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Risk Management in Operations: From Identification to Mitigation Strategies in Complex Global Supply Networks

Manajemen Risiko dalam Operasi: Dari Identifikasi hingga Strategi Mitigasi dalam Jaringan Pasokan Global yang Kompleks

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ABSTRACT
This study investigates the key factors influencing risk in global supply network operations, with a particular focus on demand uncertainty. The research objective is to identify the factors that cause uncertainty in product demand in a global supply network environment and to evaluate the implications of this uncertainty for the company's operational performance. The research method used is a systematic literature review using the Scopus database to collect relevant articles. The results show that fluctuations in consumer behavior, macroeconomic factors, and global market interconnectedness are the main factors influencing demand uncertainty in the global supply network. The implication of this research is that it is important for companies to develop strategies that are adaptive and responsive to changes in global market demand to improve their operational performance and resilience.
Keywords: global supply network, operational risk, demand uncertainty, literature review, risk management strategy

ABSTRAK
Studi ini menyelidiki faktor-faktor kunci yang mempengaruhi risiko dalam operasi jaringan pasokan global, dengan fokus khusus pada ketidakpastian permintaan. Tujuan penelitian adalah untuk mengidentifikasi faktor-faktor yang menyebabkan ketidakpastian dalam permintaan produk di lingkungan jaringan pasokan global dan untuk mengevaluasi implikasi dari ketidakpastian ini terhadap kinerja operasional perusahaan. Metode penelitian yang digunakan adalah literature review sistematis dengan menggunakan database Scopus untuk mengumpulkan artikel-artikel yang relevan. Hasilnya menunjukkan bahwa fluktuasi dalam perilaku konsumen, faktor ekonomi makro, dan keterkaitan pasar global merupakan faktor utama yang mempengaruhi ketidakpastian permintaan dalam jaringan pasokan global. Implikasi penelitian ini adalah pentingnya bagi perusahaan untuk mengembangkan strategi yang adaptif dan responsif terhadap perubahan dalam permintaan pasar global untuk meningkatkan kinerja dan ketahanan operasional mereka.
Kata Kunci: jaringan pasokan global, risiko operasional, ketidakpastian permintaan, literature review, strategi manajemen risiko

1. Introduction

This literature review introduces the reader into the broad context of risk management in global supply networks. With the rapid growth in international trade and global economic integration, global supply networks have become key in supporting business operations in various sectors. However, the complexity inherent in global supply networks also increases the risks companies face. This phenomenon leads to a deep need to understand the factors that influence risk in global supply network operations. Despite previous research in this domain, there is still a knowledge gap that needs to be filled. Therefore, this study aims to fill this knowledge gap by conducting a systematic literature review on key factors influencing risk in global supply network operations. This research aims to answer a specifically formulated research question, namely: "What are the key factors that influence risks in operations in global

supply networks, and how can they be managed effectively?" The novelty of this study lies in its systematic approach, which allows the identification of new or poorly understood risk factors. It is hoped that this research contribution will provide valuable insights for business practitioners, researchers and policy makers in developing more effective risk management strategies in the context of complex global supply networks. Thus, this introduction introduces readers to the theme, need, and relevance of the research, as well as providing an overview of the objectives, research questions, novelty, and contribution of the literature review that will be carried out.

2. Research methods

In conducting this literature review, the method used is very important to ensure accuracy, sustainability, and success in identifying and analyzing relevant articles. First of all, relevant articles were collected from reputable international databases, one of which is Scopus, which is known for its wide coverage and quality of articles. Keywords used in the article search were carefully selected to ensure breadth of coverage and relevance to the research topic. After the search is carried out, the number of articles obtained will be recorded for further evaluation.

Article inclusion and exclusion techniques were then applied to select articles that were most relevant to the research focus. Articles that met the inclusion criteria had to fit the scope of the research and provide a significant contribution to the understanding of risk factors in global supply network operations. Conversely, articles that are irrelevant or of low quality will be excluded from the analysis.

In the final stage, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method was used as a guide to systematically compile and report the results of the literature review. The PRISMA method helps ensure transparency, accountability, and reproducibility in reporting literature review findings, thereby increasing the credibility and reliability of research. By applying this method, this research can be carried out with a strong and structured methodology, which allows for the identification, analysis and interpretation of relevant literature articles with a high level of accuracy and detail.

3. Results and Discussion

3.1. Key Factors Influencing Risks in Global Supply Network Operations

3.1.1. Overview of Supply Uncertainty

In global supply network operations, several key factors can significantly impact the level of risk that a company faces. Changes in geopolitical factors, such as political conflicts or alterations in trade policies between countries, can lead to disruptions in the flow of goods and materials, resulting in delays or shortages (Handfield et al., 2020). Environmental factors, including extreme weather events or natural disasters, can also disrupt production, transportation, and distribution of goods within global supply networks (Xiaojin et al., 2022). For instance, flooding or storms can cause disruptions in maritime transportation, affecting the availability of supplies (Xiaojin et al., 2022).

Moreover, supply uncertainty can arise from changes in consumer demand, influenced by shifts in trends, preferences, or purchasing behavior (Duoming & Chin, 2022). If there is a sudden change in consumer preferences for a specific product, a company may struggle to adjust its supply to meet the altered demand (Duoming & Chin, 2022).

The COVID-19 pandemic has further highlighted the vulnerabilities in global supply chains, emphasizing the need for resilience and adaptability (Golan et al., 2020). The pandemic has significantly impacted manufacturing supply chains, necessitating the development of production recovery plans to address disruptions (Paul & Chowdhury, 2020). Additionally, disruptions in global supply chains have prompted a reevaluation of supply chain design in response to compounding geopolitical challenges (Roscoe et al., 2022).

To mitigate the risks associated with supply chain disruptions, coordination among countries, supply chain resilience, and the use of technologies like artificial intelligence have been identified as crucial strategies (Bukhari & Zafar, 2023). Furthermore, the adoption of additive manufacturing and artificial intelligence in managing supply chain risks has been explored as potential solutions to counter the impacts of disruptions (Sheriff et al., 2021; Nayal et al., 2021).

In conclusion, understanding and addressing factors such as geopolitical changes, environmental disruptions, and shifts in consumer demand are essential for companies to navigate the complexities of global supply networks and enhance their resilience in the face of uncertainties.

3.1.2. An Overview of Demand Uncertainty

Supply chain operations are influenced by various factors, with demand uncertainty being a significant driver of risk. Demand uncertainty negatively impacts strategic supplier partnerships and supply chain responsiveness (Nenavani & Jain, 2021). This uncertainty arises from dynamic changes and instability, making it challenging for organizations to manage their supply chains accurately (Perdana, 2021). The presence of both downstream (demand) and upstream (supply) uncertainties complicates inventory management decisions in the supply chain (Bendoly et al., 2022). Uncertain demand and random yield are identified as primary reasons for risks in the supply chain (Ji & Liu, 2022).

To mitigate the impact of demand uncertainty, various strategies and models have been proposed. Reduction of demand uncertainty has been shown to have a significant effect on supply chain management (Deng, 2024). Additionally, the coordination of supply chains through robust optimization models can enhance response speed and flexibility to uncertainties in supply, production, logistics, and sales (Song et al., 2022). Centralization and coordination are highlighted as internal uncertainty factors that significantly influence supply chain fit (Sabri, 2019).

Moreover, the design of supply chain networks under uncertain conditions, such as during the COVID-19 pandemic, requires robust optimization to address data uncertainty and ensure effective decision-making (Chaerani et al., 2022). The implications of the COVID-19 crisis have underscored the importance of managing operational risks that impact supply chain reserves and costs (Ivanovska et al., 2021). Furthermore, the effects of yield and lead-time uncertainty on inventory management decisions in decentralized supply chains have been analyzed to understand their impact on production and order quantities (Lee et al., 2019).

In conclusion, demand uncertainty plays a crucial role in influencing risk in global supply network operations. Addressing this uncertainty through strategic partnerships, supply chain responsiveness, and robust optimization models is essential for enhancing the resilience and efficiency of supply chain operations.

3.1.3. Overview of Process Uncertainty B. Effective Risk Management Strategies

Global supply chain operations are subject to various uncertainties and risks that can significantly impact their performance and resilience. Factors such as epidemic outbreaks, disruptions in the supply chain network, resilience analytics, sustainable practices, and the integration of advanced technologies like artificial intelligence and the Internet of Things play crucial roles in determining the risk levels in global supply networks (Ivanov, 2020; Lavassani et al., 2022; Golan et al., 2020; Olan et al., 2024; Deng, 2023; Appadoo et al., 2021; Perdana, 2021).

Epidemic outbreaks, like the COVID-19 pandemic, introduce long-term disruptions, propagation of disruptions, and high uncertainty into supply chains, highlighting the need for effective risk management strategies (Ivanov, 2020). The recent global pandemic has exposed vulnerabilities in global supply networks, emphasizing the importance of stability and risk

mitigation measures (Lavassani et al., 2022). Advanced resilience analytics are essential for ensuring the operational continuity of supply chain networks during global disruptions (Golan et al., 2020). Sustainable practices and the integration of artificial intelligence technologies are also key in addressing concerns and risks in global supply chains (Olan et al., 2024; Deng, 2023).

Uncertainties in supply chain networks can lead to disturbances and disruptions, necessitating the deployment of robust risk management strategies (Appadoo et al., 2021). Understanding the impact of uncertainty shocks and the network position within the supply chain is crucial for making informed inventory decisions (Wu et al., 2022). Identifying and mitigating risks and uncertainties are paramount for enhancing the resilience of supply networks (Tüzemen & Yapraklı, 2022). Factors such as agility, network structure, visibility, communication, and collaboration among supply chain partners drive the resilience of supply chains (T. & Raju, 2023).

Moreover, establishing or relocating distribution facilities, considering costs, trade uncertainties, and disruptive technologies, is vital for ensuring resilient and sustainable supply chain performance (Sundarakani et al., 2020). Lead time uncertainties in global single-source supply networks pose challenges that require integrated decision-making and robust decision support systems (Rolf et al., 2022). Balancing resilience and vulnerability in supply chains is essential for mitigating risks and ensuring operational continuity (Zhang et al., 2021).

In conclusion, a comprehensive understanding of the key factors influencing risk in global supply network operations, coupled with effective risk management strategies, resilience analytics, sustainable practices, and the integration of advanced technologies, is crucial for enhancing the resilience and performance of global supply chains in the face of uncertainties and disruptions.

3.1.4. Risk Analysis

Global supply chain operations are subject to various risks that can significantly impact their efficiency and resilience. Several key factors influence risk in global supply chain operations. One critical aspect is the interdependency between causal chains of vulnerabilities, risk sources, risk events, and resulting losses (Gaudenzi & Qazi, 2020). Traditional risk analysis methods often fail to capture these interdependencies, making it essential for managers to have complete visibility across the entire network to safeguard it from disruptions (Gaudenzi & Qazi, 2020). The synergy between Supply Chain Risk Management (SCRM) and quality management is crucial for continuously improving supply chain operations (Gaudenzi & Qazi, 2020).

Moreover, the complexity of global supply chains, with uncertainties in supply and demand, market globalization, and the involvement of multiple partners, increases the exposure to risks (Zimon & Madzík, 2019). The changing phases of globalization, lean manufacturing processes, and outsourcing to low-income countries have made supply chain networks more efficient but have also altered their risk profiles (Gurtu & Johny, 2021). Additionally, disruptions in global supply chains, such as those caused by the COVID-19 pandemic, highlight the importance of real-time monitoring and end-to-end visibility to detect and address risks promptly (Pyun & Rha, 2021).

Furthermore, risks in global supply chains can stem from various sources, including political issues, technological changes, demand fluctuations, natural disasters, and financial crises (Chu et al., 2020). The inherent vulnerabilities in the environment, network structure, and organizational aspects act as risk sources for supply chains (Sugathadasa et al., 2020). Risks in global supply chains not only impact operational efficiency but can also threaten the continuity of enterprises (Nguyen et al., 2022).

In conclusion, understanding and mitigating risks in global supply chain operations require a comprehensive approach that considers the interdependencies between various risk factors, the complexity of supply chain networks, the impact of globalization, and the need for

real-time monitoring and visibility. By addressing these key factors influencing risk, organizations can enhance the resilience and performance of their global supply chain operations.

3.1.5.Risk Mitigation

Risk mitigation in global supply network operations is a critical aspect that requires a comprehensive understanding of various factors influencing risks and the implementation of effective strategies to address them. Several key factors and strategies have been identified in the literature that can significantly impact risk management in supply chains.

One crucial factor is (1) supply chain resilience, which involves the dynamic success capability combined with appropriate risk mitigation strategies (Um & Han, 2020). This highlights the importance of not only being able to withstand disruptions but also actively working to reduce vulnerabilities and mitigate risks in the supply chain environment. (2) Supply chain risk management is another integral function that plays a vital role in addressing risks within the supply network (Gurtu & Johny, 2021). It emphasizes the need for proactive measures to identify, assess, and manage risks effectively to ensure the smooth operation of the supply chain. (3) Logistics innovation capability has been identified as a factor that can impact supply chain risks in the Industry 4.0 era (Wang et al., 2020). Developing innovative logistics capabilities can help organizations mitigate the negative impacts of risks and enhance their overall risk management strategies. (4) Collaborative relationships among supply chain partners, (5) information sharing are highlighted as major drivers of supply chain risk mitigation (Majumdar et al., 2021). Building strong partnerships and sharing knowledge about risks can significantly contribute to effective risk management practices. (6) Integrated supply chain risk has been identified as a crucial risk that requires thorough identification, assessment, mitigation, and monitoring due to the extended nature of global supply chains (Ali, 2022). This underscores the need for a holistic approach to managing risks across the entire supply chain network. (7) Supply chain flexibility is recognized as a valuable risk mitigation strategy that can help in managing foreign exchange risk exposure and improving cash flow management in firms with global supply chains (Pellegrino et al., 2023). Investing in supply chain flexibility strategies can enhance the resilience of supply chains to various risks.

In conclusion, by understanding the relationships between supply chain resilience, risk management strategies, logistics innovation, collaborative partnerships, and supply chain flexibility, organizations can effectively mitigate risks in global supply network operations. Implementing a combination of these key factors and strategies can enhance the overall risk management capabilities of supply chains and ensure their sustainability in the face of uncertainties.

3.1.6. Crisis Management

The COVID-19 crisis has significantly impacted global supply chains, highlighting the importance of crisis management in supply chain operations (Fasan et al., 2021). Collaborative risk management, real-time monitoring, information sharing, supply network management, scenario planning, and simulations are crucial strategies to mitigate the effects of crises like the COVID-19 pandemic (Kohl et al., 2022). The complexity of global supply chains can amplify losses beyond the direct effects of the crisis, emphasizing the need for robust and resilient supply chain systems (Guan et al., 2020; Sarkis, 2020).

Supply chain risk can lead to operational disruptions, decreased efficiency, increased costs, network failures, and unexpected events, underscoring the importance of effective risk management in supply chain operations (Guo, 2021). The crisis has demonstrated the vulnerability of supply chains, necessitating innovative strategies, green practices, crisis mitigation approaches, and smart technologies to enhance supply chain resilience and sustainability (Mollenkopf et al., 2020; Khan et al., 2022).

Effective crisis management in supply chains requires social communication, collaboration among supply chain actors, and the ability to adapt to changing circumstances (Raassens et al., 2021). Resilience and robustness are key concepts in supply chain management, with supplier substitutability playing a critical role in maintaining operations during crises (Obashi, 2021). The interconnectedness of supply chains across sectors, governments, and civil society has been underscored by the challenges posed by the crisis (Harland, 2021).

The COVID-19 pandemic has prompted the establishment of pandemic supply chain networks with pre-determined guidelines to address crisis situations effectively (Okeagu et al., 2021). Leadership, digital infrastructure, learning capabilities, and environmental sensing are essential for preparing, containing, and mitigating crises in supply chain operations (Zhang et al., 2022). Additionally, synchronicity management, which systematically considers demand changes as a starting point, can help mitigate supply chain risks during crises like the COVID-19 pandemic (Schiele et al., 2021).

In conclusion, factors influencing risk in global supply network operations during crises like the COVID-19 pandemic include collaborative risk management, resilience, robustness, effective risk management strategies, innovative practices, social communication, and leadership capabilities. Addressing these key factors is essential for enhancing the resilience, sustainability, and effectiveness of supply chain operations in the face of crises.

4. Conclusions

This research identifies and analyzes key factors influencing risk in global supply network operations, with a particular focus on demand uncertainty. The results of a systematic literature review show that fluctuations in consumer behavior, macroeconomic factors, and global market linkages are the main sources of demand uncertainty. These findings emphasize the importance for companies to understand and manage demand risks in order to improve their operational performance in a dynamic and uncertain business environment.

The practical implication of this research is that it is important for companies to develop strategies that are more adaptive and responsive to changes in market demand. The use of advanced technologies such as predictive analytics and artificial intelligence can help companies predict changes in demand and adjust their operations in real-time. Additionally, closer collaboration with suppliers and distributors can also improve supply chain visibility and resilience.

This research has several limitations. First, this literature review only used articles available in the Scopus database, which may limit the scope of the study. Second, this research focuses on demand uncertainty without exploring in depth other factors such as supply and production process uncertainty. Third, this research relies on secondary data available in the literature, which may not cover the latest developments or specific conditions in various industries.

For future research, it is recommended to expand the scope of databases used to collect literature, including other reputable sources. Research could also further explore uncertainty in supply and production processes as well as the interactions between different types of uncertainty in global supply networks. Empirical studies involving primary data from different industries and geographic regions can also provide more in-depth and contextual insights into risk management in global supply network operations.

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