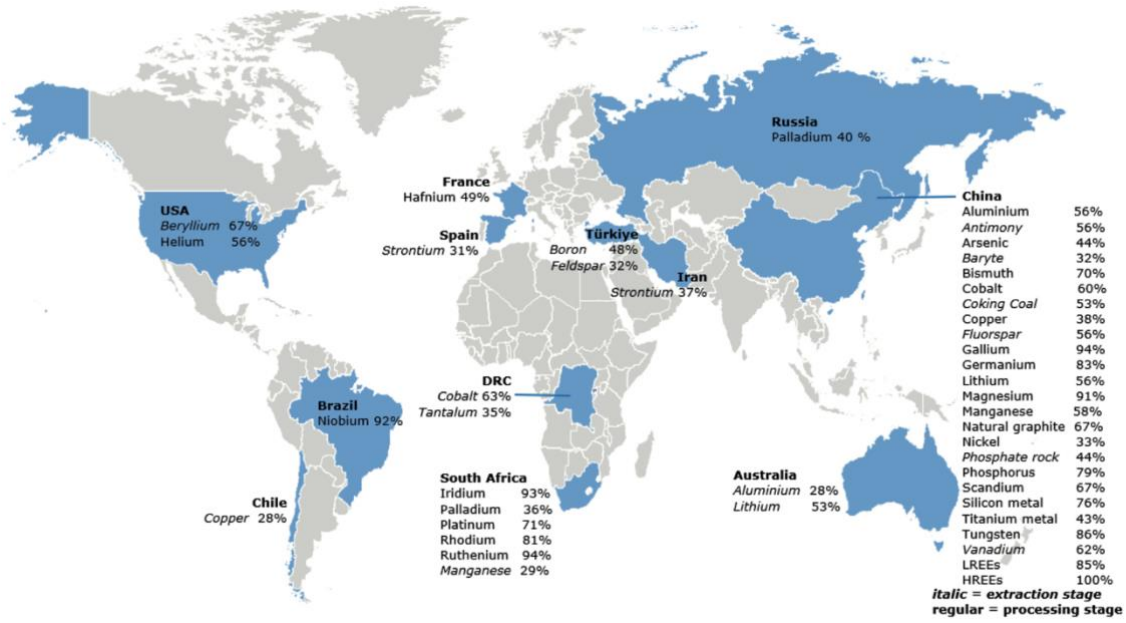

Figure 1. Countries representing the largest portion of global supply of critical raw materials (European Commission, 2023)

The refining and processing of CRMs are even more geographically concentrated than their mining. For example, China holds a dominant role in the processing of several key materials, such as graphite, accounting for a significant share of the global processing capacity (Maltais et al., 2026, p. 8). These kinds of concentrations create strong global dependencies on the countries a limited number of suppliers and countries that process these materials. As a result, critical raw material supply chains are complex, and disruptions can happen in refining and processing in addition to mining. As a consequence, disruptions can occur at multiple points in the supply chain, making it challenging to predict and manage them.

2.2 Procurement in critical raw material supply chains

Procurement is a central function in supply chains and companies. Waters (2009, p. 304) defines procurement as the process of acquiring materials by an organisation. In a broader sense, procurement encompasses all the activities that are required to acquire the necessary resources from external suppliers (Van Weele, 2010, pp. 5–7).

Procurement has a key role in supply chains, as it is responsible for ensuring material availability and coordinating the material flows.

Traditionally, cost and speed have been among the driving criteria when choosing suppliers (Hult et al., 2014, pp. 159–161). Procurement has been driven by these factors because they can give a competitive advantage. However as critical raw material supply chains are complex, other factors become increasingly important. According to Li (2025, p. 865) stabilization of critical raw material supply flows is one of the key objectives in procurement strategies.

To maintain a steady supply of critical raw materials, companies need to adopt long-term procurement strategies. Typically, the mining and refining of these materials is a time-consuming task and it takes years to develop more production capacity (Ku et al., 2024, pp. 1212–1214). As a result, companies aim to create long-term partnerships with suppliers to establish the continuity of supply. Li (2025, p. 873-874) finds that long-term supply agreements and strong relationships with key suppliers ensure timeliness and reliability, which help ensure consistent access to critical raw materials.

At the same time, procurement strategies need to remain flexible and adaptable. Supply chains are exposed to changing conditions, which may lead to disruptions or shifts in material availability (Ku et al., 2024, pp. 1208–1209). The ability to react to these disruptions is integral, as material shortages can disrupt production processes and negatively impact profitability (Li, 2025, p. 865). This highlights the importance of procurement strategy, which balances long-term supply stability with short-term adaptability to respond to changing conditions.

3 Procurement and supply chain risks

Supply chain and procurement risks are closely interconnected and often influence one another. In a supply chain context, risks can be defined as the likelihood of unexpected events that impact the supply chain, which can lead to operational, strategic or tactical irregularities and failures (Ho et al., 2015, p. 5). These risks can greatly impact supply chain performance, which is why understanding the types of risks and their sources is important.

Supply chain and procurement risks are classified in a variety of ways in the literature. One of the earlier classifications was proposed by Ghoshal (1987, p. 430), who divides supply chain risks into four categories. The categories Ghoslal (1987, p.430) proposed are macroeconomic, policy, competitive and resource risks. This classification provides a broad overview of possible risks, but it does not best suit the complex nature of modern global supply chains. A more recent proposed classification system by Rangel et al. (2015, pp. 6885–6886) categorises risks based on which part of the process they affect. This classification offers a more detailed classification that fits complex global supply chains better, as it differentiates more risks and their sources.

3.1 Types of risks

Supply chain and procurement risks can arise from internal or external sources. External and internal risks can also be referred to as macro and micro or disruption and operational risks (Ho et al., 2015, p. 4). According to Manners-Bell (2024, pp. 10–11) internal risks can be external to the company and occur within the supply chain, while external risks originate outside the supply network and are largely beyond the organisation’s control. Ho et al. (2015, p.4) describe external risks as adverse relatively rare events such as natural disasters and man-made risks such as war, terrorism and political instability. In contrast, internal risks are recurrent events that originate from within the supply chain or company such as demand, supply, manufacturing and infrastructure risks (Ho et al., 2015, p. 4).

Supply risks are particularly important in the context of procurement, as they directly affect the availability of materials. According to Ho et al. (2015, p. 4) supply risks are defined as risks that affect upstream actors in supply chains. Rangel et al. (2015, p. 6885) further classify supply risks as stemming from supply chain process inefficiencies such as the unavailability of materials, increased price and problems in the flow of material. These risks directly impact procurement, because they influence material availability and cost.

Rangel et al. (2015, p. 6885) describes environmental risks as originating outside the supply chain such as environmental, governmental and economic instabilities. Environmental risks are often sudden and unexpected, which can cause a shock to the supply and make it more difficult to transport goods. Other risks such as economic and governmental are less sudden but can have a large impact on businesses. For example, Manners-Bell (2024, p. 29) names trade wars as a particular risk for importers, which can raise prices and affect the trade of strategic goods.

External shocks and disruptions may lead to the disruption of material flows. Rangel et al. (2015, p. 6885) describe disruption risks as resulting from discontinuity in the flow of materials within the production process. These risks are often caused by external matters such as those associated with environmental risks, they may also be caused by internal failures within the supply chain.

The frequency and impact of supply chain risks increase as the complexity of supply chains increases. Bode and Wagner (2015, p. 215) find that disruptions are more frequent in complex and interconnected supply chains, since dependencies between actors increase the supply chain's vulnerability to disruptions. Ivanov et al. (2014, p. 15) highlight that disruptions can create ripple effects across supply chains, spreading the impact of the across the supply chain. Ripple effects cause a local disturbance to spread to other actors and affect the supply chain upstream and downstream leading to an impact on the performance of the supply chain (Ivanov et al., 2014, p. 2).

3.2 Procurement risks in the context of critical raw materials

Critical raw materials amplify certain procurement and supply chain risks due to the characteristics of their supply chains. The supply chains are complex, global and difficult to trace (Dietrich & Melcher, 2022, p. 596). This complexity, combined with the dependencies within the supply chain, increases the likelihood of disruptions (Bode & Wagner, 2015, p. 215).

As discussed in Section 3.1, both the mining and refinement of critical raw materials are geographically concentrated in only a few geographical regions. These concentrations create dependencies on specific countries and suppliers, which increase the risk of supply disruptions (Månberger, 2023, pp. 75–76). Such dependencies hieighten the exposure to geopolitical tensions. Liu et al. (2023, pp. 14–15) demonstrate that China's cobalt supply chains are highly vulnerable to disruptions due to their reliance on the Democratic Republic of Congo as a supplier. This dependence disruption risks as a significant share of global supply originates from a single region.

These dependencies reduce flexibility in procurement, as companies have fewer alternatives for sourcing. For example, cobalt mining is heavily concentrated in the Democratic Republic of Congo, which illustrates how global supply chains rely on a limited number of regions (Liu et al., 2023, p. 2). Therefore, there is a limited number of suppliers, which makes identifying alternative suppliers difficult. In addition, disruptions may affect a whole region or countries instead of individual suppliers. Macro risks that Ho et al. (2015, p. 4) describe such as natural disasters or war, could disturb the material production in a specific region. A disruption that affects all of the actors in a certain region can trigger supply chain disruptions globally (Månberger, 2023b, pp. 75–76). In these cases, identifying alternative suppliers can be challenging due to their limited availability worldwide.

The strategic and economic significance of critical raw materials intensifies procurement risks. These materials are essential for major industries, such as electric vehicle and renewable energy, to operate worldwide (Nwaila, 2024, p. 8). According to Hool et al.(2024, pp. 662–664), many European countries are dependent on imports to secure access to these critical raw materials. This dependence can be used as a method to advance foreign policy by the supplier countries' governments (Månberger, 2023a, p. 76). Tariffs, export restrictions and other trade barriers may be used, which can affect the cost and amount of available material worldwide and disrupt procurement processes.

According to Dietrich and Melcher (2022, p. 596) critical raw material supply chains are difficult to trace, which makes the anticipation of risks more difficult and increases the chances of unexpected external disturbances having a large-scale impact. Such disturbances can create ripple effects throughout the supply chain (Ivanov et al., 2014, p. 15). These ripple effects may spread upstream and downstream, which can weaken the supply chain performance. The limited transparency in these supply chains reduces the ability to anticipate disruptions, which further increases exposure to external risks(Dietrich & Melcher, 2022, p. 596). As a result, companies may be unaware of their supply chains exposure to high-risk regions for disturbances.

3.3 Geopolitical risks in critical raw material procurement

Geopolitical risks have a central role in the risk management of critical raw material procurement. A widely used definition of geopolitical risk is by Caldara and Iacoviello (2022, p. 1197) who define it as "the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tension among states and political actors that affect the peaceful course of international relations". These risks are largely beyond the control of an individual organisation, which makes them external or an macro risk (Ho et al., 2015, p. 4).

Government policies and trade measures are among the key geopolitical risks in critical raw material procurement. Gheorghe and Panazan (2025, pp. 3–4) note that critical raw materials are frequently affected by export bans, sanctions or strategic supply disruptions. Consistent with this, Hunger et al. (2026, p. 2) note that export restrictions targeting critical raw materials have increased drastically in the last decade. The strategic importance of the materials is a key reason behind their classification as critical raw materials (Nwaila, 2024, p. 3).

The strategic nature of these materials creates an opportunity for producing countries to advance their government policies by affecting the trade flows and supply availability. As Månberger (2023, pp. 75–76) highlights, producer countries can weaponise supply by restricting exports or imposing tariffs, which significantly affects the procurement of these materials. While typically producer countries are the ones using restrictions, Dietrich and Melcher (2022, p. 595) note that importing nations may impose trade measures. In the case of the war in Ukraine, import restrictions were used by the European Union (Dietrich & Melcher, 2022, p. 595). These restrictions force organisations within these nations to seek alternative sourcing options.

Geopolitical disruptions can occur simultaneously across multiple regions, which further complicates procurement processes. Roscoe et al. (2022, pp. 1409–1410) highlight that geopolitical risks are often compounding, where several different geopolitical events interact and amplify the overall risk. This makes it difficult to anticipate the impact of a specific disruption and to maintain stable sourcing strategies. Gheorghe and Panazan (2025, pp. 13–14) highlight that the effects of individual disruptions can be difficult to isolate during times in which multiple geopolitical crises occur simultaneously.

4 Procurement risk management and supply chain resilience

Supply chains and procurement processes are subject to a variety of risks, such as the those discussed in the previous sections. To address these risks there are multiple strategies, such as the supply chain risk management framework. Supply chain risk management framework consists of several key stages such as risk identification, assessment, management and monitoring (Ho et al., 2015, pp. 7–18; Rangel et al., 2015, p. 6870). Procurement risk management strategies such as long-term supplier contracting and diversification may be utilised (Li, 2025, p. 873-874).

Risk management strategies aim to reduce and manage risks, while also aiming to improve the supply chain's capacity to cope and respond to risks. Supply chain resilience is the ability to return to the original or a improved state after being disturbed (Christopher & Peck, 2004, p. 4). Guo et al. (2025, p.1) describe resilience theory as supply chains are able to withstand disruptions, respond to them and recover after adverse events.

4.1 Procurement risk management strategies

A fundamental part of risk management is the use of a systematic, structured approach to identify, respond to and monitor risks. According to Ho et al. (2015, pp. 7–18) a supply chain risk management framework typically involves stages of identifying a risk, assessing it, managing it and continuously monitoring for risks. Additionally Rangel et al. (2015, pp. 6885-6886) highlight that all parts of a supply chain contain vulnerabilities, which makes continuous monitoring essential. The effective use of a supply chain risk management framework can help organisations anticipate potential disruptions and their impact (Ho et al., 2015, p. 26).

One of the most notable strategies to combat procurement risks is supplier diversification. By utilising multiple sourcing and further diversifying supplier location across different regions, organisations can help mitigate risks (Guo et al., 2025, p. 451).

Hunger et al. (2026, p. 2) note that supplier diversification is frequently identified as one of the key methods of risk management in previous literature. Similarly Li (2025, p. 871) notes that diversification can act as a buffer against the impact of disruptions. Additionally Roscoe et al. (2022, p. 1424) highlight that a key principle behind supply chain managementto maintain supply continuity, which is typically achieved by maintaining a diverse set of suppliers and in some cases relocating functions to other regions. However, Hunger et al. (2026, p.5) note that while diversification reduces risks, it also leads to more complexity in supply chains and higher costs.

Diversification, long-term contracts and strong relationships with suppliers can help cope with disruptions. Li (2025, p. 873-874) describes that long-term supply agreements ensure reliability and timeliness. Hosseini Shekarabi et al. (2025, p. 719) find that using a multi-tier sourcing promotes agility when supply chains are faced with a disruption. In the case of critical raw materials, this can be difficult as identifying lower-tier actors can be challenging due to the limited supply chain transparency (Dietrich & Melcher, 2022, p. 596). Improving the transparency of the supply chains is therefore a key step in better anticipating and identifying risks.

Flexibility and adaptability are critical components of procurement risk management. Spot market sourcing can be used to improve procurement flexibility as an alternative to long-term supplier contracts. Hunger et al. (2026, p. 11) highlight that spot market sourcing reduces dependencies on critical suppliers. However, Hunger et al. (2026, p. 11) also note that organisations should fully rely on spot market sourcing, as its reliability is not perfect especially during geopolitical disruptions. Short-term effects of a disruption can also be managed by stockpiling or building an inventory buffer (Guo et al., 2025, p. 458). However, stockpiling is expensive and not a long-term strategy as reserves may be depleted quickly in case of high demand (Guo et al., 2025, p. 451).

Strategic shifts such as re-shoring or friend-shoring can be adopted in order to mitigate geopolitical risks (Maltais et al., 2026, p. 1217). For example, Maltais et al. (2026, p.

2017) note that Russia's invasion to Ukraine has led to the European Union to adopt re-shoring and friend-shoring strategies. However Ku et al. (2024, p. 1217) note that re-shoring can trigger reciprocal action from the other parties. Relocating supply chains is a time-intensive and expensive process and may not always be possible, such as in the case of mining for critical raw materials due to their geographical constraints.

Strategies for managing procurement risks are adapted according to the nature and impact of disruptions. Moradlou et al. (2025, pp. 847–849) find that organisations use different mitigation strategies when dealing with sudden disruptions compared to disruptions that unfold over a longer period of time. Ku et al. (2024, pp. 1213–1214) describe that in the context of critical raw materials, both short-term and long-term responses may need to be implemented to manage risks.

4.2 Supply chain resilience

Supply chain resilience describes a supply chain's ability to mitigate, adapt to and recover from disruptions (Guo et al., 2025, p. 450). In the context of critical raw material supply chains, resilience is particularly significant due to the exposure to a variety of risks and uncertainties. In addition Yang et al. (2025, p. 434) emphasise that supply chain resilience does not only concern the recovery, but also preparation and response during the uncertainties.

Ivanov et al. (2014, pp. 4–5) describe supply chain resilience as a process with similar stages as risk management frameworks such as preparedness, mitigation, stabilisation and recovery. Similarly, Yang et al. (2025, p. 434) propose that supply chain resilience can be assessed through absorptive, adaptive and restorative capacity. It has been shown that supply chain risk management positively contributes to supply chain resilience. (El Baz & Ruel, 2021, p. 8)

Risk management is therefore, a key component in building supply chain resilience. Hunger et al. (2026, p. 4) suggest that effective supply chain risk management

practices strengthen supply chain resilience, by enabling organisations to better anticipate and respond to disruptions. El Baz and Ruel (2021, p. 9) further demonstrate that organisations should focus on adopting and developing risk management practices, to strengthen supply chain resilience and robustness.

Hosseini Shekarabi et al. (2025, p. 716) note that, supply chain resilience has become a greater focus for organisations, following the COVID-19 pandemic, and many have developed their risk management strategies to better prepare for future disruptions. At the same time geopolitical tensions have further increased the complexity of managing supply chains. Guo et al. (2025, pp. 456–457) highlight that geopolitical tensions make building resilient supply chains more difficult as there are additional stakeholders such as governments, which can alter supply chain structures. The developments in recent years indicate that supply chain resilience has grown in importance in uncertain environments (Guo et al., 2025, pp. 456–457; Hosseini Shekarabi et al., 2025, p. 716)

5 Discussion on Results and Findings

This literature review reveals several important patterns related to the procurement risks in critical raw material supply chains during geopolitical crises. For example, the literature shows that critical raw materials are highly concentrated in specific geographical regions increasing supply chain vulnerability (Ku et al., 2024; Maltais et al., 2026). Across selected studies, the findings indicate that this concentration, combined with geopolitical tensions, contributes to increased risk exposure for firms operating in global supply chains (Gheorge & Panazan, 2025; Månberger, 2023). The topic can be understood through multiple interconnected factors such as dependencies on suppliers, supply chain complexity and geopolitical instability (Bode & Wagner, 2015; Ho et al., 2015; Maisel et al., 2023). A key finding emerging from the literature is that companies must adopt more resilient procurement practices to mitigate these risks (Guo et al., 2025). Three main themes could be identified from the literature.

The first identified theme was the vulnerability of critical raw material supply chains to geopolitical risks. The literature highlights the role of geographical concentrations and the limited number of suppliers these materials have, which creates reliance and dependencies among suppliers and regions (Liu et al., 2023; Maisel et al., 2023). In addition, the strategic importance of these materials makes them a target of trade barriers (Dietrich & Melcher, 2022; Nwaila, 2024). The selected literature emphasises that these structural features make critical raw materials more vulnerable to disruptions during geopolitical crises (Månberger, 2023; Nwaila, 2024; Rangel et al., 2015).

The second identified theme was the types of procurement and supply chain risks during geopolitical crises. Across the selected articles, research indicates that trade barriers such as tariffs and export and import restrictions have become increasingly more common in recent years and are a key risk (Dietrich & Melcher, 2022; Gheorge & Panazan, 2025; Hunger et al., 2026). The studies highlight that these

disruptions are often compounding and amplify the overall risk (Gheorge & Panazan, 2025; Roscoe et al., 2022).

The third identified theme was procurement risk management strategies and their link to supply chain resilience. For example, the literature shows that supplier diversification, long-term supplier relationships, and re-shoring and friend-shoring are among the long-term strategies that companies can adopt (Guo et al., 2025; Hunger et al., 2026; Li, 2025; Maltais et al., 2026). In addition, spot sourcing and stockpiling are highlighted as short-term strategies to combat disruptions (Guo et al., 2025; Hunger et al., 2026). A key finding from the literature is that risk management contributes to the development of more resilient supply chains (El Baz & Ruel, 2021; Guo et al., 2025).

Taken together, these findings indicate that critical raw material supply chains are inherently vulnerable to geopolitical risks due to their characteristics (Ku et al., 2024; Månberger, 2023; Rangel et al., 2015). Companies can reduce these vulnerabilities by adopting procurement strategies and practices for supply chain risk management (El Baz & Ruel, 2021; Ho et al., 2015; Li, 2025; Rangel et al., 2015). These practices improve a company's ability to anticipate, manage, and recover from disruptions, strengthening supply chain resilience during geopolitical instability (El Baz & Ruel, 2021; Hunger et al., 2026; Guo et al., 2025).

5.1 Answers to research questions

This study aimed to address the following research questions. By analysing the finding and results of this study, conclusions can be drawn to answer these questions.

5.1.1 How can companies manage procurement risks of critical raw materials during geopolitical crises to ensure supply chain resilience?

The main research question was "How can companies manage procurement risks of critical raw materials during geopolitical crises to ensure supply chain resilience?" The

literature review shows that critical raw materials have a strategic nature along with geographical concentrations. These factors, combined with the complex supply chains critical raw materials typically have, leave them vulnerable to geopolitical disruptions.

Companies can manage these procurement risks by combining systematic supply chain risk management practices with targeted procurement strategies. The findings in this study indicate that a structured approach involving the identification, assessment, mitigation and monitoring of risks is beneficial to supply chain resilience. In addition to this procurement strategies such as supplier diversification, long-term contracting, spot market sourcing, re-shoring and friend-shoring, allow companies to mitigate disruptions. Together these approaches allow companies to prevent and recover from disruptions, improving supply chain resilience.

5.1.2 What types of procurement risks arise during geopolitical crises?

The answers to the first sub-question, “What types of procurement risks arise during geopolitical crises” have been found to be the following. During geopolitical crises risks primarily arise from external sources and are out of the control of individual organisations. Key risks include supply disruptions caused by geopolitical tensions or conflicts, trade barriers, and export and import restrictions imposed by governments. Geopolitical risks can be compounding and amplify each other.

5.1.3 What strategies are used to prevent or mitigate supply disruptions?

The second sub-question was “What strategies are used to prevent or mitigate supply disruptions?” According to the findings, several different strategies can be identified. One key strategy that was identified was supplier diversification, which reduces dependencies. Long-term supplier relationships are used to ensure supply stability. Other key strategies include spot market sourcing, stockpiling and re-shoring or friend-shoring. Improving supply chain transparency can help prevent disruptions by better identifying risks.

5.1.4 How do these strategies contribute to supply chain resilience?

To address the final sub-question, “how do these strategies contribute to supply chain resilience?” Risk management strategies contribute to supply chain resilience by reducing vulnerability and strengthening the responsiveness to disruptions. Supplier diversification decreases dependencies on specific suppliers and regions, which reduces the impact of local disruptions. Long-term supplier contracts and relationships ensure supply stability, supporting supply continuity. Spot market sourcing and stockpiling help mitigate the impacts of disruptions in the short term, while re-shoring and friends-shoring are long-term strategies. Improved supply chain transparency helps anticipate disruptions and identify possible risks. The usage of a supply chain risk management framework gives a systematic approach to risk management.

6 Conclusions

The research shows that critical raw materials have unique global supply chains due to their geographical concentrations, complex supply structures, and strategic importance. These characteristics make their procurement especially vulnerable to external disruptions, particularly those driven by geopolitical tensions.

The research identified that key procurement risks arise primarily from external factors, during geopolitical crises. Among the key risks are supply disruptions caused by local disturbances and ripple-effects, compounding risks that amplify each other, and trade barriers implemented by governments such as, tariffs and import and export bans. Geopolitical crises can occur simultaneously, creating compounding disruptions, that amplify these risks and lead to more severe impacts.

Procurement strategies and supply chain risk management practices strengthen supply chain resilience. In the context of critical raw materials, reducing dependencies, long-term contracting, increasing flexible sourcing approaches and supply chain transparency, are among the strategies that reduce vulnerabilities and enhance the ability to respond to disruptions. A systematic approach to risk management further strengthens resilience by enabling organisations to identify, assess, mitigate and monitor them effectively.

6.1 Evaluation of source reliability

The articles included in this thesis were collected from multiple academic databases such as ABI Inform Complete (ProQuest), ScienceDirect (Elsevier), Academic Search Elite (EBSCO), Emerald and Springer Nature Link. A Finnish classification and rating system for academic journals known as the JUFO-portal was used to verify scientific quality. All of the journals used in this study are identified in the JUFO-portal. The vast majority of journals used in this thesis are rated between 1 and 3 in the JUFO portal.

6.2 Limitations and suggestions for future research

This thesis has certain limitations that should be recognised. This thesis was conducted as a narrative literature review, which is based on previously published research. Therefore, the findings of this thesis are dependent on existing literature and not on empirical evidence.

This thesis has a limited scope, with the analysis restricted to a general perspective and does not focus on a specific company, industry or geographical region. While this approach allows for a broader applicability, it also limits the ability to provide context-specific insights. Procurement risks and effective mitigation strategies may vary significantly based on the company and the geographical location.

This thesis considers critical raw materials as a broad category rather than analysing individual materials in detail. Different critical raw materials have unique geographical concentrations, supply chain structures and risks, which are not fully explored in this analysis.

During the review of relevant literature, it became evident that the resilience of supply chains for critical raw material has received less research attention compared to the risks associated with them. Future research on the recovery of supply chains after disruptions could provide valuable insights.

Future studies could examine the long-term effects of geopolitical developments on critical raw material supply chains. As geopolitical tensions continue to evolve, understanding how these developments influence procurement strategies are an important are of research. Examining the resilience of these supply chains during compounding risks and disruptions would be particularly relevant, as in recent years multiple geopolitical crises have occurred simultaneously and have had compounding effects.

Another potential area for future research is the analysis of the impact of a particular geopolitical crisis on critical raw material supply chains. Examining the comparisons between exporting and importing countries could provide insight into how specific geopolitical dynamics influence critical raw material supply chains. Individual critical raw materials could also be examined in depth, as this could identify more targeted risks and risk management approaches, during these disruptions.

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Appendices

Appendix 1. List of the reviewed articles according to theme

Author(s) and year	Title of the article	Related theme(s)
Bode, C., & Wagner, S. M. (2015)	Structural drivers of upstream supply chain complexity and the frequency of supply chain disruptions	Supply chain disruptions, complex supply chains
Caldara, D., & Iacoviello, M. (2022)	Measuring Geopolitical Risk	Geopolitics, geopolitical risk
Dietrich, V., & Melcher, F. (2022)	Mineral Raw Material Supply Chain Transparency and Traceability: Does Provenance Matter in the Supply Chain?	Critical raw materials, supply chain transparency and traceability
El Baz, J., & Ruel, S. (2021)	Can supply chain risk management practices mitigate the disruption impacts on supply chains' resilience and robustness? Evidence from an empirical survey in a COVID-19 outbreak era	Supply chain resilience, supply chain risk management
Gheorghe, C., & Panazan, O. (2025)	Geopolitical risk contagion across strategic sectors: Nonlinear evidence from defense, cybersecurity, energy, and raw materials	Geopolitical risk, critical raw materials
Guo, Y., Liu, F., Song, J.-S., & Wang, S. (2025)	Supply chain resilience: A review from the inventory management perspective	Supply chain resilience, risk management strategies
Ho, W., Zheng, T., Yildiz, H., & Talluri, S. (2015)	Supply chain risk management: A literature review	Supply chain risk, supply chain risk management framework
Hool, A., Helbig, C., & Wierink, G. (2024)	Challenges and opportunities of the European Critical Raw Materials Act	Critical raw materials, critical raw materials act

Hosseini Shekarabi, S. A., Kiani Mavi, R., & Romero Macau, F. (2025)	Supply Chain Resilience: A Critical Review of Risk Mitigation, Robust Optimisation, and Technological Solutions and Future Research Directions	Supply chain resilience, multi-tier sourcing
Hunger, T., Erfurth, P. J., Arnold, M. G., & Wichmann, M. G. (2026)	Integrated strategic sourcing of critical raw materials in an era of global disruptions	Critical raw materials, supply disruptions
Ivanov, D., Sokolov, B., & Dolgui, A. (2014)	The Ripple effect in supply chains: Trade-off 'efficiency-flexibility-resilience' in disruption management	Supply chain resilience, risks, ripple effect
Ku, A. Y., Alonso, E., Eggert, R., Graedel, T., Habib, K., Hool, A., Muta, T., Schrijvers, D., Tercero, L., Vakhitova, T., & Veeh, C. (2024)	Grand challenges in anticipating and responding to critical materials supply risks	Critical raw matrials, challenges and future of critical raw materials
Li, B. (2025)	Procurement and Inventory Control Mechanisms for Critical Raw Materials in Semiconductor Supply Chains	Procurement strategies, critical raw materials
Liu, W., Li, X., Liu, C., Wang, M., & Liu, L. (2023)	Resilience assessment of the cobalt supply chain in China under the impact of electric vehicles and geopolitical supply risks	Dependencies, supply disruptions, risks
Maisel, F., Neef, C., Marscheider-Weidemann, F., & Nissen, N. F. (2023)	A forecast on future raw material demand and recycling potential of lithium-ion batteries in electric vehicles	Critical raw materials, future demand
Maltais, A., Canales, N., & Larsen, R. K. (2026)	Challenges in Balancing Sustainability, Competitiveness and Geopolitics in Critical Mineral Supply Chains	Geographical concentrations of critical raw materials

Moradlou, H., Skipworth, H., Bals, L., Aktas, E., & Roscoe, S. (2025)	Geopolitical disruptions and supply chain structural ambidexterity	Geopolitical disruptions, mitigation strategies
Månberger, A. (2023)	Critical Raw Material Supply Matters and the Potential of the Circular Economy to Contribute to Security	Dependencies, disruptions, geopolitical risks
Nwaila, G. T. (2024)	A systematic framework for compilation of critical raw material lists and their importance for South Africa	Critical raw materials, classifications and criteria
Rangel, D. A., De Oliveira, T. K., & Leite, M. S. A. (2015)	Supply chain risk classification: Discussion and proposal	Supply chain risks, risk classification
Roscoe, S., Aktas, E., Petersen, K. J., Skipworth, H. D., Handfield, R. B., & Habib, F. (2022)	Redesigning global supply chains during compounding geopolitical disruptions: The role of supply chain logics	Geopolitical disruptions, compounding
Yang, C., Tian, K., & Gao, X. (2025)	Supply chain resilience: Measure, risk assessment and strategies	Supply chain resilience
Zhou, J., & Mei, J. (2025)	Supply chain integration and innovation performance of manufacturing firms: The moderating role of research and development investment intensity	Resource dependence theory

Appendix 2. Statement on the use of artificial intelligence

In this thesis artificial intelligence tools were only used as supportive tools. It was used for language maintenance, such as correcting grammatical errors, refining language and translation. Grammarly and ChatGPT (OpenAI) tools were used for these purposes. Artificial intelligence was not used to generate any text or other content.