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# INVESTIGATING CHALLENGES AND RESPONSES IN SUPPLY CHAIN MANAGEMENT AMID UNFORESEEN EVENTS

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The emergence of increasingly complex global supply networks and the rising risk of unpredictable events may have far-reaching consequences for various industries and the global economy. The impact unpredictable events have on supply chains remains a relatively underexplored area that requires further research and analysis. Current studies primarily concentrate on singular events, particularly the COVID-19 pandemic and its effects on supply chains. This research aims to identify the main challenges in supply chain management resulting from unforeseen events and the actions taken in supply chains in response to them. The research is based on individual in-depth interviews conducted with a purposive sample of experts in supply chain management using a partially structured interview questionnaire. The research results were analysed using Nvivo v. 17.1, software for qualitative data analysis. A hybrid approach was employed for data coding. The research indicates several problems and the main remedial actions in supply chains in response to unforeseen events. Unforeseen events in the supply chain affect almost all supply chain operations: procurement, planning (including inventory planning and maintenance of company resources and production lines), logistics management (including transportation), and order management. The research indicated that cooperation, integration, and information exchange within the supply chain are crucial for effective responses to unforeseen events. Furthermore, the research highlighted the positive impact of unforeseen events on supply chain innovation. Moreover, there is an observed prevalence of intuitive management, particularly when responding to unexpected events. The research findings can serve as a basis for further discussions and studies on the potential impact and consequences of future unexpected events on supply chain resilience.

**KEY WORDS**

**supply chain, unforeseen events, disruptions resilience, just-in-case, cooperation, information exchange, trust, demand, supply, framework agreements**

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**INTRODUCTION**

Liberalisation of foreign trade, favourable conditions for foreign direct investments, and the dynamic development of transportation and information and

communication technologies have significantly facilitated the creation of international supply chains. However, today's supply chains encounter numerous challenges, including uncertainty, rising operational costs, complexity, and susceptibility to disruptions (Núñez-Merino et al., 2020; Gatenholm & Halldorsdóttir, 2022). Stone and Rahimifard (2018) emphasised

that supply chains are increasingly confronted with growing variability and dependence on various factors, such as exchange rates, energy costs, and resource availability. The environment is also characterised by unpredictability, the overlap of different problems, the absence of straightforward cause-and-effect relationships, and ambiguity, all of which increase decision-making risks. These characteristics epitomise the VUCA environment (volatility, uncertainty, complexity, ambiguity) (Bennett & Lemoine, 2014). Today's environment can also be aptly described using the acronym BANI — brittle, anxious, nonlinear, and incomprehensible — (Cascio, 2020), portraying business conditions as unstable, chaotic, or entirely unpredictable.

Particularly difficult to predict are the consequences of so-called "black swan" events, which are unpredictable, large-scale occurrences with profound consequences when they occur (Makridakis & Taleb, 2009). An example of such an event is the COVID-19 pandemic, which began in 2019 and caused a shock to the global economy and an unprecedented impact on supply chains (Antipova, 2020; Weber, 2021). Most events, such as earthquakes, tsunamis, or wars, usually remain limited to specific countries or regions and have relatively short durations. The COVID-19 pandemic lasted for many months, and its end was difficult to predict. It affected over 210 countries and impacted supply chains in most industries, both on the demand and supply sides (Ali & Alharbi, 2020). Another instance of an unpredictable event is the Ukraine conflict, which substantially impacted global supply chains, particularly in energy, food, fertilisers, and raw materials, exacerbating the adverse effects caused by the pandemic.

Determining whether the COVID-19 pandemic and the Ukraine conflict can be accurately classified as "black swan" events is challenging, as pandemics and conflicts occur worldwide. However, they were undoubtedly unforeseen disruptions for which supply chains were unprepared, and the impact scale was vast, taking the world by surprise. According to Siegenfeld et al. (2020), COVID-19 proved to be a "black swan" event as nations were unaware of its impact on supply chains and how industries could operate during a pandemic outbreak.

With the emergence of increasingly complex and global supply networks, the risk of unpredictable events also rises, potentially resulting in far-reaching consequences for various industries and the global economy. The impact of unpredictable events on supply chains remains a relatively underexplored area

and requires further research and analysis. The literature makes many references to the influence of disruptions on supply chains (Wilson, 2007; Oke & Gopalakrishnan, 2009; Hopp et al., 2012; Parast et al., 2019; Rajesh, 2021; Katsaliaki et al., 2022; Azam et al., 2023). Certain studies explore the consequences of unforeseen events on supply chains (Pettit et al., 2010; Ong et al., 2015). However, current studies primarily concentrate on singular events, particularly the COVID-19 pandemic, and its effects on supply chains (Remko, 2020; Kumar et al., 2020; Chowdhury et al., 2021; Ketudat & Jeenanunta, 2021; Singh et al., 2021; Raj et al., 2022; Pujawan & Bah, 2023).

Research lacks pinpointing the main challenges in supply chain management resulting from unforeseen events and responsive actions within supply chains. Thus, the research question is: What are the primary areas of supply chain management affected by unforeseen events which are unpredictable, of considerable scale, and have significant consequences, and what general actions are undertaken within supply chains in response to these events?

The study draws upon insights from in-depth individual interviews (IDIs) with experts in supply chain management. The research findings were rigorously analysed using NVivo v. 17.1, a qualitative data analysis software.

The article presents the issue of unforeseen events' impact on the resilience of the supply chains, using the COVID-19 pandemic and the Russia-Ukraine war as examples. It describes the methodology and results of the conducted qualitative research and recognises the main problems in supply chain management that result from unforeseen events and actions taken in response. The article closes with conclusions and recommendations for further research.

## 1. RESEARCH BACKGROUND

### 1.1. UNFORESEEN EVENTS AND SUPPLY CHAIN RESILIENCE

Unforeseen events (unexpected events, emergencies, or uncertainties) are disruptions that are challenging to predict and forecast and that significantly impact supply chains. Such events encompass war, epidemic, terrorism or ecological disaster. The recent surge in unforeseen events and their profound influence on supply chain operations has increased con-

cerns about risk and resilience. Supply chain resilience is defined as the ability of a supply chain to prepare for and respond to disruptions (Hussain et al., 2023). The term “resilience” is derived from the Latin word “resiliens”, meaning “to bounce back” or “to rebound”, and it refers to the ability to quickly recover or restore equilibrium following a period of instability. Disruptions within the supply chain pose a threat to the normal execution of business operations in the affected enterprises within the supply chain (Konecka, 2015). Resilience plays a pivotal role in effectively mitigating risks and enables swift and efficient restoration of regular operations, sometimes resulting in improved outcomes even after a disruption (Yu et al., 2022).

The concept of supply chain resilience combines the principles of supply chain risk management (SCRM) and business continuity management (BCM) (Wieteska, 2019). Supply chain risk management focuses on anticipating threats, assessing risks, and employing various methods to reduce the likelihood of disruptions in the supply chain's operations and minimise the consequences of unplanned events (Hafiani et al., 2021). While supply chain risk management aims to identify and gain control over risks to limit their impact, supply chain resilience is an adaptive capability designed for addressing unexpected events and responding to them. Supply chain resilience can be assessed across three phases: readiness for the potential disruptions/risks, their response to such events, and the restoration to the pre-risk operating state (Ali et al., 2022).

Several factors influence supply chain resilience, including the coordination and streamlining of processes throughout supply chain links, collaboration, agility, and awareness of the risks present in the supply chain (Christopher & Peck, 2004). Supply chain risk management and the unpredictability of disruptions are interconnected issues, yet SCRM alone is insufficient for dealing with unexpected events (Olivares-Aguila & Vital-Soto, 2021).

Business continuity management (BCM) encompasses a set of principles, standards, and tools designed to underpin the safeguarding of an organisation's critical functions and processes essential for maintaining operational continuity in the face of disruptions (Suresh et al., 2020). BCM's objective is to enhance the supply chain resilience against potential threats and enable it to sustain operations even under highly unfavourable events. In contrast to the conventional risk management approach, BCM typically concentrates on events characterised by high propa-

gation of disruptions and low likelihood of occurrence, leaving decision-makers with very little time to react and take appropriate actions. Business continuity management predominantly relies on risk analysis and crisis management, particularly in scenarios involving the loss of critical resources (Wieteska, 2019).

## 1.2. IMPACT OF UNFORESEEN EVENTS ON SUPPLY CHAINS

### 1.2.1. EXAMPLE OF THE COVID-19 PANDEMIC

The first case of SARS-CoV-2 infection likely appeared in early November 2019 in China. The first infections outside China were reported in January 2020 in Thailand and subsequently spread to the USA and Europe. As of the end of April 2023, the WHO reported nearly 763 million confirmed cases of COVID-19, with nearly seven million fatalities (WHO, 2023).

The global crisis caused by COVID-19 profoundly impacted nearly every sector of the global economy (Sebaa & Slimane, 2022). The crisis led to a negative demand shock due to consumer concerns and a supply shock caused by border closures, business disruptions, and disruptions in supply chains. A notable surge in demand occurred for essential products and services, particularly food. Additionally, the demand for medical products, including masks, gloves, face shields, and medical equipment, such as ventilators, experienced a significant increase. In the initial phase of the pandemic, most major economies around the world implemented nationwide lockdowns. Restrictions in many cities, along with limited availability of workforce, raw materials, and consumables, resulted in the shutdown or suspension of production capacity in nearly all sectors of the economy (Sridhar et al., 2022).

The pandemic also disrupted transportation connections and impeded the flow of goods between suppliers, manufacturers, and customers (Kumar et al., 2020; Kuźmicz, 2022). Uncertainty in demand and supply, including price and volume volatility, shortages of materials for production, and delays in goods deliveries, seriously disrupted the availability and delivery of a wide range of raw materials, materials, semi-finished goods, and finished products. As Xu et al. (2020) highlighted, the COVID-19 pandemic caused disruptions in most global supply chains, especially in the pharmaceutical, food, electronics, and automotive industries. According to a Fortune

Report (2020), 94% of Fortune 1000 companies experienced supply chain disruptions due to the pandemic.

The pandemic has also prompted questions regarding the costs and benefits of operating global supply chains. COVID-19, by significantly slowing down the global economy, has triggered irreversible changes, which in turn have created new challenges for global supply chains (Jackson et al., 2021). Global supply chains, which have demonstrated a high level of resilience to various disruptions in recent decades, now confront novel and unprecedented challenges (Blessley & Mudambi, 2022). According to Raj et al. (2022), the repercussions of the SARS-CoV-2 virus significantly impacted various facets of international logistics enterprises, with the primary focus on production processes, material management, transportation, and distribution. Meanwhile, studies conducted by Chowdhury et al. (2021) indicate the impact of the COVID-19 pandemic across different areas of supply chains, including demand management, supply management, production management, transportation and logistics management, relationship management, overall supply chain impact (affecting operations up and down the supply chain), financial management, and sustainable development management. The main disruptions identified include (Chowdhury et al., 2021; Remko, 2020):

- surges in demand for essential goods, shortages of these products, delivery delays, and decreased demand for other products;
- supply shocks, materials and components shortages, forecasting difficulties, supply disruptions, a lack of preparedness for disruptions, and limited use of existing contingency plans and crisis management;
- disruptions and delays in production, reduced production capacity, labour shortages;
- transportation and distribution delays, restrictions on international trade/transportation, loss or lack of physical goods distribution, changes in distribution methods (e.g., shifting from offline to online channels or introducing mixed distribution channels);
- limited social contacts, uncertainties in information flow, lack of supplier engagement, or opportunistic behaviour;
- domino effect, i.e., the impact of problems occurring in one part of the supply chain on other operations, supply chain disruptions, facility closures, including production plants;

- decreased financial performance of supply chains (e.g., losses, reduced financial stability), decreased financial flows, and asset freeze;
- reduced focus on social and environmental issues, limited practices and sustainable development initiatives within supply chains, threats to the health and safety of workers, less interest in the development of green and low-emission energy sources, and an increase in waste and materials suitable for recycling.

### **1.2.2. EXAMPLE OF THE RUSSIA–UKRAINE CONFLICT**

The war in Ukraine is another event that was challenging to foresee. The repercussions of this event, including economic sanctions (primarily affecting the financial sector, real estate, and the import and export of various products and services) imposed on Russia, the withdrawal of numerous companies from both the Russian and Ukrainian markets, the reduction or limitation of energy supplies from Russia, fuelling global inflation, and transportation restrictions (including those resulting from sanctions imposed on Belarus supporting the Russian regime) have had a notable impact on global supply chains, further intensified the negative effects caused by the pandemic. For instance, economic forecasts suggest that economic sanctions could potentially lead to a reduction of up to 50% in Russian imports from Europe and the United States (Liadze et al., 2023).

The armed conflict in Ukraine has predominantly impacted the supplies of energy, food, fertilisers, and raw materials. Russia is one of the world's largest crude oil producers and energy exporters. The European market was significantly dependent on Russian energy sources, including coal, crude oil, and natural gas, with approximately one-quarter of crude oil imports and almost half of natural gas imports to the EU originating from Russia (some countries, like Germany and Italy, were even more reliant on Russian energy supplies). Disrupted supply chains have led to a substantial surge in energy prices, affecting the functioning of supply chains across various industries.

Ukraine and Russia were responsible for approximately 30% of the world's wheat and barley exports, 15% of corn, and a remarkable 65% of sunflower oil (White et al., 2022). Prior to the conflict, around 6

million tons of agricultural goods were exported monthly from Ukrainian Black Sea ports (Dyson et al., 2023). Presently, the scarcity of these products is impacting food security, especially in poorer countries in the Middle East, North Africa, and Western and Central Asia (Jagtap et al., 2022). Additionally, Ukraine and Russia represented roughly one-third of the world's ammonia and potassium exports, resulting in price increases for agricultural fertilisers. Both countries also played significant roles as suppliers of titanium, nickel, palladium, platinum, steel, and other essential metals, the shortages of which affected the automobile, smartphone, and aircraft manufacturing industries (Liadze et al., 2023). The challenges faced by these industries also led to increased defence spending in many countries and growing demands from the defence industry.

The war in Ukraine has triggered shifts in demand. In countries like Poland, which received the largest number of war refugees from Ukraine, the onset of the conflict led to an upsurge in demand for essential products. Also, shortages were observed for other products, such as sleeping bags, flashlights and power generators. On the other hand, the heightened global inflation has made customers more inclined to save, resulting in decreased demand for many products.

### **1.3. ACTIONS TAKEN IN THE SUPPLY CHAIN IN RESPONSE TO UNFORESEEN EVENTS**

#### **1.3.1. SHORTENING THE SUPPLY CHAINS**

The crisis triggered by such unforeseen events as the COVID-19 pandemic and the war in Ukraine emphasised the importance of supply chain resilience (Rajesh, 2021; Pujawan & Bah, 2023). Many companies, with their lean production and complex global supply networks, faced challenges and had to respond to disruptions. Among the shifts in supply chain management, a prevalent response has been the endeavour to shorten supply chains as a response to seek production sources closer to the market and reduce the operational risk of losing critical resources or control over them (Nandi et al., 2021; Chen et al., 2022).

Insourcing, backshoring, and nearshoring strategies emerged because of rethinking supply chain and production approaches. Insourcing involves utilising an organisation's internal resources to perform tasks that were previously outsourced to external parties (Cabral et al., 2014). Backshoring entails bringing

back production and services, primarily offshored for cost reduction, to the country of origin (Foerstl et al., 2016). Despite higher labour costs, backshoring offers increased quality control and supply chain flexibility. In contrast, nearshoring involves relocating production and services to geographically closer locations, such as countries much closer to the market (Foerstl et al., 2016). Nearshoring reduces transportation costs and time while minimising cultural barriers.

Another response to the possibility of unforeseen events is friendshoring, which entails collaborating with countries that align with norms and values governing global operations (Paché, 2022). As organisations seek ways to mitigate supply chain risks, further production relocations are expected in the coming years. For example, countries like the United States, Japan, and Europe are decreasing their dependence on the Chinese manufacturing sector (Kearney Report, 2021).

However, it is important to note that these strategies can also carry inherent risks. Sheffi (2020) underscored that relying solely on domestic production to meet domestic demand may not be viable if production is halted due to pandemic restrictions or other disruptions, potentially leading to the collapse of the domestic economy.

#### **1.3.2. SUPPLY SOURCE DIVERSIFICATION AND REGIONALISATION**

On the other hand, as indicated by Lopes et al. (2022), companies are diversifying their sources of supply and markets to mitigate disruptions. This often entails increasing the number of links in supply chains. In response to supplier challenges, companies adopt the strategy of "dual sourcing", which involves sourcing from multiple suppliers (Namdar, 2018). This allows them to have alternative primary component suppliers, often from different countries, to ensure a steady supply of the required components. According to Sheffi (2020), diversification is a practical solution only for large, highly internationalised companies with extensive supply chain networks, and it may not be as suitable for small and medium-sized enterprises due to increased administrative costs and a shift in the management model.

Verheijen (2022) identifies regionalisation as one of the strategies for reducing supply chain risks. This strategy involves multinational corporations creating multiple distinct supply chains, such as one in Europe, one in China, one in North America, and one in Southeast Asia. This approach enables the considera-

tion of sourcing from nearby and local suppliers, reduces dependence on a single supplier, and broadens the geographic scope of raw material sourcing.

### **1.3.3. JUST-IN-CASE INVENTORY MANAGEMENT**

Certainly, in uncertain times, the approach to inventory management is also evolving. Companies are primarily increasing safety stock (Remko, 2020). Companies' approaches are shifting from the concept of just-in-time inventory management to the just-in-case approach. This means that organisations diversify suppliers, even at the cost of higher prices for purchased goods and maintain a certain level of inventory to safeguard against unexpected production stoppages due to disruptions in the supply of components. This shift emphasises a balance between efficiency and resilience.

### **1.3.4. OPENNESS TO INNOVATION AND GREATER FLEXIBILITY**

Unforeseen events give rise to various disruptions in supply chains, but they can also yield positive effects on resilience-building initiatives and risk management in global supply chains (Ozdemir et al., 2022). As Rozhkov et al. (2022) demonstrated, the multitude of factors influencing disruptions in global supply chains allows for greater flexibility in seeking new preventive solutions for future disruptions. An openness to innovation and proactive risk management efforts fosters the development of supply chain resilience. Innovation and knowledge, according to Orlando et al. (2022), are regarded as driving forces in establishing supply chain resilience to disruptions, directly impacting the ability to counteract disruptions.

While events such as COVID-19 and the armed conflict in Ukraine have revealed that the risks associated with supply chain fragmentation and globalisation were inadequately estimated and largely ignored (Maternowska, 2021), they have also accelerated the development and adaptation of various technologies and practices that may ultimately enhance the stability and resilience of supply chains in the face of future disruptions. These changes aim to achieve greater supply chain flexibility and agility, enabling the production of smaller quantities of products in shorter cycles, often with a focus on mass customisation (Perret et al., 2022). Oliveira-Dias et al. (2022) also underscore the need to shorten product

development cycles in a dynamic environment. According to the authors, this is partially achievable due to the reduced significance of constraints like the geographical distance that separates supply chain partners. The pandemic has revealed that personal contact can be replaced by online meetings. Technological platforms facilitate easier access to necessary resources or services and the offering of unique resources to other organisations, such as know-how and non-material resources, that are difficult or impossible to replicate (Faro, 2022).

Concepts like Open Supply Chain Management (OSCM) are seen as a new paradigm in the evolution of supply chain management, where companies can leverage integrated physical and conceptual resources to promote efficiency and flexibility in key supply chain processes. These processes encompass procurement and delivery, production, distribution, and marketing. The OSCM concept incorporates trends, such as crowdsourcing, open innovation, Industry 4.0, cloud manufacturing, the Internet of Things (IoT), Big Data, and Digital Twin, which have emerged in recent decades and offer opportunities for building more resilient supply chains (Xiong et al., 2021; Rahmazadeh et al., 2022). Pisz (2021) highlights the significant increase in innovation and progress in the digitisation processes of enterprises as a positive outcome of the pandemic on supply chains. Digitalisation and fast, reliable global connectivity enhance the flexibility and efficiency of supply chains, directly influencing how companies must address disrupted supply, fluctuating demand, excess inventory, and the exploration of long-term, global opportunities and distant markets for both sourcing and selling.

### **1.3.5. IMPROVED CONNECTIVITY, GREATER VISIBILITY AND TRANSPARENCY**

According to Modgil et al. (2022), recent events have accelerated many developmental trends in supply chains, focusing on enhancing connectivity between different supply chain links. Greater visibility and transparency across the entire supply chain have become even more critical. For example, during COVID-19, Rohlig Suus Logistics based its supply chain risk management and resilience-building efforts on actions related to monitoring and analysing the market situation and identifying new opportunities. In response to supply chain continuity challenges, Rohlig Suus implemented a Control Tower (CT) service for proactive supply chain management.

The Control Tower function allowed for the monitoring of the entire flow of goods and improved communication with customers, providing them with notifications of potential threats, such as delivery delays or other ongoing issues that could affect order fulfilment. The accuracy and timeliness of the acquired information empowered supply chain managers to make swift and well-informed decisions during crisis situations (Gumel, 2021).

### 1.3.6. DEVELOPMENT OF SUSTAINABILITY AND VIABILITY

A positive aspect may also involve the development of Sustainable Supply Chains (SSCM). Shifting suppliers to local factories or those relocating from the Far East to Europe reduces transportation routes for raw materials, components, semi-finished products, and finished goods from production sites to consumption locations. This, in turn, directly leads to reduced CO<sub>2</sub> emissions and positively impacts supply chain costs (Milewska, 2022).

The ability of a supply chain to endure and adapt in a changing environment through redesign of its structure and re-evaluation of logistics processes from a long-term perspective is known as viability (Ivanov, 2020). Viability is considered a fundamental property of supply chains, encompassing three perspectives: agility, resilience, and sustainable development.

The core principles of the Viable Supply Chain (VSC) model are built on the development of adaptive mechanisms. Viable supply chains respond with agility to events and demonstrate the ability to survive short-term and long-term disruptions and global shocks related to social and economic transformations. The Viable Supply Chain model can assist companies in making decisions regarding the repair and reconstruction of supply chains after global, long-term crises (Joshi & Sharma, 2022).

## 2. RESEARCH METHODOLOGY

The objective of this article is to identify the key issues in supply chain management that arise from unforeseen events and to examine the response actions. The research is grounded in qualitative method (individual in-depth interviews). This approach is employed to gain a comprehensive understanding of new or previously unexplored phe-

nomena in all their diversity and complexity (Maison, 2019). The interviews were conducted from 1 May 2022 to 9 June 2022, with a purposive sample of six experts who possessed at least several years of experience in supply chain management and represented different industries. The respondents were affiliated with companies with over 49 employees in the FMCG, sanitary-heating, automotive, agriculture machinery, and furniture sectors (Table 1).

On average, each interview lasted approximately 60 minutes. The research findings were analysed using Nvivo v. 17.1, qualitative data analysis software. The data underwent a coding process that utilised a hybrid approach, combining both deductive and inductive approaches. Deductive coding involves applying a predetermined set of labels (codes) based on literature or theory, while inductive coding involves assigning labels to the data based on recurring patterns, themes, and issues observed in the data. In the hybrid approach, the predefined code structure was complemented based on the analysis of the collected data. In total, 28 codes were applied and

Codes	Search Project	Files	References
④ Name			
⑤ SCM general information		6	17
○ information systems		1	1
○ SCM understanding		6	7
④ strategies, methods, tools		6	8
⑥ Main challenges		6	87
○ the future		1	1
○ rising warehousing costs		2	2
○ areas the most affected		2	4
○ deliveries		3	5
○ container availability and prices		3	4
○ maintaining continuity of production		3	5
○ rising transport costs		3	4
○ broken supply chains		3	5
○ rising volatile prices		4	10
○ difficulties in scheduling, delivery delays		4	15
○ volatility, uncertainty		4	7
○ changes in demand		4	12
○ availability of materials		4	11
⑦ Remedial actions		6	84
○ changes to the production plan		1	1
○ taking action together with customers and suppliers		3	6
○ risk and crisis management		3	4
○ changes in transport		4	4
○ people's safety		4	6
④ diversification of supplies		4	4
○ ensuring continuity of production		5	6
④ information exchange		5	9
④ ○ relationships in the supply chain		5	19
○ searching for new sources of supply		6	8
④ ○ changes in inventory management		6	16

Fig. 1. Data coding in the NVivo software

Tab. 1. Description of experts

EXPERT INFORMATION	COMPANY	MAIN AREAS OF ACTIVITY	COMPANY'S DESCRIPTION
Expert 1  Brand Manager for CE region; 5–10 years of experience	A	FMCG, production of soap, cosmetics and detergents, washing and cleaning agents	One of the largest companies in the world selling 40 product categories in over 180 countries around the world. It operates 60 factories worldwide and employs nearly 180,000 employees
Expert 2  Head of the supply department; 25–30 years of experience	B	Production of home and institutional furniture	One of the largest manufacturers of metal furniture in Europe with over 30 years of experience. It currently employs over 600 people and produces approximately 280,000 products annually, with a total sales value of around PLN 200 million, 70% of which is exported worldwide
Expert 3  Branch Manager; 25–30 years of experience	C	Sale of cars and car parts	An importer and distributor of spare parts for passenger cars, vans and trucks in Central and Eastern Europe. It has 338 branches in Europe (Czech Republic, Slovakia, Ukraine, Lithuania, Latvia, Hungary, Croatia, Romania, and Bulgaria) and offers over a million different spare parts for passenger cars and trucks
Expert 4  Sales Department Manager; 15–20 years of experience	D	Engineering services, semiconductor and renewable energy production	Leading manufacturer of battery systems for public transport, AGV, and ESS for energy and telecommunication. It sells its products and services around the world, including Europe, North America, and Asia
Expert 5  Manager in Purchasing and Logistics Department; 5–10 years of experience	E	Production of agricultural, construction and mining machines	A Polish manufacturer of trailers, agricultural, grassland, municipal and recycling machines, as well as disc wheels. It has nine production plants and its own steel wholesaler. It has a dealer network in all European Union countries and cooperates with partners in Asia, Africa, North America, South America and Australia. It has 3000 employees
Expert 6  Head of Purchasing Department; 25–30 years of experience	F	Production of plastic products (water and heating systems)	An experienced manufacturer of modern KAN-therm installation systems recognised worldwide. It employs over 1100 people. Has a branch network in Poland and subsidiaries in Germany, Hungary, Ukraine, the UAE, India, China, and the CIS countries. The products are exported to 68 countries around the world. The distribution chain covers Europe and a significant part of Asia, Africa and America

organised into two primary thematic categories: (1) challenges in supply chain management when unforeseen events occur and (2) actions taken to address the challenges (Fig. 1).

### 3. FINDINGS

#### 3.1. MAIN CHALLENGES IN SUPPLY CHAIN MANAGEMENT RESULTING FROM THE OCCURRENCE OF UNFORESEEN EVENTS

The qualitative research participants cited several examples of recent events that have had an impact on supply chain management, including factors like inflation, the war in Ukraine, the COVID-19 pandemic, and disruptions in the Suez Canal, such as the blockage caused by the container ship Ever Given in March 2021. One participant noted, “Rising inflation, the war in Ukraine, the pandemic, and a blocked

canal are things that few people would have expected a few years ago”.

The respondents observed that areas in the supply chain directly affected by such events include transportation management, demand, and supply, while production and inventory management are indirectly impacted. Experts emphasised that many of these issues were primarily a result of “the pursuit of cost reduction without consideration of risk and the extension of supply chains to seek low prices far beyond the country’s borders”.

##### 3.1.1. DISRUPTIONS, DELAYS AND ALLOCATIONS IN SUPPLY

The occurrence of unforeseen events primarily results in disruptions, delays, unavailability, or limited availability of certain goods, materials, and raw materials. One expert explained, “In our company, the most significant issue is the highly dynamic changes in component availability in the market.

Depending on the products, lead times have sometimes extended by up to six months for advanced technologies”.

Availability issues mainly stemmed from periodic factory and port closures during the pandemic. An expert shared, “Ports in China are constantly opening and closing, even with a few infection cases. It’s a huge ordeal for us. For instance, when an American company that manufactures a component in Europe sends it to China, produces it there, and then sends it back to Europe, the supply chain becomes long (...). It’s important for us to run a trial production of this [product], but unfortunately, it is not as smooth as it used to be. These are the effects of COVID-19 and the lockdown in Shanghai”.

The limited availability of goods, materials, and raw materials led manufacturers to introduce allocations, creating challenges in supply planning and inventory management. One respondent noted, “We have lead times, but they are often postponed or changed, and the quantity received is not as ordered. It’s much more complicated than it used to be”. Another added, “Before, our supply chains were intact, and we could plan deliveries freely from week to week, from month to month, with deliveries at any time. Today, it’s all on the go. We spend the entire Monday and three hours of each subsequent day trying to save production continuity and putting out fires”. This problem affected every supply chain to a greater or lesser extent. According to the respondents, there were hardly any products, materials, or components that did not encounter problems in the last two years.

### **3.1.2. PRICE INCREASES**

The limited availability of goods led to price increases, with one expert stating, “Increased demand for products manufactured in Asia led to reduced availability of components in the market, resulting in higher prices”. Respondents suggested that these price hikes could also be attributed to deliberate manufacturers’ policies. One expert explained, “Raw materials availability is poor, and there are allocations for most raw materials. Due to high demand, manufacturers of less common plastics, for instance, introduce allocations, meaning monthly quantities are much smaller than market demand. This is partly a strategy to raise prices. Why operate four additional production lines when you can increase the prices fourfold and sell the same quantities at higher prices?”. Furthermore, it was noted that large, global organisations involved in

crude oil processing for plastics achieved historic profits. As a result of these challenges, companies were compelled to search for new supply sources, often at higher procurement costs. One expert shared, “There were instances where, a week before an expected delivery, it turns out that a particular product couldn’t be shipped, and we had to hastily find alternatives. Even if the price in Poland was five times higher, we had no choice but to accept it”.

### **3.1.3. LOWER AVAILABILITY AND HIGHER TRANSPORTATION COST**

Another challenge is transportation planning due to restrictions on movement or safety concerns (e.g., during wartime) and, as a result, reduced availability of transportation infrastructure and even multiple increases in all modes of transport costs. One expert stated, “When it comes to transportation management, since the start of COVID-19, we have seen a decrease in the number of available drivers and transport costs have surged. Container prices have skyrocketed tenfold. [The problem is also] reduced tracking or planning of deliveries because a container from China can take various routes. [...] It is not uncommon for a later shipment to arrive earlier than an earlier planned one”. The expert further added, “There were also instances when we wanted to ship by air, and there were no planes [available] because everyone wanted to ship by air. (...) The significant difference was that everyone wanted to get the products from China right now”. Additionally, there were fluctuations in freight prices. One expert noted, “These fluctuations occurred every half a month, every week, and every two weeks. Forwarders were reluctant to provide specific freight amounts, making it somewhat of a mystery regarding what the final costs would be”.

The disruptions extended to other modes of transportation as well, with one expert mentioning, “We used trains for certain materials from Asia, but at the moment, due to the war, train transport became unavailable. Broken supply chains meant that we had to accept huge costs to bring in a few pallets of goods by air”. In maritime transportation, issues included a shortage of available containers and loading equipment, slow container rotation, container rolling (which extended the loading and sailing time of containers compared to the previously established schedules), blank sailing (where vessels deviated from set schedules and skipped certain ports), and extended waiting times for goods in ports and during customs processing. One expert shared, “There were situations

where the goods were ready, but they had to be transported to the nearby warehouse, and we had to wait for a week or even two before they were loaded onto the ship". Another added, "In some cases, ships had to undergo quarantine and wait on the water for two weeks after COVID-19 tests were conducted before entering the port". The issues were exacerbated by carrier alliances, with another expert noting, "Problems like the lack of available containers and loading equipment were compounded by carrier alliances, who frequently raised prices and revised them every two weeks".

### **3.1.4. DIFFICULTIES IN INVENTORY MANAGEMENT**

Another challenge is the rising costs associated with maintaining inventory, coupled with capital freezing due to increased warehousing requirements. Respondents shared that companies adopted strategies to manage these issues, "At this moment, we grab onto everything, particularly higher inventory levels. We try to convince our suppliers to maintain larger stocks if possible. We also rent additional warehouses and increase our inventory levels to ensure a longer security period compared to before". The necessity of building up inventory levels to address these challenges was further emphasised. An expert noted, "We have minimum stock levels for every raw material, and this stock is automatically increased because if a product comprises, let's say, ten or a hundred components, and one is missing, we cannot start production. Due to various reasons, like COVID-19, war, and other things".

However, despite efforts to increase inventory, many companies still struggle to meet customer demands. One expert described the situation, saying, "We are trying to catch up with the rabbit. Currently, we are fulfilling customer orders that were placed several months ago. There is such high demand and limited raw materials supply that, despite increasing production by thirty per cent, we are unable to produce the required quantity and meet our customers' needs for certain products".

### **3.1.5. DEMAND FLUCTUATIONS**

Unforeseen events also lead to significant fluctuations in demand. Both the outbreak of the pandemic and the war in Ukraine led to a tremendous surge in demand for essential goods. The research respondents pointed out that customers themselves were

responsible for shortages of products in stores as they made panic purchases in bulk, "There was a huge surge in purchasing hygiene products. People were hoarding baby diapers, toilet paper, etc. because they feared shortages in stores, which was completely untrue in our situation". In the case of industries like construction, the increase in demand during the pandemic was related to the rising demand for properties and securing themselves against potential shortages and further anticipated increases in the prices of raw materials and materials. One respondent explained, "Our industry is closely tied to the construction industry. There was a time when our customers were buying pipes and connectors in large quantities; there was a general belief that everything would run out". On the other hand, the outbreak of armed conflict in Ukraine accelerated inflation and led to a collapse in the mortgage market and a decline in demand for real estate.

The increased but temporary demand also caused problems for some manufacturers who experienced the cancellation of previously placed orders. This was also influenced by fluctuations in raw material prices. As mentioned by an expert, "Everyone placed large orders. When everyone orders a surplus of goods, there will be a lot of unsold inventory in the market. Customers will cancel their orders, and when production capacities are reserved in factories and components are already ordered, each producer will lower the price. When we produce a product with more expensive steel, but the price of steel is continuously dropping, soon we will have to sell it at the new price, even if it means selling below production costs. It can be a dangerous situation".

A positive aspect revealed in the research is the change in some customers' habits and their choice of new, previously unchosen products. A respondent noted, "People had the opportunity to try out some products that used to stay on the shelf, and they found them acceptable. Even though they hadn't used them before, they later discovered that these products were fine".

### **3.1.6. GROWING UNCERTAINTY AND AMBIGUITY**

According to experts, today's businesses confront an array of challenges that are more intricate. These challenges encompass the constant increase in customer demands coupled with a decrease in customer loyalty, shifts in the power dynamics within the supply chain, and social and environmental issues. The

escalating influence of technological innovations compounds these challenges. One expert observed, “In my work, I notice that every eight minutes, some supplier declares bankruptcy [...]. Customers are becoming more demanding and less loyal. Forecasting and planning supply chain processes are becoming increasingly difficult, and the growing number of suppliers at different levels and changes in the supply chain’s power structure is leading to fewer yet more dominant suppliers and clients. Social and environmental challenges are further contributing to the chaos in the supply chain. I believe that the rapidly growing role of technological innovations also significantly influences these dynamics”.

The use of the crisis as a justification for disruptions exacerbates planning difficulties, even if it isn’t the root cause, with another expert noting, “Today, everyone can cite force majeure, leading to varying consequences”.

### **3.1.7. DIMINISHED SIGNIFICANCE OF CONVENTIONAL SUPPLY CHAIN MANAGEMENT METHODS AND TOOLS**

According to the respondents, the primary objective of supply chain management is to seek opportunities for improving customer satisfaction, cost reduction, and enhancing performance achieved by the supply chain, and this objective does not change when events occur unforeseen “Supply chain management is, regardless of time and circumstances, about seeking the greatest cost reduction ensuring that we meet customer needs at a level that satisfies them. I would describe it as a living organism that is continually evolving”. The experts emphasised that managing the flow of materials and services between businesses is the most critical aspect of supply chain management. This encompasses the planning, execution, and control of supply chain flows, as well as the identification of areas where issues may arise and the ability to respond promptly to disruptions in the supply chains. Managing information and financial flows also plays a significant role.

The research experts indicated that their companies use supply chain process management methods and tools such as Just in Time, Vendor Managed Inventory, Product Lifecycle Management, Lean Management, and Total Quality Management. However, the significance of these well-known supply chain process management methods was emphasised to have diminished during the COVID-19 pandemic. One expert mentioned, “When we consider the

impact of COVID-19, I suspect that any mistakes [in supply chain management] today mean much less. It’s just about having that product. Essentially, price is already secondary, so each of these tools loses some value. We simply need to use all possible means to have the product available and the inventory as large as possible”.

## **3.2. IDENTIFICATION OF ACTIONS TAKEN IN THE SUPPLY CHAIN IN RESPONSE TO UNFORESEEN EVENTS**

### **3.2.1. INCREASED SAFETY STOCKS**

The respondents in the study frequently mentioned increasing safety stock as a response to disruptions caused by unforeseen events affecting the supply chain. Safety stocks served as a safeguard against unexpected changes in product demand or delays in the delivery of raw materials and production materials. As indicated by the respondents, for example, during the COVID-19 pandemic, the safety stock levels were raised and remained at a higher level for an extended period. Companies attempted to boost their inventory wherever possible, creating a buffer: “Companies built warehouse stocks to cover a year’s production, especially for components with long lead times”. Safety stocks were adjusted based on market conditions, and ongoing monitoring of product and raw material availability was necessary.

The creation of larger safety stocks contributed to the reduced availability of materials and raw materials in the market, leading to an increase in their prices. However, businesses were willing to bear the high costs of building and maintaining these inventories to ensure continuity of production and sales. The respondents observed, “The planning department had to adjust its indicators for inventory management, and companies accepted additional costs such as renting extra warehouses and doubling the value of inventory to increase safety stocks. Such practices became commonplace”.

Safety stocks were increased both in companies and among their suppliers. Suppliers stocked up raw materials with larger safety stocks than before, incurring additional costs. Nevertheless, this enabled them to deliver products, and companies could maintain a smooth flow in the supply chain. In experts’ opinion, “At this point, one grabs everything, especially the appropriate stock levels”. Companies worked on persuading their suppliers to also keep larger stocks: “It is necessary to plan long-term demand for compo-

nents, purchase larger quantities of components, and store them in our company or in the warehouses of our suppliers”; “[Suppliers] were ordering raw materials, creating larger safety stocks, much higher than before, which, of course, came at a cost. However, thanks to this, they were able to deliver the product to us, and after some time, we were able to ensure a smooth supply chain, even in the case of semi-finished products that did not come from us but from suppliers. These semi-finished products were then made in China and stored in Europe”.

### **3.2.2. FRAMEWORK AGREEMENTS WITH SUPPLIERS**

Enterprises also began to sign framework agreements with suppliers more frequently than before, giving them greater influence over prices and delivery volumes. According to the respondents, “If the material is available, there is no need to conclude framework contracts. It’s a convenience in a way, but it didn’t have the added value it has today. Today, these agreements allow us to negotiate better prices and certainly help suppliers plan their production or supply of raw materials better, whether to us or the supplier”.

Therefore, the question arose about the passing on of costs to the producing company. One expert stated, “I believe these costs were certainly passed on to us, but in the situation of maintaining continuity of supply, it was not a problem. At least we could sell something to the client; without these agreements, we would not have been able to sell anything. I think this cost is fixed in the framework contracts with the suppliers”.

### **3.2.3. CHOICE OF ALTERNATIVE MODES OF TRANSPORT**

Companies also explore alternative transport methods, choosing to change their mode of transport, opting for pricier yet faster solutions, and prioritising deliveries. For instance, respondents note, “When there were delays in smaller ports, sometimes lasting up to two weeks, we sought the fastest route. In situations where we received an order from the factory for ten containers of goods that were ready, we significantly adjusted our approach. We prioritised two to four of these containers, which were required immediately, and arranged for them to be shipped via the intermediate port in Hamburg. Ships from Asia sail thirty days, and from India, where we import the

most, sail even forty days. In such scenarios, we had to explore alternatives. We considered intermodal transportation as an option. Eventually, we chose to transport by sea, followed by land transportation via trucks, bypassing the rail system due to inconsistencies in scheduling. This approach proved successful at the time, but we primarily utilised it for priority situations, even though it incurred an additional cost of one and a half times”. Another expert describes, “We previously used trains for some materials imported from Asia, but the train service is currently unavailable due to the war. As a result, all shipments are being sent by sea or air, albeit at considerably higher costs”.

### **3.2.4. DIVERSIFICATION OF SUPPLIERS AND SUPPLY CHAIN SHORTENING**

To ensure a continuous supply, companies also took action, such as establishing connections with new suppliers and diversifying their supplier base. One respondent mentioned that they “Expanded their collaboration with new suppliers within the industry, even those serving competitive companies”, another explained, “We scoured the globe for missing components”, and yet another emphasised that they “aimed to have at least two suppliers for each raw material or semi-finished product. While this practice was routine, it gained much more importance today”. The majority of companies sought alternative supply sources within regional and local markets. For instance, one respondent stated, “When we place orders from Korea, we don’t solely rely on Korean suppliers because we understand that delivery times can vary. We also engage with local (I mean European) suppliers”; another noted, “Nowadays, we actively seek products on the Polish market”; and a third explained, “Our backup plan involved securing deliveries from Poland, especially for crucial components or custom-made items, which we could obtain within a week”.

The respondents also mentioned actions such as making changes to the production plan to account for missing components and delayed deliveries. To a lesser extent, they discussed phenomena like back-shoring. One respondent stated, “From my perspective, the only positive aspect was the relocation of some production from China to Poland and Europe”. This could be attributed to the fact that these strategies are implemented over a more extended period. As one respondent explained, “Relocating factories is a complex endeavour. It involved diversifying the supplier portfolio and seeking suppliers of these raw

materials, often at a higher cost but closer. The majority of our products have factories in Europe, but they rely on various semi-finished products sourced from China, Pakistan, etc. Now, it's a two-year process, with some factories in other countries reintroducing these semi-finished products formerly produced in China. We also identified suppliers capable of meeting our quality standards. While the new ones are more expensive, their proximity to Europe allows for faster delivery".

One positive effect highlighted by experts is the increased innovation and the search for solutions that might not have been explored in a stable situation. As one expert put it, "Today, we are certainly opening more doors because we are forced to. For example, a certain type of granulate was not supplied to Europe, and there are only two sources in Europe to meet the demand. We received information that an American manufacturer is entering the European market. We were among the first to establish contact with them, and now we reap the benefits. Despite the allocation, we can now obtain this raw material at a very competitive price and in the required quantity. However, for certain sectors, materials, and components, with only two global producers, there is a challenge. Due to certain circumstances, we also managed to discover an overlooked material from another American company, which has been forgotten but can serve as a substitute, and so we are opening the door to overcome the lack of this raw material".

### **3.2.5. IMPORTANCE OF RELATIONSHIPS NETWORK**

Pre-existing relationships developed before a crisis had a notable impact on business during the crisis. As one respondent noted, "I believe that a well-established network of contacts played a role in ensuring supply continuity, where our supply chain partners often function as both our customers and suppliers. These relationships greatly assisted us in sourcing products locally, and it was certainly a significant help during that time".

First and foremost, existing and regular partners, especially key customers, received priority in the supply chain. For instance, one respondent stated, "We encountered no issues in acquiring products/materials, mainly because of the company's size and reach. We are the top customer for most suppliers, and for some, we are the sole buyer for specific products". Another emphasised, "Suppliers were focused on serving their most important customers. With alu-

minium allocations, for example, we couldn't purchase 3,000 tons, only 2,000 tons. When approaching another supplier, they'd explain they had allocations and could only deliver to their regular customers who had previously made purchases. These were the challenges we faced. Today, you need to request someone to sell to you".

The study's respondents also highlighted the significant role of interpersonal relationships in managing unforeseen events. One respondent emphasised, "What works today are interpersonal relations. Strong interpersonal relationships can sometimes influence logistics or sales policies in both directions. In my case, it is very evident". Another participant stressed, "The importance of interpersonal relationships has become increasingly significant. Positive relations between suppliers and buyers are especially valuable today".

Furthermore, the participants provided examples of initiatives that supported local partners during crises; for instance, respondents mentioned, "At one point, our production department sent out an email recommending outsourcing transportation to local transport companies to support these businesses".

### **3.2.6. VALUE OF TRANSPARENCY AND VISIBILITY OF INFORMATION**

The exchange of information played a crucial role. Information was shared more frequently, and the timeliness of information became even more critical. Respondents highlighted constant communication with supply chain members. As one of them stated, "Yes, we maintained constant contact with our suppliers". Another mentioned, "We made an effort to stay in constant touch with our suppliers and respond promptly to any changes in demand or component availability. An encouraging development is the increased level of interaction with suppliers today. With tools like MS Teams, we can easily connect at any time of the day, which has proven to be quite positive. In the past, we typically met with company representatives from Switzerland or the USA only once a year during contract negotiations. Today, meetings on MS Teams and online video conferences, where we can see each other on camera, have become a part of our daily routine".

The respondents' statements reveal that open information exchange in some cases was challenging, with partners in the supply chain not being forthright about their problems. For instance, one respondent mentioned, "At first, it was a bit hidden [reduced

production plans]. The producers didn't want to say it was that bad. Production then fell to twenty per cent. Suppliers did not want to signal problems; they just wanted to wait so that no one would cancel their orders. So there was contact with them, but intermittent and not entirely clear, so even if they said that the goods would be available in, say, a month, we had to add half a month more because there was simply less production capacity. It was a bit of a cat and mouse game".

However, the prolonged crisis eventually led to greater transparency and collaboration in supply chains. As some respondents noted, "Behaviours varied. Initially, some of them tried to hide any crisis situations for fear of losing customers. The development and scale of the problems forced the exchange of information and joint arrangements and the search for solutions to emerging problems and crises."

The ability to track and monitor supply chain processes plays a vital role during times of uncertainty. Unforeseen events often lead to increased efforts to enhance visibility in the supply chain. For instance, one respondent mentioned, "Due to the difficulties, we have launched a system for providing information on the level of delivery to our suppliers". However, the transparency of these processes, as reported by respondents, can vary significantly. In some cases, there is a high degree of transparency, with one respondent stating: "We have many suppliers. In some cases, we can see right down to literally chemical components like sodium stearate, etc. The level of transparency depends on the product and category being considered". In contrast, more often, respondents indicated that supply chain transparency is low or limited to their first-tier suppliers or buyers. For instance, some respondents mentioned, "Unfortunately, I have no insight into suppliers" and "If I miss a valve, I ask what the problem is, I find out that the gasket. I have no contact with the company that supplies the gasket for our valve" or "Usually this is the first step, we have control down to the level of delivery to our suppliers".

This variability in transparency levels affects an enterprise's ability to quickly identify problems or bottlenecks in the supply chain flow, allowing corrective action to be taken in real-time. This may include re-routing a shipment, changing production schedules, or adjusting inventory levels. The respondents cited the possibility of tracking containers in sea transport as an example: "The publicly available tools for monitoring sea transport helped us a lot. I think this is also one of the reasons why many companies

choose [this form of transport] (...) we can keep up to date with everything. If the container sails, we have its number; we stick it on the [website] of the ship-owner, and we have information on whether it has been loaded on the ship or not. There are also public pages, and then you can monitor the load in real-time".

### **3.2.7. SIGNIFICANCE OF TRUST, PARTNERSHIP AND COOPERATION**

A positive aspect is the increased importance of partnership and cooperation in supply chains. As one respondent put it, "If I were to mention any positives, it would be a greater willingness to cooperate, better understanding of problems, greater involvement in joint search for solutions, and increased creativity". The respondents stressed the significance of inter-organisational relations within the supply chain. They highlighted that supply chain management acts as a "unifying force between suppliers and buyers".

Various activities were also emphasised, including conflict management, supplier development, building partnerships/alliances, early inclusion of suppliers, etc. Partners in the supply chain engaged in knowledge and experience sharing, and experience sharing and collaborated to find solutions to the issues at hand. One participant noted, "Of course, we have appropriate systems, but in this case, they did not work (...). We were looking for solutions more with the client than relying on the systems alone". Another mentioned, "As long as the problem can be resolved in consultation with the supplier, we try to do so. Sometimes a supplier tries to pull a product from someone who doesn't currently need it". Representatives of enterprises expressed that this increased collaboration enabled them "to communicate much more directly than before".

### **3.2.8. IMPORTANCE OF SUPPLY CHAIN RISK MANAGEMENT AND BUSINESS CONTINUITY MANAGEMENT**

The conducted research highlights that the occurrence of unforeseen events such as the COVID-19 pandemic or war has led to an increased awareness among enterprises regarding the role and importance of supply chain risk management and business continuity management. As one participant stated, "As a positive, we can mention, among others, the ability to react faster to crisis situations, the ability to run

a company remotely, the ability to work under time pressure. We learned a lot during that time".

In response to recent events, enterprises have either developed new crisis procedures or enhanced their existing ones. Some are in the process of planning and implementing such procedures. For instance, one respondent noted, "We do not have crisis response procedures specifying how to deal with crisis situations, but it is in the company's plans".

## 4. DISCUSSION

The resilience of the logistics system refers to its ability to deliver, maintain, and improve service quality in the face of changes and threats. It can be described as the capacity to respond to unexpected disruptions and restore continuity in supply chain processes or the ability to maintain, resume, and restore operations after being impacted by disruptions. Recent examples of unforeseen events that have significantly affected supply chain management include rising inflation, the war in Ukraine, the COVID-19 pandemic, and traffic disruptions, such as the Suez Canal blockade in March 2021.

The occurrence of unforeseen events leads to various challenges in supply chains and remedial actions taken in response to unforeseen events (Fig. 2).

Making a generalisation based on respondents' answers, the occurrence of unforeseen events in the supply chain affects almost all operations within the supply chain, i.e., procurement, planning (including inventory planning and maintenance of company resources and production lines), logistics management (including transportation), and order management. This finding aligns with the results of studies conducted by Chowdhury et al. (2021), Raj et al. (2022), Kumar et al. (2020), and Remko (2020), who examined the impact of the COVID-19 pandemic on supply chain management. The conducted research also highlighted such aspects as limited availability of goods, favouring selected customers, implementing allocations, and sometimes unjustifiably raising prices of offered raw materials and materials during crisis situations. Research findings also indicate a positive aspect of difficulties in meeting customer demand, as it sometimes leads to changes in customer preferences and the choice of new products not previously selected.

Actions taken in the supply chain in response to unforeseen events primarily aim to ensure continu-

ous flows of goods, meeting production needs and satisfying customer demand. To achieve this, companies begin by building safety stock, transitioning from just-in-time to just-in-case inventory management. The significance of these actions during uncertain times has been emphasised by authors like Remko (2020). Shortening supply chains, often as a response to seeking production sources closer to the market, has been discussed by Nandi et al. (2021) and Chen et al. (2022), primarily in the context of the COVID-19 pandemic. Furthermore, diversifying supply sources and expanding into new markets, even beyond the pandemic, has been underlined by Lopes (2022) and Sheffi (2020). As highlighted by Golan et al. (2020), while globalisation exposes supply chain networks to disruptions, leading to increased complexity and uncertainty and numerous factors that can have unforeseen impacts, it also presents significant opportunities for optimising supply chains and diversifying sources of supply.

Research findings have demonstrated that during unforeseen events, cooperation and integration within the supply chain become even more crucial. According to Hu (2022) and Tabaghdehi and Kalatian (2022), the COVID-19 pandemic provided opportunities for developing and enhancing existing inter-organisational relationships and establishing new ones, contributing not only to resilient but also trust-based inter-organisational supply chains. Additionally, Panwar et al. (2022) discussed the reconfiguration of global supply chains into global value chains as one of the supply chain management practices in the short and long term. The perspective of transforming global supply chains into global value chains highlights the shift from competition towards more cooperative forms of collaboration (Ryciuk, 2020, Ryciuk, 2022).

Qualitative research results further indicated that communication with suppliers during the pandemic often presented challenges, with partners sometimes withholding information about emerging problems. However, over a longer period, this situation eventually led to greater transparency in supply chains, fostering closer relationships and collaborative problem-solving in response to disruptions. It is also worth noting that responding to unforeseen events poses greater challenges for supply chains with lower maturity levels.

The conducted research also shed light on the positive impact of unforeseen events on supply chain innovation. When asked whether the pandemic's impact on supply chain management was entirely

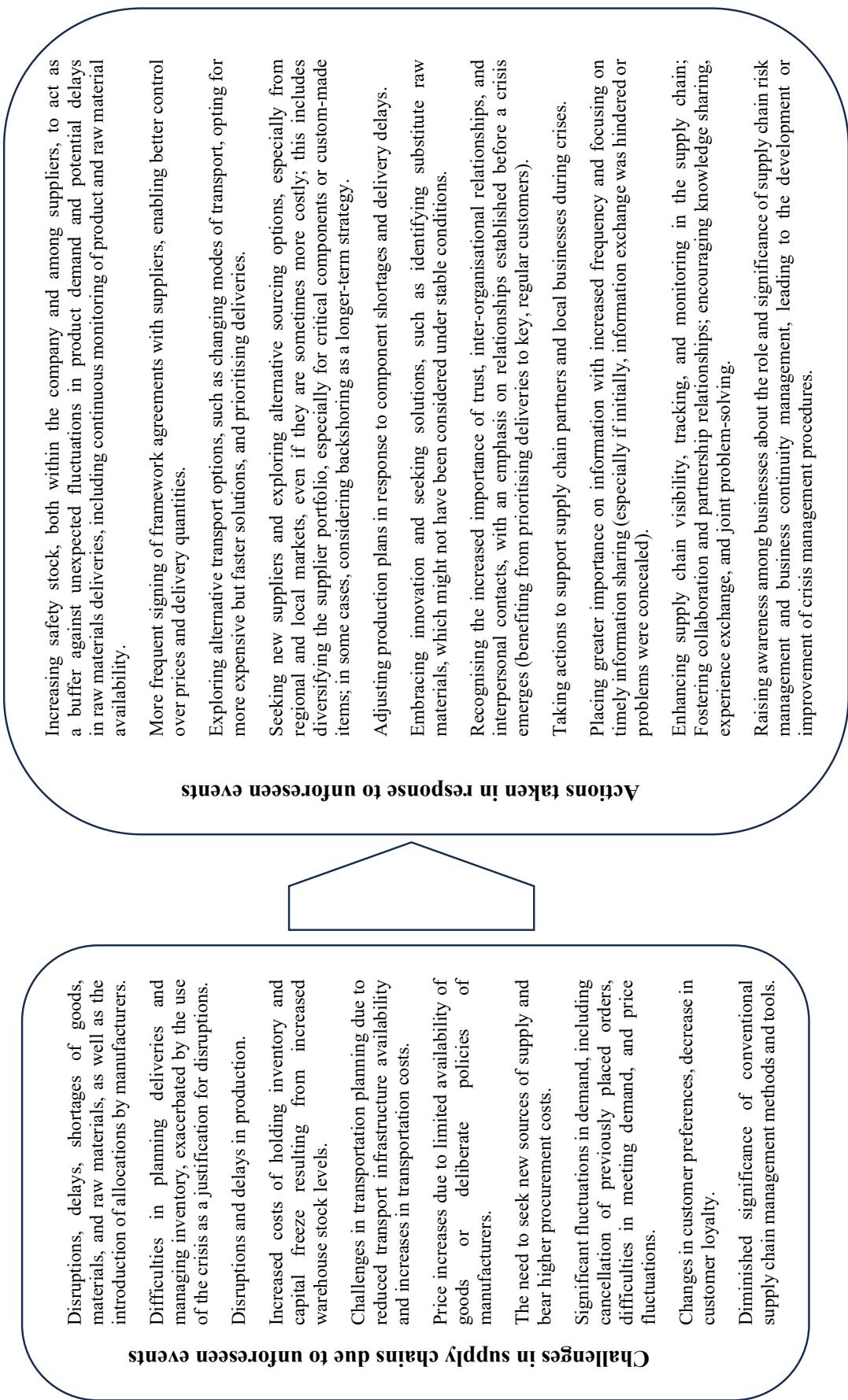


Fig. 2. Main challenges in supply chain management that arise from the occurrence of unforeseen events and the actions taken in response to them

negative, the respondents disagreed. An example illustrating increased openness to innovations during challenging times is the sourcing of an alternative for a hard-to-obtain raw material. Similarly, Maternowska (2021) emphasised that the pandemic accelerated the development and adaptation of many technologies and practices, potentially enhancing supply chain resilience to future disruptions. Recent unforeseen events have also coincided with the emergence of new technologies within Industry 4.0 and the establishment of intelligent supply chains (Ryciuk, 2019).

However, the research findings did not demonstrate a significant impact of unforeseen events on the establishment of sustainable supply chains. Actions like backshoring or nearshoring, as pointed out by Milewska (2022), may lead to reduced CO<sub>2</sub> emissions, but they appear to be somewhat unplanned consequences of responses to unforeseen events.

## CONCLUSIONS

The purpose of the article was to identify the primary challenges in supply chain management resulting from the occurrence of unforeseen events, such as the COVID-19 pandemic or armed conflict in Ukraine, and to explore the responses within supply chains addressing them.

The research findings highlight several key challenges in supply chain management, including disruptions, delays, and limited availability of specific goods, materials, and raw materials, often exacerbated by manufacturers implementing allocations; difficulties in transportation planning due to restrictions in movement, reduced transportation infrastructure availability, and rising transportation costs; price driven by constrained availability of goods or deliberate strategies by manufacturers; the necessity to identify new supply sources and incur higher procurement costs; increased costs of maintaining inventories and capital freezing; fluctuations in commodity prices and substantial fluctuations in demand.

The primary corrective measures adopted by supply chains in response to unforeseen encompass various strategies, including augmenting safety stock and heightened monitoring of prices and availability of products and raw materials; more frequent engagement in frame agreements with suppliers; exploring alternative delivery methods, switching transportation modes, choosing faster albeit pricier solutions, and prioritising deliveries; actively seeking new sup-

pliers and diversifying sources of supply to fortify supplier portfolios; encouraging innovations; placing a heightened emphasis on trust, cooperation, inter-organisational relations, and interpersonal connections; fostering increased information exchange, knowledge sharing, and collaborative problem-solving; and raising corporate awareness about the pivotal role of supply chain risk management and continuity management.

The research findings provide a valuable foundation for discussions and investigations into the potential impact and consequences of unforeseen events on supply chain resilience. Today's challenges in supply chain management markedly differ from those of just a few years ago. The pandemic placed significant strain on supply chains, while the ongoing conflict in the East underscored the extent to which these chains rely on global political situations. These findings also invite reflection on the future of supply chains operating within specific countries or regions and their role in bolstering the competitive advantage of global economies. It is worth noting the remaining need for broader awareness among managers regarding supply chain management strategies, methods, and tools. Moreover, there is an observed prevalence of intuitive management, particularly when responding to unexpected events.

The study comes with certain limitations tied to its methodology. In qualitative research, context and specific cases play a pivotal role in elucidating the studied issue. The primary constraint of qualitative research may be the limited representativeness of the results and a certain degree of subjectivity, both in the assessments of respondents and in the interpretation of the findings. Nevertheless, the researchers made diligent efforts to mitigate subjectivity by emphasising objectivity and sensitivity to ensure the highest possible quality and value of the conducted research.

Noteworthy are the research findings, their limited generalisability, and the ability to derive overarching conclusions regarding the impact of unforeseen events on supply chains, which are influenced by the predominant focus on the COVID-19 pandemic. This pandemic is underscored as the primary unforeseen event occurring in the last three years. This emphasis on a specific event might constrain a more comprehensive understanding of the effects of various unforeseen events on supply chains.

Future research may involve complementing qualitative research with quantitative research. There are plans to conduct research on a representative sample of enterprise representatives and to develop

models of the impact of unforeseen events on actions taken in response to them. This approach aims to provide a more comprehensive understanding of the dynamics between unforeseen events and supply chain management, allowing for the formulation of data-driven strategies and recommendations for enhancing resilience in the face of uncertainties. Additionally, the research will explore how different industries and organisational sizes respond to these events, providing valuable insights for tailored risk mitigation strategies and adaptive measures.

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