



**Risk Mitigation Strategies in the Area of Sourcing and Procurement
in Case of Such Disruptions as 2022 Russian Invasion of Ukraine**

Baiba Berzina

Haaga-Helia University of Applied Sciences

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Abstract

Author(s) Baiba Berzina
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<p>While there is no way to predict when a such geopolitical crisis as 2022 Russian Invasion of Ukraine will happen again, organizations feel unsecure that almost every organization has been trying to redesign its structure and processes to stay consistent in these new unique situations. Although some organizations were prepared better than others, the confidence in global supply chain operations has come under vigorous questions, were the true agility and resilience analysed, and the most effective mitigation strategies identified. Therefore, the objective of this research is to identify and analyse possible risk mitigation strategies in area of sourcing and procurement for the purpose of developing a guideline that would help organizations to be better prepared in case of similar situation would occur again.</p> <p>Thesis is exploring theoretical background of risk mitigation strategies within area of sourcing and procurement. Further thesis is looking into the causes of severe disruptions to identify the underlying factors that contribute to disruptions and by better understanding these factors organizations put themselves in a better position to deal with these severe occurrences.</p> <p>Lastly research findings indicate that most important risk mitigation strategies in sourcing and procurement can be classified into two broad categories and those are redundancy and flexibility. Data researched indicates that redundancy strategies such as keeping excess stock, practicing multilevel sourcing and having disperse supplier and raw material base proven to be most effective ones, whereas flexibility related mitigation strategies such as using technology that enables better visibility, accuracy and enhance interorganizational capabilities and applying automation and predictive analytics can give organizations that extra edge to identify threats early enough to stay agile and resilient in turbulent situations.</p> <p>This research is intended as a desktop-based study and to meet the objective of the study, various publicly available sources were explored either from public libraries or otherwise from publicly available, well trusted news outlets and publications.</p>
Key words Supply Chain Disruptions, Sourcing and Procurement, Risk Mitigation Strategies

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1 Introduction

In today's complex business environments strongly driven by global competition and rapid and more frequent market changes, supply chain management practices have become extremely important. These practices include continuous flow processing with low inventory volumes, levelling, and just-in-time (JIT) production and accurate scheduling of transport. Furthermore, the pressure for cost reductions has led to the outsourcing and offshoring of many logistics, manufacturing and research and development activities. These trends place enormous pressure on companies to provide stability while they are operating, but also increase their vulnerability to disruptions. Firms have started taking supply chain disruptions more seriously hence past events show that disruptions are becoming more frequent which create a need for designing resilient supply chains and preparing contingency plans for inevitable disruptions.

On the other hand, when global supply chain just slowly tries to recover from many years long disruptions caused by corona pandemic (COVID-19) 2022 Russian invasion of Ukraine brings another severe disruption. As a result, shortly before and after invasion various air spaces were closed and various airline routes were re-routed or completely removed, many countries around the world imposed multiple financial and economic sanctions and in addition excluding key Russian banks from SWIFT international payment system. Following the decision of several major companies to withdraw from operating in the Russian market, many international companies formed a solidarity and decided to cease business transactions with Russian companies either in the export or import of products and services. Russian invasion of Ukraine also created tensions in relationships among the world's biggest market players such as US and China and that has brought many challenges to current supply chain processes.

Although companies have a high level of awareness about supply chain risks, many businesses still believe that they lack fully effective supply chain risk management practices. That also raises the question of how organizations can deal with unforeseeable events. The answer comes from a different type of approaches that is not particularly based on an analysis of identifying risks - but also looking for ways to deal with disruptions to a supply chain, regardless of how these disruptions occurred. For instance, a company might consider the failure in a key transport link due to 2022 Russian invasion of Ukraine and they try to see what it can do get operations working again, regardless of how the damage was done to the transport link. (Waters 2011, 215.) Therefore, risk mitigation in supply chain activities is an increasingly important topic of supply chain management as for industry executives as for supply chain experts. In favour of this also speaks Dmitry Ivanov and Boris Sokolov (2010) in their book 'Adaptive Supply Chain Management' that duality of the

main goals of SCM - maximizing the service level and minimizing costs - should be enhanced by the third component - maintaining SC stability.

Ultimately, analysing severe disruptions and its effects on supply chain in area of sourcing and procurement is the central focus of this thesis. Further identifying risk mitigations strategies that organizations could build adaptability, stability and crisis resistance into their operations and be more prepared for similar situations in the future is the main objective of this research.

1.1 Background

The risk associated with global supply chains has increased in recent years, so organizations need to actively assess their risk exposure and regularly review their risk management and mitigation strategies.

Evidence suggests that organizations are moving away from reactive risk management strategies toward more proactive supply chain initiatives that increase resiliency. Market conditions and technology trends, such as the adoption of advanced analytics that enable predictive risk management, help explain this shift. These proactive initiatives appeal to organizations because they are not only less expensive than more reactive approaches, but also enable them to perform better in turbulent environments. Organizations should therefore focus on building supply chain agility and resilience rather than simply risk management. Yet such agility and resilience require the development of certain capabilities aligned across many partners in the supply chain.

Disruptions in global and local supply chains may become more frequent, so supply chain management professionals should continue to seek new ways to prevent disruptions and mitigate their effects.

1.2 Research objective and research questions

This thesis aims to analyse causes of supply chain disruptions and how 2022 Russian Invasion of Ukraine affected global supply chain and the outcome of the thesis is to create a practical guide that will help supply chain managers and its different industry executives to learn about possible effects of disruptions on the supply chain networks and identify the right risk mitigation in order to learn how companies could build greater resilience and stability into their supply chains to avoid being impacted by this kind of conditions in the future.

The international aspect required by degree programme of this theses aims to analyse global supply chain without distinction of specific industry or market and that is made with the purpose that all

the results found from this research could be applicable for wide range of organizations that take part in global supply chain of any scale.

The research question (RQ): **What are risk mitigation strategies in the area of sourcing and procurement in case of such disruptions as the 2022 Russian invasion of Ukraine?**

The research question was divided into investigative questions (IQ) as follows:

IQ 1. What are the risk mitigation strategies in area of sourcing and procurement?

IQ 2. What factors contribute to disruptions in supply chain?

IQ 3. How was sourcing and procurement affected by 2022 Russian invasion of Ukraine?

IQ 4. What could be the possible risk mitigation strategies considering similar geopolitical events in the future?

1.3 Delimitation or Project scope

The thesis is intended as desktop-based research that focuses on supply chain activities such as sourcing and procurement and analyses possible risk mitigation strategies which could be the most relevant in the context of 2022 Russian invasion of Ukraine and similar disruptions in the future.

The limitations of this investigation should be noted as the invasion took place many months ago and is still in progress at the time of writing this thesis. All desktop research was conducted only using materials that were accessible in public libraries or available electronically online. Nevertheless, author of this study believes that present findings will provide valuable insights into the supply chain disruptions and risk mitigations strategies that could be applied in area of sourcing and procurement and in addition be applicable for wide range of industries and organizations, It is important to note that future events may alter the findings in unanticipated ways.

The major limitation of this study is the absence of previous research on the subject matter. Military conflicts are not a regular occurrence. Furthermore, if the military conflict continues for a long time, there will be a further change in global supply chain, and the appropriateness of this study will surely be under the question.

A fully desk-based approach was taken for this thesis as an independent study. This allowed for generality in the data, as well as for a high degree of independence in the analysis. However, it prevented the ability to perform interviews with key stakeholders from multiple organizations or to experiment with new concepts and hypotheses related to this research.

1.4 International aspect

This thesis research question is concerned with risk mitigation theory and strategies applied in area of sourcing and procurement and explore which of the mitigation strategies could be the most appropriate and effective in case of such severe geopolitical disruptions as 2022 Russian invasion of Ukraine. The subsequent investigative questions are designed to reinforce the international focus of the research and to ensure that the results have a wide appeal.

This thesis explores how business executives and supply chain experts can integrate resilience into their risk management strategies to mitigate threats to supply chains. The study categorizes and explains the various elements of risk and outlines why the subject has become a serious concern for businesses in recent years. It focuses on the need for executives to acquire a deep understanding of the nature of risk, which is essential to improving supply chain resilience.

The topic of corona pandemics, military conflict, and environmental crises is timely for current and future supply chain experts because severe disruptions like these occur more often than previously thought. This research may be a highly beneficial resource for supply chain audiences.

1.5 Key concepts

The following terms will be used throughout the course of this research. They offer a basic level of understanding, which should ease the understanding of the thesis.

Risk mitigation is a strategy to prepare for and lessen the effects of threats faced by a business. Comparable to risk reduction, risk mitigation takes steps to reduce the negative effects of threats and disasters on business continuity (BC) (Lutkevich 2021).

Supply chain (SC) is the sequence of events that cover a product's entire lifecycle, from conception to consumption. A supply chain, in other words, extends from the original supplier or source to the ultimate customer. (Blanchard 2021.)

Procurement is the process of managing a broad range of processes associated with a firm's need to acquire goods and services in a legal and ethical manner that are required to manufacture a product (direct) or to operate an organization (indirect) (Myerson 2015, 89).

Sourcing process takes the procurement process further by focusing more on supply chain impacts of procurement and purchasing decisions and works cross-functionally within the business firm to help achieve the organization's overall business goals that includes data collection, spend analysis, market research, negotiation, and contracting while minimizing cost and risk. (Myerson 2015, 89.)

Supply chain disruptions are result of perturbation influences (disturbances that are consequence of risks). They may affect operations, processes, plans, goals, or strategies. To adjust the supply chain in the case of disruptions (deviations), adaption measures need to be taken. (Ivanov & Sokolov 2010, 71)

Geopolitical risk as the risk associated with wars, terrorist acts, and tensions between states that affect the normal and peaceful course of international relations. Geopolitical risk captures both the risk that these events materialize, and the new risks associated with an escalation of existing events (Caldara & Iacoviello 2018, 2).

1.6 Risk management

Potential risks include the reliability of the data being collected related to the Russian invasion of Ukraine in 2022. As this event is still ongoing, it is sometimes difficult to verify the validity of the data made publicly available online including wide range of news outlets.

The study and research were conducted since the beginning of the invasion on February 24, 2022 until July 24, 2022. However, due to the fact that the event still continues until this time, this study only reflects the information gathered during a limited period of time. This may present some limitations for readers who want more details about the subject matter.

As a student aiming to undertake independent research toward my degree, I may be undertaking a task requiring long hours at the desk. These working habits can lead to back and neck pain. I therefore take it upon myself to be conscientious of my health and safety while conducting this research.

2 Risk mitigation strategies in sourcing and procurement

Risk mitigation strategies refer to company actions aimed at reducing the likelihood of occurrence and negative effects of risks (Jüttner & al. 2003; Miller 1992). To this date, academics have suggested various supply chain risk mitigation strategies such as keeping strategic emergency stock (buffer inventory) (Sheffi 2001), encouraging cooperation (collaboration) between supply chain members (Jüttner & al. 2003), increasing supply chain flexibility (Skipper & Hanna 2009) and resilience (Pettit & al. 2010; Stewart & al. 2009; Zsidisin and Wagner 2010), and developing agility (Oloruntopa & Gray 2006). It is important to emphasize that according to article 'A contextual approach to supply chain risk mitigation (Chang & al. 2014) it is important to apply the "right" supply chain risk mitigation strategy for particular risk contexts.

Supply chain risk mitigation strategies can be classified into two broad categories based on how each of the alternative approaches reduces uncertainty: **redundancy** and **flexibility**. Redundancy approaches sets focus on limiting or mitigating the negative effects of a risk by increasing product availability by "keeping some resources in reserve to be used in case of a disruption" (Sheffi and Rice Jr. 2005, 44). Increasing strategic inventory, holding safety stock, maintaining multiple suppliers, and adding capacity are the most common forms of redundancy mitigation strategies (Sheffi and Rice Jr 2005; Zsidisin and Wagner 2010). In contrast, flexibility solutions consist of "building organizational and interorganizational capabilities to sense threats to supply continuity and to respond to them quickly" (Zsidisin and Wagner 2010, 3). Promoting collaboration and integration, encouraging information sharing (communication), and increasing responsiveness are examples of flexibility mitigation strategies.

On the other hand, purchasing insurance, holding safety stock or having multiple suppliers can reliably mitigate the negative impact of potential supply chain disruptions. However, the "insurance" aspect of redundancy risk mitigation strategy tends to be expensive from a resource investment perspective (Chopra and Sodhi 2004; Sheffi 2001). Thus, Zsidisin and Wagner (2010, 3) contend that "although redundant supply chain practices can buy time for a firm to recover from a disruption, there are associated costs with this strategy, such as tying capital into inventory and additional transaction costs from managing multiple suppliers.

As shown in Table 1, the alternative risk mitigation strategies are founded on markedly different inventory and relationship management strategies that are consistent with the primary objectives of each approach. In addition, both primary approaches have associated benefits and drawbacks.

Table 1. Characteristics of primary alternative supply chain risk mitigation strategies (adopted from Chang & al. 2014)

Source	Redundancy risk mitigation strategy	Flexibility risk mitigation strategy
Bode & al. 2011	Buffering. Gain stability by establishing safeguards that protect a firm from disturbance	Bridging. Invest in collaborative structures or initiatives or intensifying information exchange
Zsidisin & Wagner 2010	Redundancy. Keep resources in reserve such as having safety stock, maintaining multiple suppliers, and running operations at low-capacity utilization rates	Flexibility. Build organizational and interorganizational capabilities to sense threats to supply continuity and respond to them quickly
Manuj & Mentzer 2008a	Hedging. Build up a globally dispersed portfolio of suppliers to avoid a single event affecting all entities simultaneously	Control. Increase the ability to control processes, systems, and decisions through integration
Chopra & Sodhi 2004	Increase capacity, inventory, suppliers	Increase responsiveness, flexibility

3 Factors contributing to supply chain disruptions

The objective of this chapter is to provide readers with a theoretical framework for understanding disruptions that affect supply chain networks with focus to sourcing and procurement.

3.1 The analysis of supply chain disruptions

Supply chain disruptions (SCD) are the actual occurrence of risks and are unplanned and unanticipated events that disrupt the normal flow of goods and materials within supply chain (Myerson 2015, 183).

In other words, disruptions can result from unanticipated events that were not sufficiently prepared for. According to Myerson P. A. (2015, 183) these events often unforeseen are commonly referred to as triggers. They initiate a cascade of events that often may have serious consequences.

A transformation in the global political environment has brought a new threat to supply chains (Manners-Bell 2020, 3). The most disruptive supply chain events are those which have not or cannot be planned for (Manners-Bell 2020, 12).

Given the complexity and global nature of supply chains it is increasingly difficult to judge what impact an event will have in terms of disruption. Even a localized event may have massive global implications. A geopolitical conflict, depending on where it takes place, could have a very serious, disruptive impact at the global level. Seriousness each of these threats is very specific to each supply chain as well as the level of disruptiveness of the event in question. According to Manners-Bell J. (2014, 7) and Myerson P. (2015, 183) disruptive events can result in higher costs, poor performance, lost sales and profits, bankruptcy, and damage to the organization. As an example, see Figure 1.

Figure 1 indicates Impact of a 100-day supply chain disruption worldwide on companies in selected industries as of 2020, by scenario (in percentage of EBITDA). *Scenario 1* refers to a limited disruption that affects only upstream supply chain and a company has still possibility to use existing inventories to carry out business activities and *scenario 2* refers to a larger disruption that impacts both production and distribution supply chain. According to a 2020 study, a 100-day persisting disruption to both production and distribution supply chains can cause up to 90 percent decline in earnings before interest, taxes, depreciation, and amortization (EBITDA) as it is seen in the example of commercial aerospace industry. Other the most impacted industries by disruptions are automotive, chemicals, computers and electronics and electrical equipment followed by food and beverages.

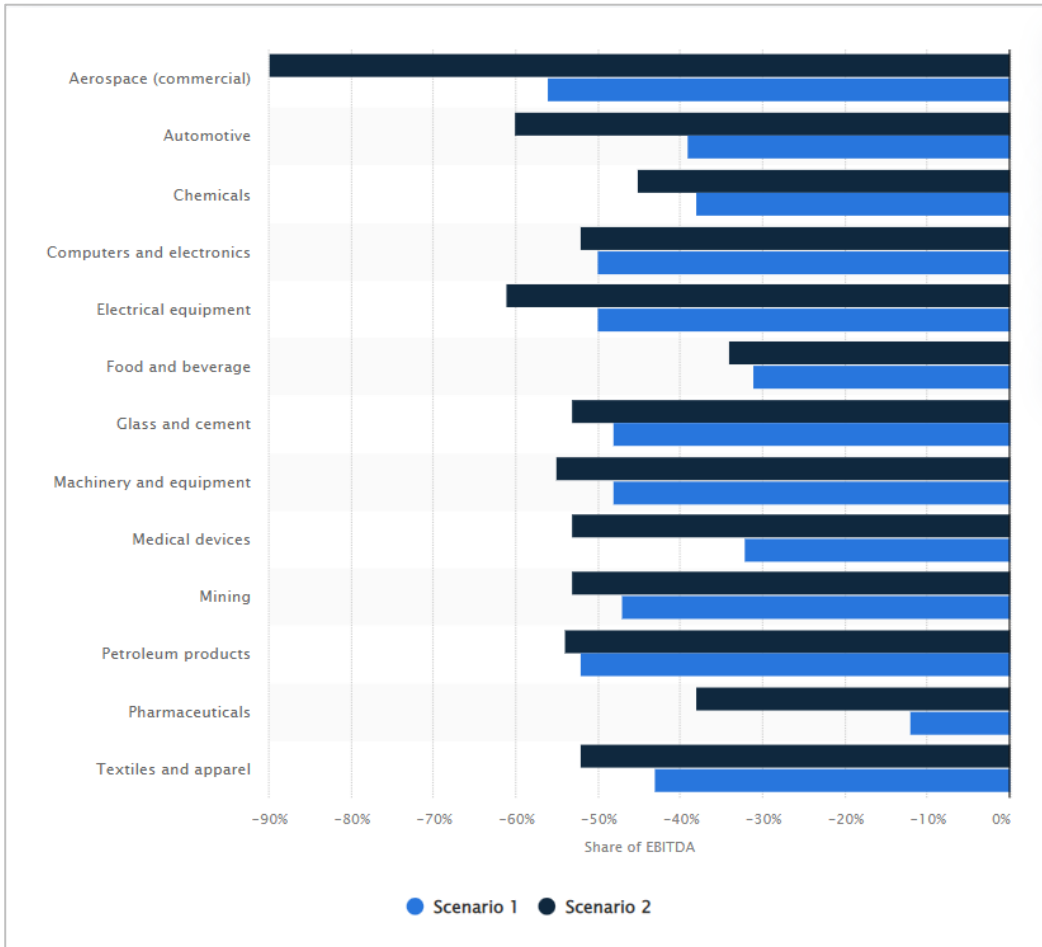


Figure 1. Impact of a 100-day supply chain disruption worldwide on companies in selected industries as of 2020, by scenario (Mazareanu 2021)

Manners-Bell (2020, 12) indicates that instead of relying on past events to gain insight into the future, it may be more valuable to identify weaknesses in supply chains. Addressing vulnerability is the best way to mitigate the impact of a disruption, although there remains the issue of how much time and money should be invested on each perceived weakness.

Manners-Bell (2020, 3) suggests that although it is impossible to predict how and when a supply chain will be disrupted by a disaster, it is possible to engineer 'risk-agnostic' resilience and in addition visibility, responsiveness and agility will be critical elements in ensuring that supply chains of the future retain their competitive advantage.

3.1.1 Complexity of supply chains

In a highly complex environment, involving the interaction of human, technological and environmental factors, it can be difficult to identify the reasons behind an event that leads to supply chain disruption (Manners-Bell 2020, 15).

Taleb (2007) argues that, because of highly integrated markets and networks, we live in periods of wild randomness where small probability events carry major consequences. Intertwined networks - energy, transport, financial, ICT and human - mean that the consequences of failure in one can be critical and unforeseen in another. From the enormous complexity of the relationships between the various networks outline, it is obvious that no organization or government could plan for any one catastrophic event. These events are variously referred to as 'high impact-low probability' (HILP) or 'Black Swans'. However, this is not an excuse to do nothing. Instead, managers and planners should focus on making operations and supply chain resilient to all shocks, not just to those that they believe may happen. (Manners-Bell 2020, 19.)

Understanding the wider impact of a disruptive event is made more difficult as it is impossible to view individual networks in isolation. Increasingly networks are interwoven and interconnected in ways that have become difficult to map or understand. (Manners-Bell 2020, 22.)

Rather than refer to supply chains we should talk instead about networks. The idea of a chain suggests a series of linear one-to-one relationships whereas the reality is that the focal firm lies at the centre of a complex web of interconnected and interrelated yet independent entities. Partly as a result of outsourcing activities that previously were performed in-house combined with the trend to offshore manufacturing, many companies have found that they have added to the complexity of their operations because the degree of interdependency across the networks has increased. Thus, an event or action taking place in one part of the network will often have overseen impacts somewhere else in the network. The unpredictability of these events is heightened by the growing volatility that characterizes today's business environment. (Christopher 2016, 173.)

The outcome of complexity in a supply chain is uncertainty, and with that uncertainty comes an increased likelihood that forecast error will increase in line with complexity. This growing uncertainty brings with it a serious challenge to the classic practice of running the business is based on forecast. It will be apparent that in conditions of stability - and hence lower uncertainty - forecast accuracy should generally be high. Equally, the opposite will be true, i.e., as uncertainty will be the norm - at least for the foreseeable future then a new approach will be required. The challenge that organizations now face is how to reduce their dependence on forecasts and to become increasingly demand and event driven. Thus, conventional forecasting tools will be less effective the greater the complexity of the network. (Christopher 2016, 174.)

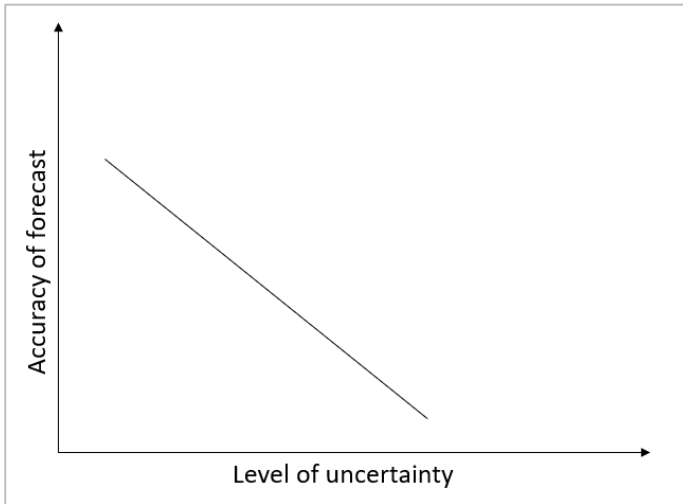


Figure 2. Interconnection between level of uncertainty and accuracy of forecast.

Lack of shared information means that many companies are forecast-driven, not demand-driven, and consequently find it difficult to react quickly to changing market conditions. The risk themselves have not become any more acute. After all, there have always been wars and natural disasters. Rather, it is the evolving supply chain and production strategies of the major global manufacturers that have changed, leading to a rebalancing of the risks inherent in various parts of the supply chain. (Manners-Bell 2020, 8.)

According to Christopher M. (2016, 181-182) to manage supply chain complexity, it is important to understand where it comes from. One way to begin this process is by identifying the sources of complexity and reviewing the categories identified (see Table 2). Supply chain network simplification and process re-engineering should be an ongoing practice in every supply chain that wants to become less complex and be more adaptive to disruptions.

Table 2. The sources of supply chain complexity (adapted from Christopher 2016, 174-179.)

The sources of supply chain complexity	Description
Network complexity	As a network's complexity grows, its vulnerability increases. Outsourcing non-core activities, many companies have greatly increased their reliance on external suppliers of goods and services.
Process complexity	The more steps in the process and the more transfers exist, the greater the likelihood that discrepancies will occur between planned and actual outcomes, increasing uncertainty.

Range complexity	As product/service variants increase, forecasting accuracy diminishes. Greater range complexity also increases the cost of the inventory due to its effect on the levels of safety stock which are needed.
Product complexity	High product complexity can result from a large number of parts or from few common parts across the bills of material for different products.
Customer complexity	A customer group is diverse when customers display different characteristics, such as the frequency of their orders, the size of their orders, or delivery requirements.
Supplier complexity	Supplier base size can contribute to supply chain complexity by increasing the number of relationships that must be managed and the total cost of transactions.
Organizational complexity	In most organizations, departments are organized around functions, resulting in a tendency for these departments to become silos with their own agendas. Also, organizational complexity can arise when you must coordinate activities across different time zones and cultures.
Information complexity	Large volumes of data move in all directions, many times inaccurate and often open to different interpretations. As a result, the data that is used for input to planning and forecasting activities is often flawed and hence forecast accuracy is reduced.

3.1.2 Uncertainty as outcome of complexity

Uncertainty is a system property characterizing the incompleteness of our knowledge about the system and the conditions of its development. In contrast to risk, uncertainty is a more comprehensive term, considering situations that cause both positive (chance) and negative (threats) deviations from expected outcome (Ivanov & Sokolov 2010, 69).

In analysing uncertainty, four aspects are usually encountered. The one is uncertainty itself, the second is risks, the third is disturbances, and the last is the disruptions. See Figure 3.

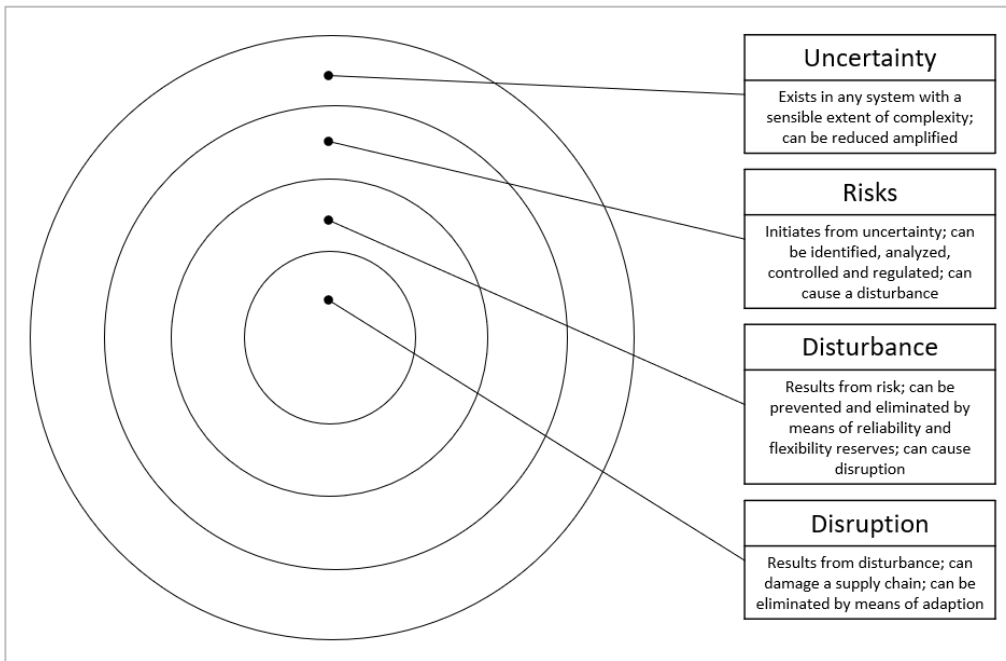


Figure 3. Interrelations of uncertainty, risks, disturbance, and disruption (adopted from Ivanov & Sokolov 2010, 71)

Uncertainty inevitably exists in supply chain. Uncertainty can be scattered over different supply chain parts, but it cannot be eliminated completely. In considering the uncertainty problem, two main aspects can be highlighted:

- uncertainty can be mitigated and
- SCM is always connected with risk that should be taken by somebody.

Even if a good balance of a system space (control area) and uncertainty space (risk area) can be found, certain risk of failure and disturbance will exist. For these type of cases different measures in the supply chain contracting and insurance should be taken. (Ivanov & Sokolov 2010, 78.)

3.1.3 Understanding the risk

Risk is the potential for unwanted negative consequences from events (Slack & Brandon-Jones 2021, 498).

Risk denotes the chance of danger, loss or injury. Risk is to be differentiated from the term 'uncertainty'. Whereas risk assumes that the probabilities of the possible results of an event are known, this is not the case with uncertainty. Hence, risk is measurable uncertainty (Waters & Rinsler 2014, 174.)

In a world where the pursuit of economic efficiencies can also mean greater vulnerabilities, managing risk is an increasingly vital task for operations managers (Slack & Brandon-Jones 2021, 497).

It is only relatively recently that corporations have started to factor in the cost of external risk to their out-sourcing and distribution decision-making process (Manners-Bell 2014)

A smarter approach is to focus risk mitigation on the twin goals of supply chain agility and velocity (Manners-Bell 2014)

When corporations take risks, they face the possibility of financial losses from several sources, including those related to their internal processes and those stemming from outside forces. A company's vulnerability to external risk is closely tied to its exposure to internal risk; reducing one type of exposure leaves the company more vulnerable to the other. (Manners-Bell 2014.)

The problem is that although high levels of stock involve increased internal risk, they also act as a buffer against external sources of supply chain disruption (Manners-Bell 2020, 2).

While corporate supply chain strategies have focused on internal risk reduction over the past few decades, it is only recently that companies have begun to realize that by shifting their focus to outside risks, they may not be reducing the overall level of risk (Manners-Bell 2014).

Table 3. Global supply chain risk – supply chain internal and external characteristics (adopted from Manners-Bell 2014. 7)

Supply Chain Characteristics	Internal Risk	External Risk
High stock levels	High	Low
Lean supply chains	Low	High
'Bundled' in-house production	High	Low
'Unbundled' outsource production	Low	High
Globalized sourcing	Low	High

It is possible to divide external threats into four main categories (see table 4)

Table 4. External threats to supply chain

External threat	Description
Environmental	Natural disasters and other extreme weather conditions comprise the bulk of external environmental risks companies will face. Earthquakes, flooding, winter storms and tornadoes can close off airports, docks and roads making delaying the shipment of goods and making it impossible to arrange travel and communication in and out of supplying countries. (GCE Logistics 2022.)
Geopolitical	Geopolitical risk as the risk associated with wars, terrorist acts, and tensions between states that affect the normal and peaceful course of international relations. Geopolitical risk captures both the risk that these events materialize, and the new risks associated with an escalation of existing events (Caldara & Iacoviello 2018, 2).
Economic	The effects of economic slowdown and political upheaval are particularly impactful on the supply chain. As currency fluctuations, instability in demand and prices, changing labor costs and inflationary pressures make it impossible for firms to accurately plan their investment in foreign markets. (GCE Logistics 2022.)
Technological	Cybersecurity is a relatively new but increasingly serious risk. Cyber risk includes hacker attacks, data breaches, virus transmission, cyber extortion and network downtime. (Slack & Brandon-Jones 2021, 515)

Businesses should be prepared in advance for risks in the supply chain by first identifying potential problems and their possible impacts. Businesses can achieve this goal by developing vulnerability maps or risk matrices to visualize unforeseen events and unwanted outcomes (see figure 4).

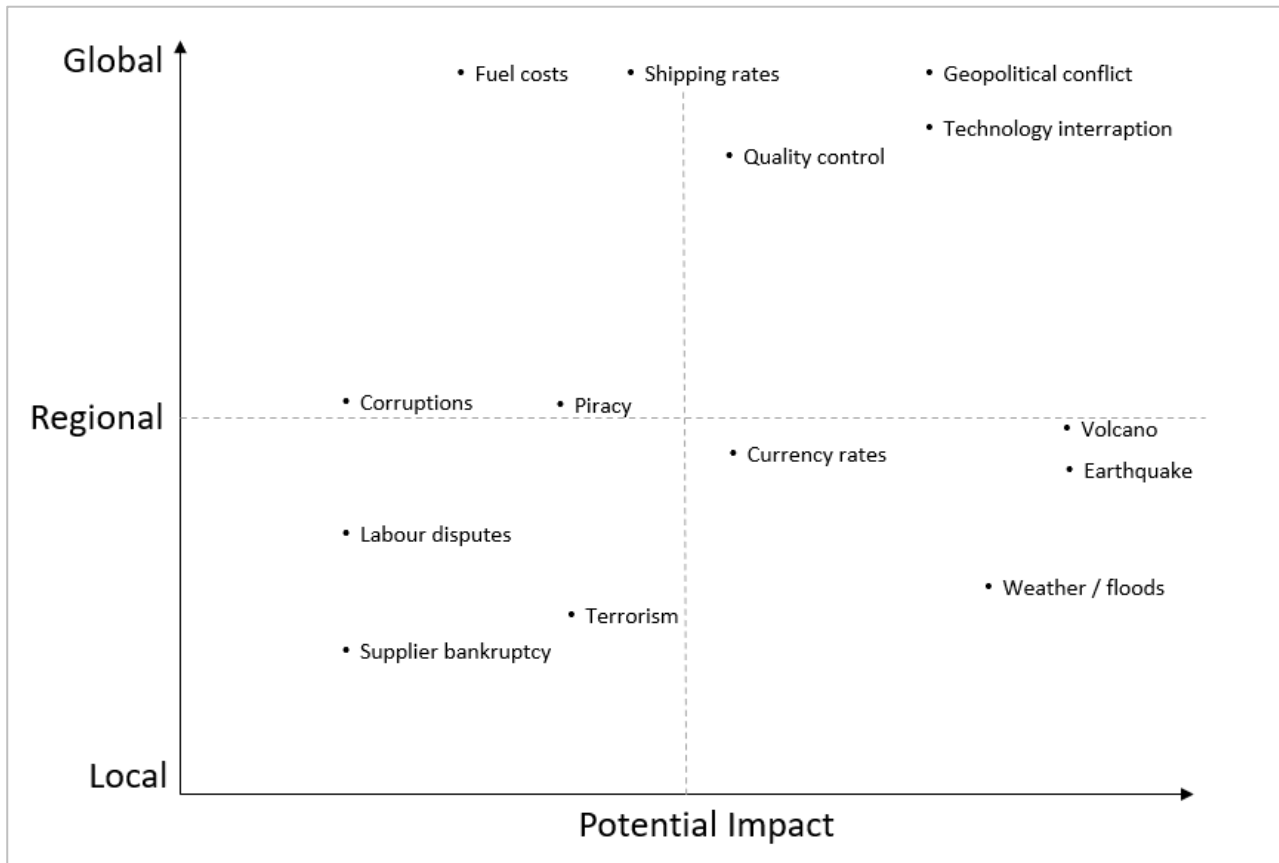


Figure 4. External event impact on supply chain (adopted from Manners-Bell 2017, 279)

3.1.4 Measuring supply chain risk

Measuring the impact of an event on a supply chain and forecasting its potential effects are difficult tasks. Many companies are good at working around frequent and small disruptions to their supply chains, with minimal cost implications. It is difficult to predict low-frequency, high-impact 'Black Swan' events, and therefore deciding on how much to invest in making a supply chain resilient to such occurrences can be challenging. (Manners-Bell 2014, 12.)

Typically, while company metrics may include inventory-on-hand, stock turns and the like, there are no metrics to measure the resilience of a company's supply chain to potential threats (Manners-Bell 2020, 1).

There is no doubt that extended supply chains are more vulnerable to external threats (Manners-Bell 2014, 9).

A small supply chain, for instance, with a single production facility is highly vulnerable to external events whereas a large, complex supply chain with multiple supplier options has the potential to be much more robust through a greater number of sourcing options, which means the probability of

overall network disruption is less than in a small supply chain (see Figure 5) (Manners-Bell 2014, 10).

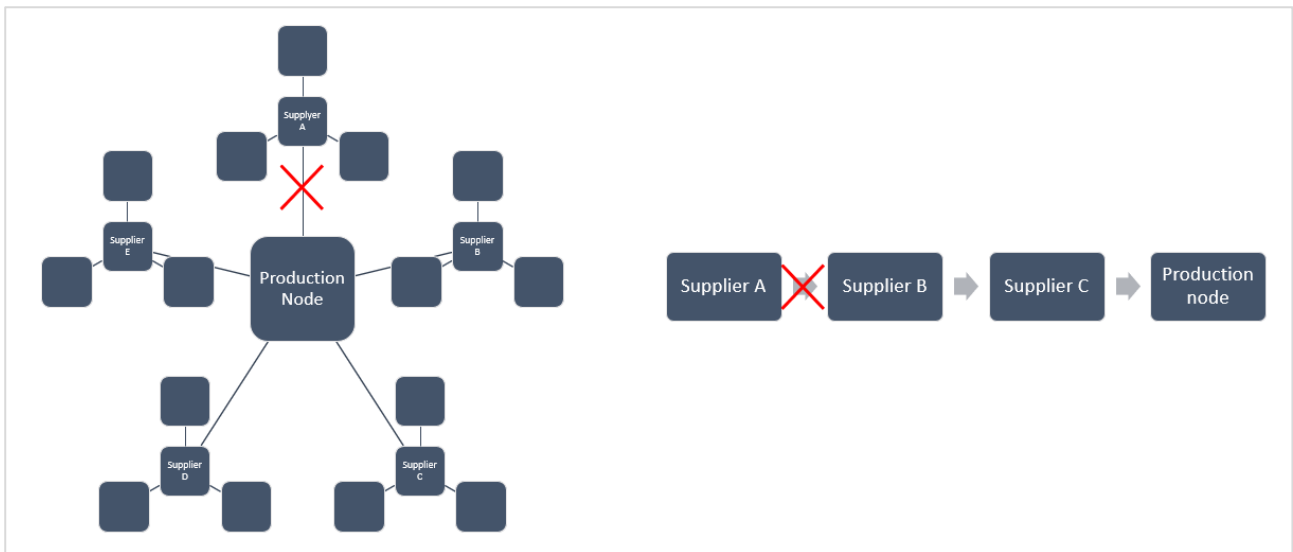


Figure 5. Global supply chain risk – probability of disruption (Manners-Bell 2014. 10)

There are several different ways in which supply chain risk can be quantified. However, one of the simplest ways of measuring risk is by viewing it as the product of the probability of any given event multiplied by its severity (Christopher & Peck, 2004).

Risk = Probability (of a given event) x Severity (negative business impact)

One of the ways of measuring the impact of a disruptive event is by tracking the share price of an affected company.

Manufacturers usually adopt one of three strategies for dealing with risk, each of which involves a cost element:

- Inventory management that involves building a safety stock
- Contingency planning for suppliers or supply chain links
- Acceptance by doing nothing as costs of mitigation outweigh benefits

Case: One pharmaceutical company undertook a cost-benefit approach to work out how it should mitigate supply chain risk. It used insurance and industry data to estimate the frequency and duration of disruptions, and using scenario-planning software, analysts worked out how many weeks a year their production would potentially be affected. They were then able to set inventory holdings at a level which would minimize disruption. Of course, the weakness of this approach was that, although it minimized disruption, the strategy imposed huge additional costs on the organization, not

only from the financing of the additional inventory, but also from the risks of redundancy of stock. (Manners-Bell 2020, 12-13.)

Modelling exercises also need to be taken into account the length of disruption as well as the probability. There are other variables: for example, the length of time it takes for alternative suppliers to ramp up production. One other increasing factor which impacts significantly on the extent of disruption is the location of the event within the supply chain. The further upstream it occurs, the longer the disruption to supply. The reason for this is that downstream processing locations act as bottlenecks and take time to fulfil backorders once upstream supply is switched back on. (Manners-Bell 2014, 13)

Previously done research indicates that extending geopolitical risk (GPR) index back to 1900 (see figure 6), geopolitical risk rose dramatically during the World War I and World War II, was elevated in the early 1980s, and has drifted upward since the beginning of the 21st century (Caldara & Iacoviello 2018).

Caldara and Iacoviello (2018) Using newspaper records constructed a monthly index of geopolitical risk (GPR) and examine its evolution and determinants since 1985. Then they studied the economic effects of geopolitical risks, and find that higher geopolitical risk depresses economic activity, lowers stock returns, and leads to flows of capital from emerging economies towards advanced economies.

As per Caldara and Iacoviello (2018) the construction of the GPR index involves three main steps: definition, measurement, and audit.

Accordingly, we define geopolitical risk as the risk associated with wars, terrorist acts, and tensions between states that affect the normal and peaceful course of international relations. Geopolitical risk captures both the risk that these events materialize, and the new risks associated with an escalation of existing events. (Caldara & Iacoviello 2018, 2.)

Figure 7 compares the GPR index with the economic policy uncertainty (EPU) constructed by Baker, Bloom, and Davis (2016), which implies that there is a correlation between geopolitical events to stock market volatility and policy uncertainty.

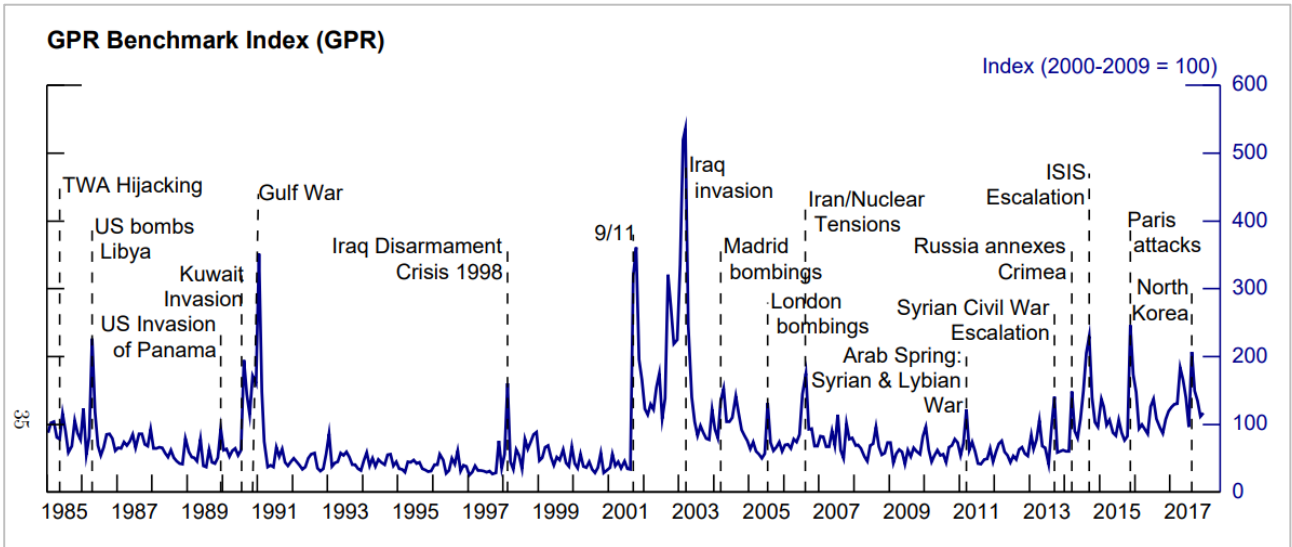


Figure 6. The geopolitical risk index (GPR) (Caldara & Iacoviello 2018, 35)

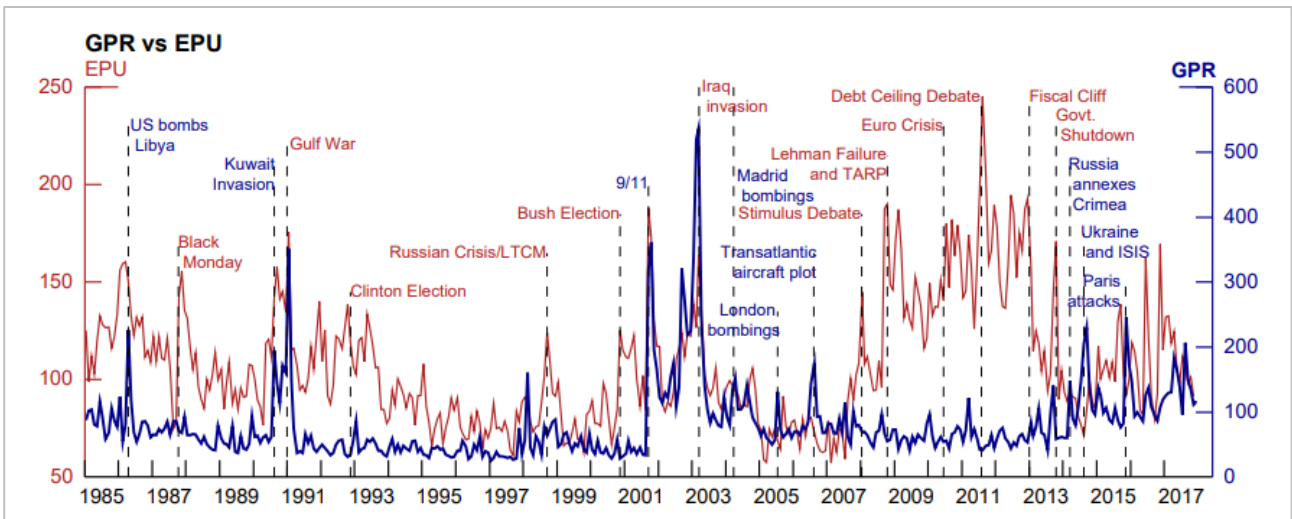


Figure 7. Comparison to economic policy uncertainty (EPU) (Caldara & Iacoviello 2018, 42)

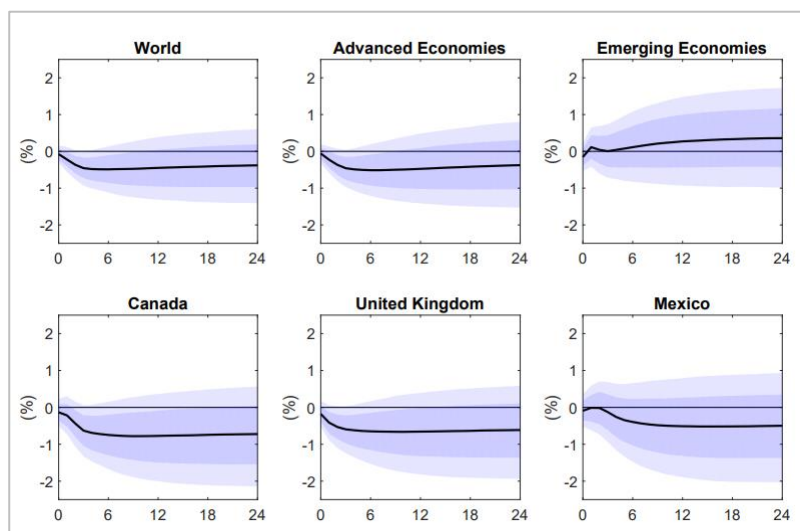


Figure 8. The international impact of increased geopolitical risk. Industrial production for selected countries and regions (Caldara & Iacoviello 2018, 47)

Figure 8 depicts the median responses of Industrial Production (IP) for the six countries and regions listed above. Industrial production refers to the output of industrial establishments and covers sectors such as mining, manufacturing, electricity, gas and steam and air-conditioning. This indicator is measured in an index based on a reference period that expresses change in the volume of production output. (OECD 2022.)

These impulse responses suggest that a geopolitical shock has global consequences, where world industrial production declines by about 0.5 percent one year after the shock but its effects are mostly concentrated in advanced economies. By contrast, the emerging economies included in the index, on average, do not respond to geopolitical risks. (Caldara & Iacoviello 2018, 22)

3.2 Managing disruption risks in supply chain

3.2.1 Supply chain security

The recent disruptions provide the evidence that integrated considerations of supply chain performance and security is a crucial and timely topic in SCM research and practice (Williams & al. 2008).

This evidence is also reflected in published international standards ISO 28000 on security management.

Supply chain security is a general system property characterising uninterrupted performance of a supply chain functioning to achieve its goals under protection against external purposeful threats (Ivanov and Sokolov (2010, 81).

3.2.2 Supply chain stability

The crisis provides the ultimate evidence that one of the main tasks of SCM is to balance profitability and stability to remain competitive in perturbed economic environment and stability of the whole SC should be the direct performance indicator of SCM (Ivanov & Sokolov 2010, xii).

Figure 9 depicts the considerations of supply chain economic performance (service level and costs) that should be brought together with supply chain stability. The duality of the main goals of SCM - maximizing the service level and minimizing costs - should be enhanced by third component - maintaining supply chain stability. (Ivanov & Sokolov 2010, 58.)

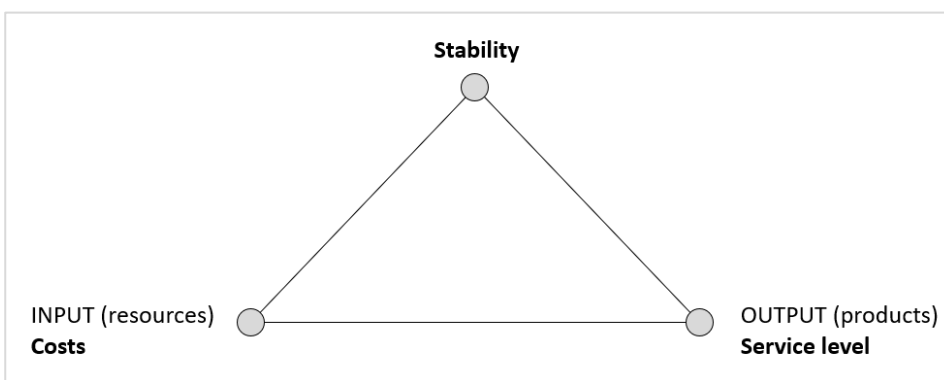


Figure 9. Triangle of SCM goals (adapted from Ivanov & Sokolov 2010, 58)

One of the most important challenges of uncertainty and risk analysis is identifying and strengthening bottlenecks. As practice shows, a bottleneck's robustness, or its flow capacity capabilities, can profoundly determine an SC's economic performance and stability. (Ivanov & Sokolov 2010, 78.)

To the supply chain bottlenecks belong:

- a supply chain part that is permanently subject to disturbances (these parts should be eliminated if possible)
- a supply chain part that is critical to the supply flow capacity (this may be handled, e.g., by the DBR (Drum-Buffer-Rope) technique)
- a supply chain part in which small deviations cause large deviations in performance indicators (this may be handled e.g., sensitivity analysis)
- a supply chain part whose adjustment after disturbance requires significant financial and (or) time consumption.

According to Ivanov and Sokolov (2010, 79) uncertainty may be reduced by means:

- introducing excessiveness in SC structures (e.g., time buffers, safety stocks, additional resources, capacity reserves, etc.)

- Improving coordination and information flows to make better quality, timeliness and accessibility
- introducing supply chain monitoring and event management systems to react quickly to disturbances and disruptions
- forming a set of not final decisions i.e., postponement and rolling/adaptive planning.

For the SCM domain, uncertainty factors and measures to compensate for the disturbance and their handling following techniques can be applied:

- Multi-criteria analysis techniques
- Supply chain security management
- Liquid assets reserves
- Strategic material inventories
- Market diversification and outsourcing
- Product lines' flexibility and modularity
- Safety stocks and time buffers
- Reserves of supply chain capacities
- Supply chain coordination, monitoring and event management.

Kleindorfer and Saad (2005) provided a conceptual framework that reflects the joint activities of risk assessment and risk mitigation that are fundamental to disruption risk management. This framework comprises three main tasks that have to be practiced continuously as the foundation of disruption risk management. The three tasks are: specifying sources of risk and vulnerabilities, assessment, and mitigation referred as SAM.

The main elements of the reliability reserves such as time buffers, safety stocks, and additional facilities, reservation of capacities, and IT-based coordination and monitoring cause certain **costs** for the creation on reliability, however, in the case of disruptions, these reserves may also be an **income** origin because of uninterrupted supply chain processes.

3.2.3 Supply chain flexibility and adaptation

The **flexibility** of supply chains is a property of a supply chain concerning its ability to change itself quickly, structurally, and functionally depending on the current execution state and reaching SCM goals by a change in supply chain structures and behaviour.

Adaptation is a changing of functioning and the abilities to function in unsettled conditions by a goal-oriented change of the supply chain parameters and/or structures.

The main elements of the adaptation reserves are unification of management functions between different supply chain decision making points:

- 'rolling' or adaptive planning, not final decisions (i.e., postponement),
- virtual reserves (alternative suppliers' pool),
- dynamic pricing and
- flexible contracting.

(Ivanov & Sokolov 2010, 88).

4 Effects of 2022 Russian invasion of Ukraine

On February 24, 2022, Russia invaded Ukraine in what many considered an act of war. The attack was the largest military assault on a European state since World War II (Wikipedia 2022).

The timeline below (Figure 10) illustrates the sequence of events of Russian invasion in Ukraine, which began on February 24, 2022, leading until March 15, 2022, and continues still. As of the date this thesis is written, the military conflict has not been ended yet, and further research may reveal more details about the events.

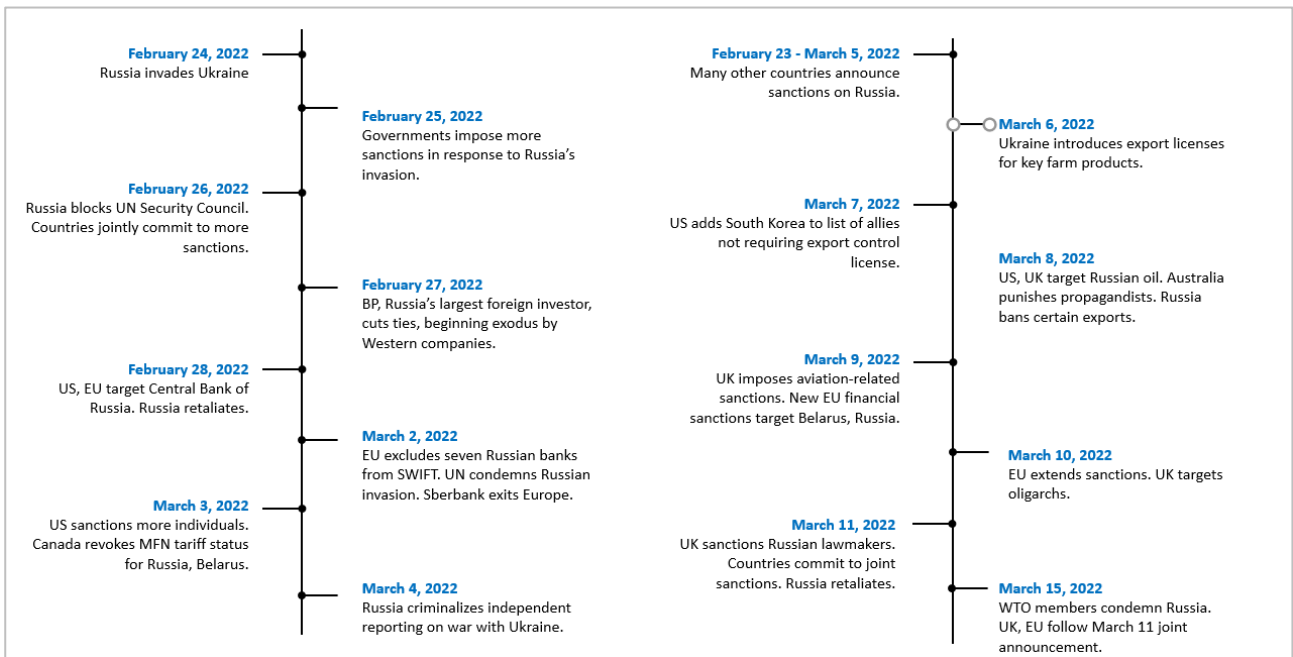


Figure 10. Russia's war on Ukraine: A sanctions timeline (adopted from PIIE 2022)

The United States and several other European countries have imposed economic sanctions on Russia in response to its involvement in the conflict in Ukraine. The sanctions freeze the assets of Russia's Central Bank and ban Western businesses from dealing with Russian government agencies and many individuals. Several European countries, including the United Kingdom, France, Germany, Italy, and Spain, have also banned all flights by Russian aircraft over their territories.

The invasion of Ukraine by Russia and the resulting economic sanctions predict decrease the supply of commodities, agricultural and manufactured goods from Russia to the global economy. This reduction in supply is likely to negatively affect many industries, including food products and high technology goods. In addition, the invasion has increased pressure on an already strained global logistics and transportation network.

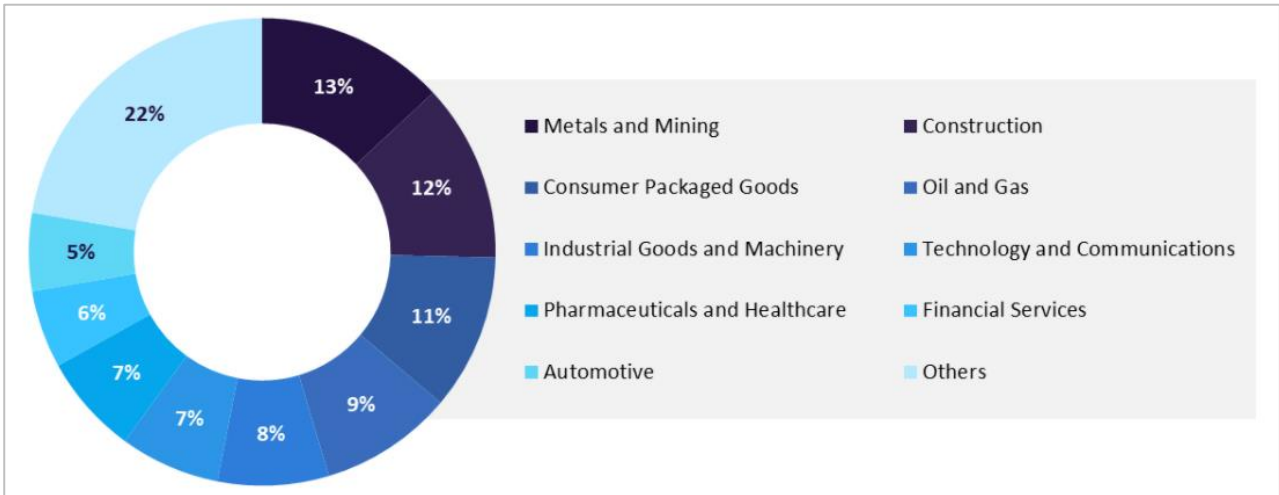


Figure 11. Most impacted sectors by Ukraine-Russia Crisis (GlobalData 2022)



Figure 12. Major impacts on supply chain caused by Ukraine-Russia conflict (McKinsey 2022a)

The following are some of the industries that have been affected according to Euromonitor (2022):

Energy Industry

Russia is an important supplier of energy products and accounted for 12% of the world's oil supplies, 18% of its natural gas supplies, and 20% of its coal supplies in 2021. High exposure to Russian energy was most prevalent in Central and Eastern Europe, where Russia provided more than half of the region's oil and gas imports. These high levels of dependency could lead to rising

energy prices for European countries if Russia were to impose sanctions following the Ukraine invasion. Oil prices are forecast to remain above USD100 per barrel throughout 2022. Prices for natural gas may rise by an additional 50%, which would impact companies with high energy consumption that are part of the metal, chemical, fertilizer, and other goods sectors.

Agriculture industry

The countries of Ukraine and Russia are among the world's top suppliers of food commodities, with Russian and Ukrainian farmers providing 15% of worldwide wheat and nearly 7% of global rapeseed production in 2021. Moreover, both countries are important suppliers of oils and fats used in food production, with Russian and Ukrainian farms contributing nearly 5% of worldwide output in 2021.

Metal Industry

Russia and Ukraine are important suppliers of metal ores and metal products. Together, they accounted for 5% of global crude steel and iron ore output in 2021. Metal producers in Russia and Ukraine were among the key suppliers in Europe. The pause on production in Ukraine, transportation problems, and concerns about additional sanctions against Russian metals inflated prices, putting metals importers at a disadvantage.

Automotive industry

Due to the invasion of Ukraine, the automotive industry faces further supply chain disruptions. Ukraine is an important supplier of wiring and electronic components to European car manufacturers, and this will exacerbate component supply problems that are already at critical levels. Total automotive exports from Ukraine stood at US\$505 million in 2020, accounting for 13% of the total production output. A shortage of wiring harnesses is the most immediate bottleneck; without wiring harnesses, car manufacturers will be unable to produce vehicles. For example, Volkswagen has already halted the production of several electric vehicles due to disrupted supplies of wiring harnesses from Ukraine. Overall production disruptions could reduce European car output by 100,000 units in 2022.

Semiconductor industry

The invasion of Ukraine is forecast to have a negative impact on the global semiconductor industry and, in particular, on the production of microchips. Based on estimates, it is believed that Russia and Ukraine together provide 50-70% of the world's neon—a by-product from the metals industry—

which is used in lasers to produce semiconductors. Production disruptions threaten the stability of the semiconductor industry's supply chain.

Transportation industry

With the invasion of Ukraine, transportation has been heavily disrupted. Land routes between Europe and Asia have been cut off, and this will especially impact Chinese companies that rely on rail to transport goods to Europe. For instance, the volume of goods carried by rail from China to Europe soared from 14 million metric tonnes in 2019 to 24 million metric tonnes in 2020, despite the pandemic. The invasion of Ukraine is expected to impact further growth.

5 Research Methods

This thesis is intended as fully qualitative desk-based research. According to Barbara Bassot **desk-based research** is a form of empirical research, where you gather your data indirectly (for example, via the internet), whereas **empirical research** is, where you gather your own data (for example, through interviews, focus groups). (Bassot 2022, 4.)

In addition to desk-based research this thesis is aimed to use qualitative data analysis. Barbara also emphasizes, that in general, qualitative research involves exploring things to gain understanding via interpretation. As Denzin and Lincoln (2018, 10) explains that qualitative research study things in their natural settings, attempting to make sense of, or interpret phenomena in terms of the meanings people bring to them.

Barbara Bassot (2022, 7) notes that there are three different type of data sources that are used in the process of carrying out research: **primary sources**, **secondary sources**, and **tertiary sources**. Primary data source contains material that is original, secondary data sources describe or analyse primary sources and tertiary data sources compile and organise mostly secondary sources to make them easier to find. In general, it is believed that all three types of data is used in this research.

Firstly, to perform desk-based qualitative research secondary data sources have been significant part to explore terminology and key concepts. Secondary data sources used were texts books that are specific to supply chain discipline obtained from Finnish publicly available libraries that were available in English.

Secondly, to analyse second investigative question in order to understand how 2022 Russian Invasion of Ukraine affected global supply chain mostly news articles were used in addition to articles published by private and governmental organizations.

Thirdly, to obtain the results to final investigative question mostly statistics from databases such as Statista and Passport were used to be able to get insights and reflections by putting together theory and research gained from latest news articles and publications.

Research is divided into three phases, where research of each investigative question (IQ) represents one phase, lastly obtaining results and conclusions from phase three provides the answer to main research question (RQ), which is the main outcome of this thesis research.

Qualitative Desk-based Research

Research Questions	What are Risk Mitigation Strategies in area of Sourcing and Procurement in case such disruptions as 2022 Russian Invasion of Ukraine?			
Investigative Questions	What are the risk mitigation strategies in area of sourcing and procurement?	What factors contribute to disruptions in supply chain?	How was sourcing and procurement affected by 2022 Russian invasion of Ukraine?	What could be the possible risk mitigation strategies considering similar events in the future
Data Collection Methods	Public Libraries: Many different theory books about supply chain and disruptions; Articles published by Council of SCM Professionals; Statistical Data Basis e.g. Statista		Publicly available and reliable news articles, studies published by banks and government and private organizations, databasis for statistics such as Statista, Passport	
Data Processing Methods	Classifying, analyzing, summarizing, and visualizing data			
Task Outcome	Theoretical Framework. IQ answered in <i>Chapter 2</i>	Theoretical Framework. IQ answered in <i>Chapter 3</i>	Observations, opinions, suggestions. IQ answered in <i>Chapter 4</i>	Syntesis of theory and reflections. IQ answered in <i>Chapter 6</i>
Thesis Outcome	Guidelines for industry experts of risk mitigation strategies in case of similar severe disruptions Mostly effective strategies used by organizations be proven as effective.			

Figure 13. Qualitative desk-based research

6 Data and results

6.1 Data research

Research published by Statista in 2020 (Statista 2022a) indicates that inventory visibility was the main priority for professionals responsible for retail stock management (See Figure 14).

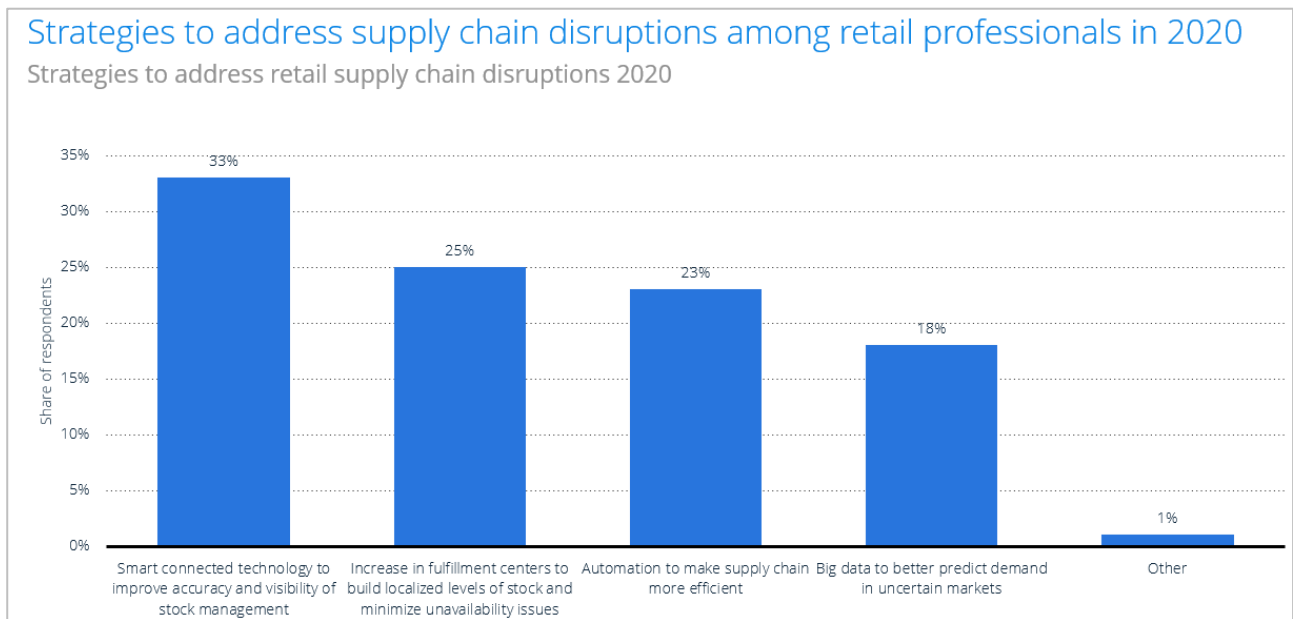


Figure 14. Strategies to address supply chain disruptions 2020 (Statista 2022a)

The same survey from 2020 also revealed that smart connected technologies were essential element to address this challenge in the retail supply chain, with 33% of answers. This also confirms Ivanov and Sokolov (2010, 79) theory that this type of uncertainty/risk could be reduced by introducing supply chain monitoring and event management systems to react quickly to disturbances and disruptions. Smart connected technologies can also help to improve coordination and information flows to make better quality, timeliness, and accessibility, which means that smart connected technologies are the key enabler to increase visibility and accuracy as internally as externally. According to Manners-Bell J. (2020, 21) information and communication technology networks support much of the present-day supply chain and logistics operations, providing visibility and automation into warehouses, enabling efficient transport management, and tracking locations and events, and facilitating communications among shipper, logistics service provider and final consumer as well as customs and border controls.

The use of Big Data for demand predictions and forecasting shows to be less important, as only 18% considered it an effective strategy. This confirms writings of Christopher (2016, 174) when there is high level of stability, forecast accuracy is expected to be high however disruptions on

other hand bring high level of uncertainty which further means an increased likelihood that forecast error will increase in line with complexity. Therefore, the challenge that organizations now face is how to reduce their dependence on forecasts and to become increasingly demand and event driven. Thus, conventional forecasting tools will be less effective the greater the complexity of the network and high level of uncertainty. (Christopher 2016, 174.)

In addition, data reveals that 25% consider that to address disruptions it is necessary to build localized levels of stock and minimize unavailability issues. How significant the impact for business is out-of-stock situation is addressed in Christopher's book (2016, 33), additionally study (Corsten & Gruen 2004) conducted identifies that significant cost penalties occur by bought manufacturers and retailers when a stock-out happens. The same study suggests, retailers can lose nearly half of intended purchases when customers encounter stock-outs (see Appendix 1). Many supply professionals (Manners-Bell 2020; Ivanov & Sokolov 2010) in their literature refer to the fact building excess is stock is necessary.

As the pharmaceutical company's case earlier in chapter 3.1.4 presented that company was able to set inventory holdings at a level which would minimize disruption, but the weakness of this approach was that, however it minimized disruption, the strategy imposed huge additional costs on the organization, not only from the financing of the additional inventory, but also from the risks of redundancy of stock. (Manners-Bell 2020, 13.) Manners-Bell (2020) also continues by saying that effective supply chain management is all about the trade-off of one set of risks against another. According to McKinsey report (White & al. 2022) by June 2021, about 60% of managers said they have increased inventories of critical products.

A little behind with 23% indicates that automation is very necessary to make supply chain efficient to respond to supply chain disruptions (Statista 2022a.) One example that can be mentioned is given by KPMG (2022) which is a result of 2022 Russian invasion of Ukraine brought a lot of sanctions, restrictions, tariffs and embargoes and very short time, which in case a not considered can all result in additional costs. Whereas automation can help to keep track of all existing and upcoming sanctions to best assess the business impact. Monitoring and assessing the far-reaching implications of the broad suite of economic sanctions impacting supply chains is paramount for future planning activities. Automated tools are essential in this quickly developing sanctions environment. Even if the conflict is resolved in the span of a few months, sanctions and restrictions may remain in place long after.

The 2019 Annual Third-Party Logistics study conducted by Infosys Consulting, Penske Logistics, Penn State University, and Korn Ferry shows that the level of importance that shippers and third-party logistics providers (3PLs) place on mitigating supply chain disruption is much greater than it

was five years ago. Figure 15 reveals that in addition to earlier mentioned mitigation strategies another important strategy is adding redundant suppliers. Redundancy refers to backup or alternative suppliers and the amount of time it takes for an organization to switch between suppliers following a disruption (Savitsky 2017). However, by adding alternative suppliers has low impact of improvement to supply chain it has higher potential to decrease disruptions, procurement risks and inventory risks, which may play significant role during disruption such as COVID-19 or 2022 Russian invasion of Ukraine.

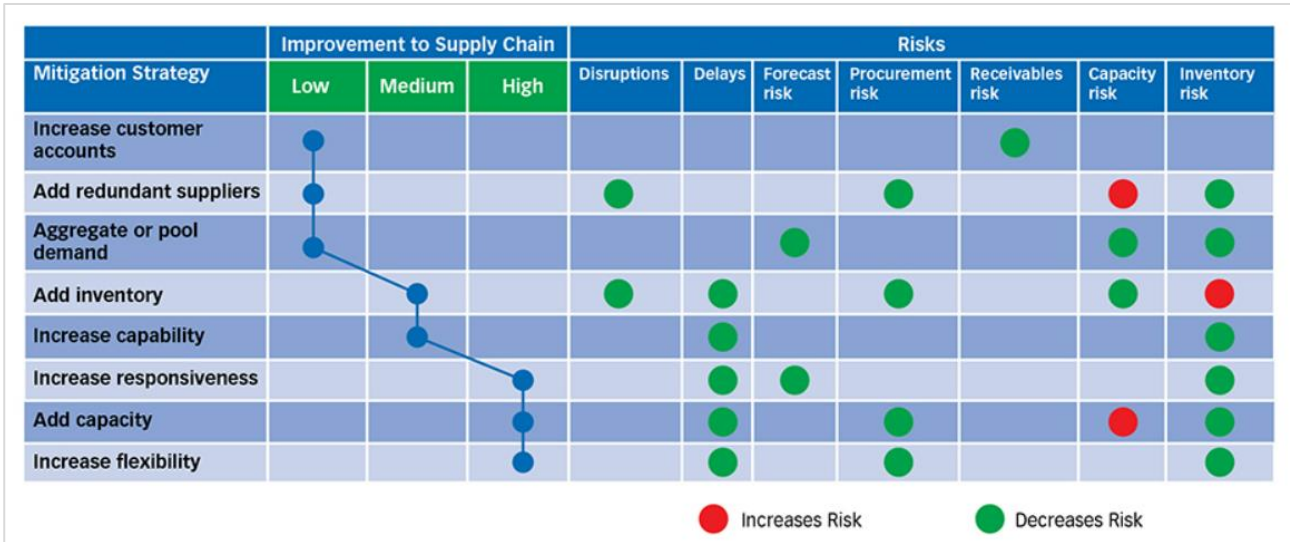


Figure 15. The impact of various risk mitigation strategies (CSCMP's Supply Chain Quarterly 2022)

According to McKinsey report (White & al. 2022) the war in Ukraine and subsequent sanctions are giving leaders yet more reasons to examine their sourcing capabilities. In McKinsey's survey of supply chain leaders, 80% of respondents said that as of March 2022, they have implemented "dual sourcing," up from 55% a few months ago (see Figure 16). Dual sourcing is set to become even more important, considering the war. Additional measures have been taken in supplying area such as regionalizing and nearshoring supply chain. An article written by Simms T. (2022) claims that the future of manufacturing supply chains is regional rather than nearshoring. In the near-term, they will be critical to mitigating disruptions in the cost of manufacturing by lowering TTR (Time to Recovery).

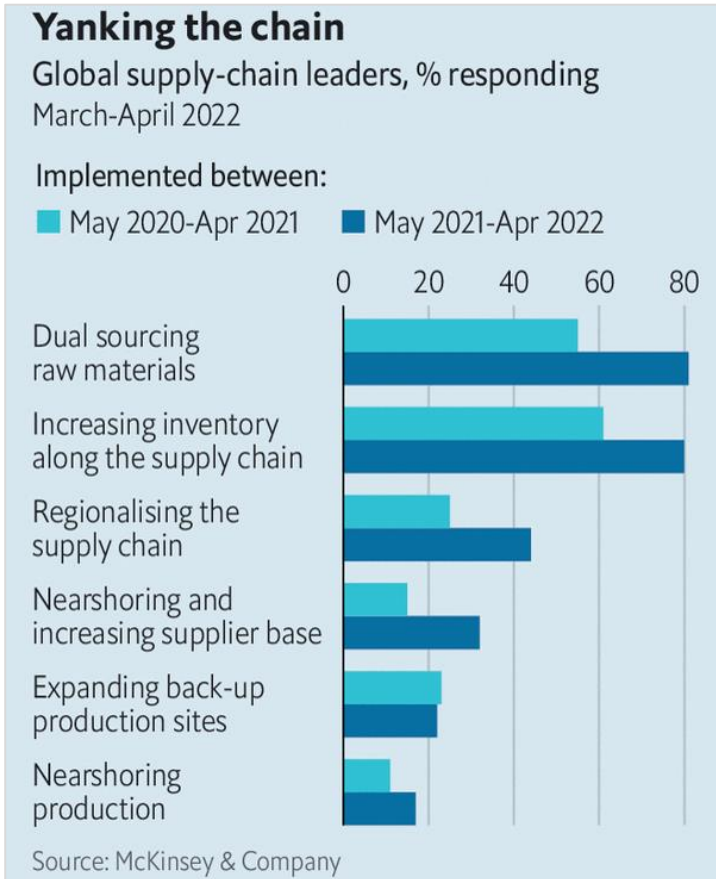


Figure 16. Yanking the chain (The Economist 2022)

Manners-Bell (2014, 10) confirms that complex supply chain with multiple supplier options has the potential to be much more robust through a greater number of sourcing options, which means the probability of overall network disruption is less than in a small supply chain.

Another interesting research conducted by company AMR (Advanced Market Research) analysed the 10 methods used in supply chain to mitigate risks and which have been the most successful in their application (see Figure 17).

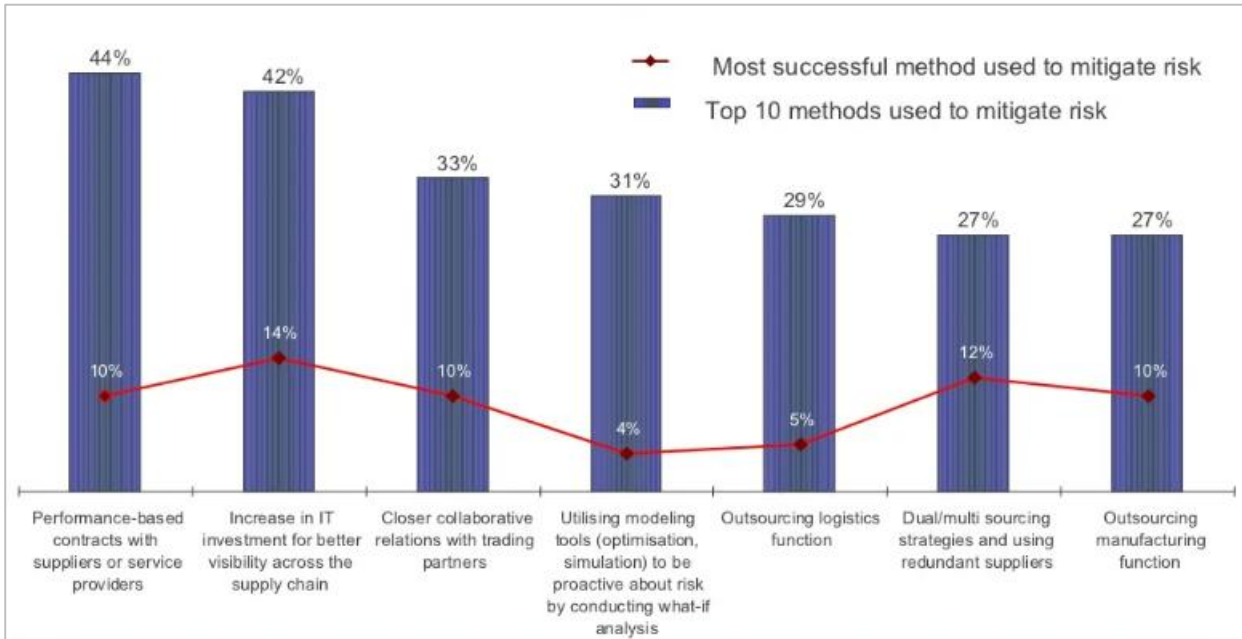


Figure 17. Supply chain risk mitigation, AMR research 2008 (Subramaniam 2009)

Further research repeatedly shows that increased investment in IT and smart connected technologies ensures better visibility across the supply chain and be proven the most successful method to mitigate supply chain risks from all the methods used by the respondents (14%).

Dual/multi sourcing strategies and use of alternative suppliers (12%) prove to be second most efficient when dealing with supply chain risk mitigation. Manners-Bell J. (2020, 32) calls it 'supply chain intelligence', which means upstream and downstream suppliers should be identified, and their functions and performance audited. Audits help to identify supplier over-dependence, which can lead to alternative sourcing arrangements. Nevertheless, creating visibility relies on high levels of collaboration throughout the supply chain, as well as an environment in which suppliers are encouraged to audit their own suppliers.

Interestingly one of the most used risk mitigation strategies among the respondents is performance-based contracts with suppliers and service providers (44%), which also deliver reasonably good results (10%) when it comes to mitigation of supply chain risks. Research also proved long time used risk mitigation strategies such as outsourcing manufacturing functions (10%) and outsourcing logistics function (5%) but in addition according to McKinsey latest research (The Economist 2022) there is a shift towards nearshoring supplier base and as well production. To maintain profitability in today's challenging business environment, companies are looking for ways to reduce costs while maintaining a high level of service. Buyers who previously sought labour and material savings from offshore suppliers are now seeking more local suppliers, knowing that their unit costs

will be higher than originally projected. And some companies are re-establishing their own manufacturing capabilities. (Weissman 2022)

6.2 Results

Ranking of risk mitigation strategies is established based on the statistical data found in previous chapters depending how many times the specific risk mitigation strategy was mentioned in the listed statistics and how highly it was evaluated as effective.

Table 5. Ranking of Risk Mitigation Strategies

Risk Mitigation Strategy	Rank	Points	Strategies to address supply chain disruptions 2020 (Statista 2022a)	The impact of various risk mitigation strategies (CSCMP's Supply Chain Quarterly 2022)	Yanking the chain (The Economist 2022)	Supply chain risk mitigation, AMR research 2008 (Subramaniam 2009)
Stock buffers, excess inventory to avoid out-of-stock situations	1	109	X (25%)	X (4)	X (80%)	
Dual, multilevel sourcing using redundant suppliers	2	95		X (3)	X (80%)	X (12%)
Technology that enables better visibility and accuracy across supply chain networks	3	47	X (33%)			X (14%)
Regionalizing supply chain	4	42			X (42%)	
Nearshoring and increasing supplier base	5	26			X (26%)	
Automation of supply chain	6	23	X (23%)			
Predictive Modelling, simulation, and what-if analysis	7	22	X (18%)			X (4%)
Nearshoring production	8	18			X (18)	
Performance based Contracts	9	10				X (10%)
Closer Collaboration with Partners	10	10				X (10%)
Outsourcing manufacturing	11	10				X (10%)
Outsourcing logistics functions	12	5				X (5%)

Results of the ranking reveal that excess inventory to avoid out-of-stock situations is the highly ranked and mentioned in 3 out of 4 different sources of statistics. Further after excess inventory, second risk mitigation strategy that has been widely used by organizations is dual and multilevel sourcing (2nd in rank). As theory earlier mentioned, these type of strategies falls into redundancy

category. Third in ranking is technology that enables better visibility and accuracy followed by automation (6th in rank) and closer collaboration with partners (10th in rank), which according to theory earlier referenced are falling into flexibility category. 4th, 5th place goes to regionalization and nearshoring of supply chain, whereas less popular has been outsourcing of manufacturing and logistics functions (11th and 12th in rank). Interestingly, big data to predict uncertain markets including modelling, simulation and what-if analyses has gained 7th place.

7 Conclusion

The final chapter summarizes the findings, presenting the main points of the research as well as presenting key findings through the investigative questions and research questions. The chapter further examines the reliability and validity of the research and findings. This is followed by recommendations that organizations can take action to address the problem and suggests further research. Lastly, the chapter examines the author's reflections on what was learned during the research.

7.1 Key Findings

The study set out to answer the main research question (RQ) by first answering four investigative questions (IQ). With the information gathered from theory books available in public libraries in addition to reliable online sources, conclusions on each investigative question were reached. By finding answers to each investigative question, it was possible to reach a conclusion for the research question.

The first IQ asked **what the risk mitigation strategies in area of sourcing and procurement are**. As concluded in the research, risk mitigation strategies can be classified into two broad categories and those are redundancy and flexibility. Redundancy focuses on mitigation of negative effects by using such strategies as **buffering** which means by keeping safety stocks, having multiple sourcing suppliers, or avoiding the same raw materials be part of all finished products and **hedging**, which implies building globally disperse supplier networks and raw material sources in that way avoiding single point effecting many or all entities at the same time. On the other hand, flexibility related category focuses on such strategies like **bridging**, by investing into collaboration to enhance interorganizational capabilities to see coming threats early and reach quickly in that way enabling higher level flexibility and responsiveness.

The second IQ focused on **what factors contribute to disruptions in supply chain**. The research brings to light that globalization has created highly integrated markets and networks and by outsourcing or offshoring organizations have added to the complexity of their operations because the degree of interdependency across the networks has increased. Thus, an event or action taking place in one part of the network will often have overseen impacts somewhere else in the network. Findings show that with higher level complexity the level of uncertainty rises which on other hand jeopardizes forecasting. Which imply that companies may need to become more demand-driven to be able to react quickly to changing market conditions and shared information may help here to build more reactive supply chain networks.

The third IQ explored **how was sourcing and procurement affected by 2022 Russian invasion of Ukraine?** Researched results show that invasion of Ukraine by Russia and its resulting economic sanctions has brought decrease the supply of commodities, agricultural and manufactured goods from Russia to the global economy. This reduction in supply is likely to negatively affect many industries, including food products and high technology goods. Some of the major industries that have been affected are energy market, agriculture industry, metal industry, automotive industry, semiconductor industry and transportation industry.

The last IQ was set to discover **what could be the possible risk mitigation strategies considering similar geopolitical events in the future.** The various research results show many similarities. The most often noted mitigation strategy by organizations is increase inventory levels to avoid out-of-stock situations. By adding excess inventory organizations decrease the level of risk in case of disruptions. The second most noted mitigation strategy is dual, multilevel sourcing by using redundant suppliers. These findings just confirms that redundancy in supply chain is the significant method to ensure stability during turbulent times. As study shows that globalizations have proven to contribute greatly to complexity of supply chain networks and one of the mitigation strategies that can be applied is regionalization or nearshoring of supply chain in some units in that way reducing risk to be exposed entire organization to disruptions. Findings show that technology and closer collaboration enables better visibility and lastly performance-based contracts with suppliers and service providers and clauses addressing 'force also prove to be effective strategies to reduce the risk of disruptions.

7.2 Recommendations for further research

It is clear that such geopolitical conflict as the 2022 Russian Invasion of Ukraine has brought major disruptions to local and global supply chains in many supply chain activities including sourcing and procurement. The findings of this research also highlight that occurrence of disruptions in last decade have increased significantly, so organizations need to be well prepared to ensure stability and flexibility in times when disruptions become a new normal. Research also emphasizes that there are not yet enough number of studies conducted on this particular subject. Author believes that more thorough research is needed on different types of mitigation strategies and measuring and comparing their effectiveness to understand which proves to be more effective and which ones less effective and what variables may influence the effectiveness of the strategy applied. Academics also note that most of the organizations do not have metrics to measure the resilience of a company's supply chain to potential threats, therefore it is believed to be area where more exploration and research is needed, and supply chain modelling could be a useful tool.

7.3 Data validity

This chapter examines the validity and credibility of the data used in this thesis. In addition, chapter 1.6 has already noted some of the concerns about the validity and reliability of this research. Since some parts of study focus on 2022 Russian Invasion of Ukraine, which is an event that is still ongoing, it is clear that sometimes it was difficult to verify the validity of the data made publicly available online especially wide range of news outlets.

However, sources used for this study were considered reliable as per author. The author collected secondary data from multiple trustworthy sources such as books found in various university public libraries, journals such as 'The International Journal of Logistics Management' and 'The Journal of Business Logistics' and research materials and publications written and published by credible authors. All of the sources used in this thesis were evaluated for their reliability. These evaluations included examining where, when and by whom a source was published. Author of this this thesis strived to find multiple sources of literature on the same subject to explore the topic more in-depth because as stated by Burns & al. (2014, 129): 'If two or more independent organizations report the same data, you can have greater confidence in the validity and reliability of the data'. This however does not prove the validity and reliability of the data comprehensively.

7.4 Personal learning

The author's interest in the topic led to this research, and novelty was a major factor in the decision to conduct this study. During the process of writing this thesis, the author learned to manage a large project independently. While studying in the university, the author has been part of many similar writing projects with her fellow students, but this time all was done on her own. This required the author to manage her time and tasks, so they could be completed on time. During the thesis writing process an author was also working in full-time job, which made it sometimes challenging to manage time, which by itself was a great learning and the skills acquired could be utilized later in author's personal and work life, because many times people need to manage multiple tasks parallelly. Writing this thesis required an author to read and summarize large amounts of literature, understand many theoretical frameworks and concepts, and develop critical thinking skills that were needed to establish arguments based on the sources used. The thesis writing process proved to be an effective tool to learn how to handle projects independently and an author sees that she benefited greatly from this task, which will help significantly in her future work life within area of supply chain she already works in.

8 Appendices

8.1 Appendix 1 Shopper behaviour when they faced with a stock-out

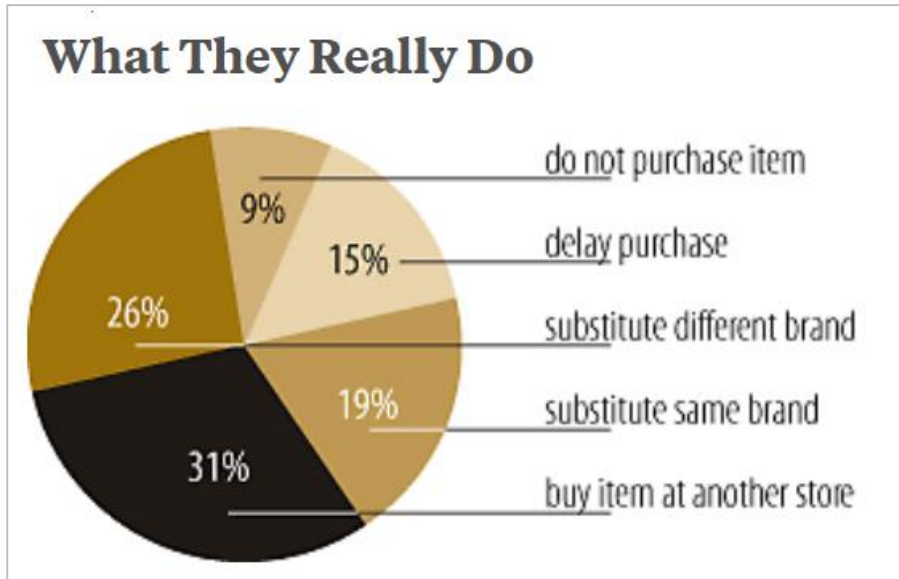


Figure 18 What They Really Do (Corsten & Gruen 2004)

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