

EXPLORING SUPPLY CHAIN RISK MANAGEMENT IN THE POST-PANDEMIC FUTURE: THE CASE STUDY OF HANDANHY COMPANY

Tong WU^{a*}

^a Bucharest University of Economic Studies, Romania

ABSTRACT

The article examines the supply chain risk of personal protective equipment in the context of the pandemic, using the Chinese private company HANDANHY as an example, and describes the main risk categories for supply chain disruptions, providing insights into supply chain risk in the personal protective equipment industry. The article uses a qualitative research approach combined with a questionnaire survey and analysis of four personal protective equipment companies. It is to explore supply chain risk management strategies in the post-pandemic and to be able to respond more nimbly to similar emergencies in the future and to provide references for reducing supply chain risk.

KEYWORDS: , *personal protective equipment, post-pandemic, supply chain risk management.*

DOI: 10.24818/IMC/2022/01.13

1. INTRODUCTION

Supply chain risk management is a systematic approach to identifying and assessing routine and unusual risks and vulnerabilities throughout a company's supply chain, developing mitigation strategies to address these threats, and ensuring business continuity. It is a way for companies to coordinate and then identify, analyse and mitigate harmful risks to the sustainability and profitability of their supply chains. Supply chain risk is an issue that many companies face, but few know how to deal with it in a systematic and pragmatic way. Risk management is important for the effective operation of supply chains in the presence of various uncertainties (Ho et al., 2015).

There are many different risks that can lead to supply chain disruptions, such as natural disasters, man-made disasters and outbreaks of infectious diseases. Pandemics are one of the main threats mainly to the human respiratory system (Rothan & Byrareddy, 2020). The World Health Organisation declared a highly infectious pandemic as a global emergency on 30 January 2020 (Sohrabi et al., 2020).

The continuing rapid rise in the number of infections in early 2020 has led to an increasing demand for personal protective equipment products. Outbreaks have led to disruptions throughout the personal protective equipment supply chain, with a significant impact on the entire operational system. In many countries and regions, in the early stages of an outbreak, some healthcare facilities had difficulties in obtaining timely supplies of personal protective equipment. Supply shortages and disruptions exposed problems in supply chain risk management.

This paper demonstrates the impact of a pandemic on the personal protective equipment supply chain. Supply chain risk management aims to minimise supply disruptions. Due to the uncertainty,

* Corresponding author. E-mail address: wt689689@gmail.com.

dynamics and complexity of the supply chain (Vilko et al., 2014), this becomes a challenge for supply chain management managers.

This paper provides a comprehensive review of personal protective equipment supply chain risk management and classifies the risks. Risk management is a broad topic that needs to be addressed; This article focuses on the operational aspects of purchasing and sales and does not include detailed financial and information risk management.

It will examine and analyse the case of HANDANHY, a private Chinese company, to explore supply chain risk management strategies in the post-pandemic future and to provide references for future encounters with similar emergencies in order to be able to respond more agilely and reduce the risks and the impact of uncertainty brought about by the supply chain. It is divided into six main parts, the first part is the introduction, the second part is the research content, the third part is the research methodology, the fourth part is the research analysis and results, and the fifth part is the conclusion.

2. CONTENT OF THE STUDY

2.1 Problem Statement

- After identifying supply chain risks, what kind of supply chain risk management does the PPE industry have to adapt to?
- How to manage and operate to reduce supply chain risks in emergencies such as during the pandemic and after the pandemic?
- What is the role of digital management in reducing supply chain risk management?

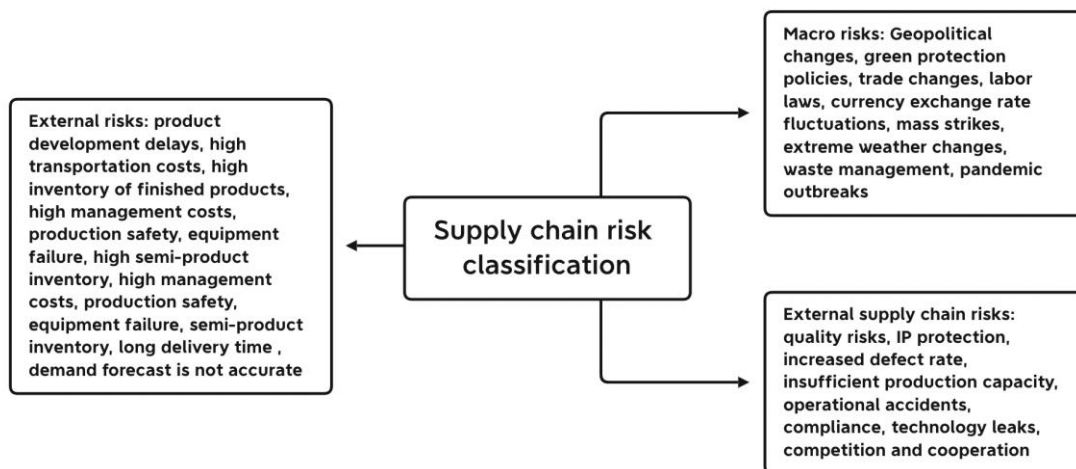


Figure 1. Supply chain risk classification

Source: Made by authors

Once the risk categories have been identified, it is important to manage these risks and take steps to address them. For example: increasing awareness of supply chain risk management and avoiding risks where possible; reducing risks by eliminating certain factors and reducing the frequency of occurrence. If this risk occurs, accept it and develop a solution in the quickest possible time.

The pilot study is a case study of HANDANHY, a small and medium-sized private company in a pandemic situation. In small and medium-sized enterprises, the reliance on the order side of the supply chain, whether it is a customer or a supplier, the supply chain processes are closely linked. Following an analysis of risk mitigation measures, six constructive approaches to measures are proposed.

2.2 Case study Handanhy company background

HANDANHY Personal Protective Equipment Company is located in Handan, Hebei Province, China and was established in 1988. The company exports a full range of personal protective equipment products, with 80% of its turnover coming from exports and 20% from domestic sales. The sales network covers the UK, France, Sweden, Holland, USA, Canada, Japan, Ireland, France, Germany and other countries. Following the outbreak, sales of the main personal protective equipment products were focused on respirator masks, safety goggles, face masks, disposable protective clothing and medical nitrile latex gloves.

HANDANHY is an example company in the personal protective equipment industry, but its experience during the pandemic is somewhat reflective of the risk issues in the personal protective equipment industry supply chain.

The outbreak was first reported in December 2019. HANDANHY checked with overseas customers and distributors to see if they needed to order surgical masks, disposable coveralls and goggles. None of them had any additional requests for these products at that time, no additional demand was expected and their current stock would last for approximately three months.

As the outbreak spread from early March to April 2020, domestic customers and overseas buyers began ordering personal protective equipment in large quantities due to a surge in demand, which led to disruptions in the personal protective equipment supply chain. Firstly, blockade policies in some cities restricted production outcomes and led to capacity constraints, leaving insufficient labour and machinery to produce personal protective equipment products. Secondly, manufacturers did not have sufficient capacity to meet such a huge increase in global demand. Finally, rising raw material prices have led to uncontrolled increases in the price of finished personal protective equipment products. In addition, the outbreak of the pandemic affected the mask machine and related accessories industry. Accordingly, product deliveries were delayed and prices rose wildly. This series of events occurred like a domino effect on the entire personal protective equipment supply chain.

Logistics were disrupted due to the impact of the pandemic outbreak and various supply chain disruptions. Since mid-March 2020, most orders for personal protective equipment products have been requested to be shipped by air. At the same time, air freight prices have more than tripled.

During the outbreak, there was a lack of visibility and information symmetry in the personal protective equipment supply chain. Visibility has a positive effect on supply chain disruption response and recovery (Khojasteh, 2018). Personal protective equipment companies need to adopt supply chain risk management to reduce and mitigate risk. This paper provides some lessons on how personal protective equipment suppliers can better respond to future infectious disease outbreaks and crises.

3. RESEARCH METHODS

3.1 Questionnaire

Because of the broad scope of supply chain risk management, this study sought to investigate supply, demand and process. The questions focused on how personal protective equipment companies ranked their risk categories and assessments to enable managers or decision makers to analyse them from their perspective and to bring sufficient attention to supply chain risk management for them after the outbreak. The main source was a questionnaire with managers of personal protective equipment companies.

3.2 Qualitative case studies

The study adopts a qualitative research method and is based on three main stages of risk management: risk identification, risk assessment and risk mitigation. The goal is to contribute to new theories, and the use of case studies provides a better basis for further research into the field.

The research questions in this paper focus on the types of risks faced by personal protective equipment companies during an pandemic and provide some guidance on how to mitigate the risks in a practical way. As such, it is from the perspective of the personal protective equipment purchaser, as well as from the supplier's perspective. As supply chain risk management is a cross-functional discipline, it involves decision makers in sales and marketing, procurement, supply chain management, logistics and finance.

The main advantage of qualitative research is that it allows for a more accurate and correct understanding of established phenomena. It allows for the identification of causes, opinions, influences and other additional information (Graebner & Eisenhardt, 2007). In order to ensure construct validity, consultations and surveys were carried out with people in charge from different personal protective equipment companies. By asking questions that were specific and relevant to the case, it was ensured that each concept used in the analysis process was supported by sufficient data. By selecting four different companies in the personal protective equipment industry, the approach to risk management in the event of an emergency crisis such as an pandemic is described. Relative guidelines are provided on how to manage risk effectively in the supply chain.

Table 1. Case Selection Overview

Company	Size	Sample size		
		Purchasing	Management	Total
Principle & Will	Medium	1		1
Ansell	Medium	1		1
Xing Ye	Small		1	1
Jin Yuan	Small		1	1

Source: Made by authors

The primary data was collected through qualitative interviews with companies in the personal protective equipment industry via telephone, email and other electronic platforms as necessary. To analyse the data, the paradigm model approach suggested by Strauss and Corbin in 1990 was used in this paper as the initial data was unstructured but information-rich (Wuttked et al., 2013). The analysis consisted of two parts, with the first part conducting a within-case analysis, followed by a cross-case analysis in which common patterns in the cases were identified. It demonstrated the theory in the data collected and explained the statements more accurately. These steps increased transparency and ultimately the reliability of the data collected since the case studies followed the interpretive paradigm framework.

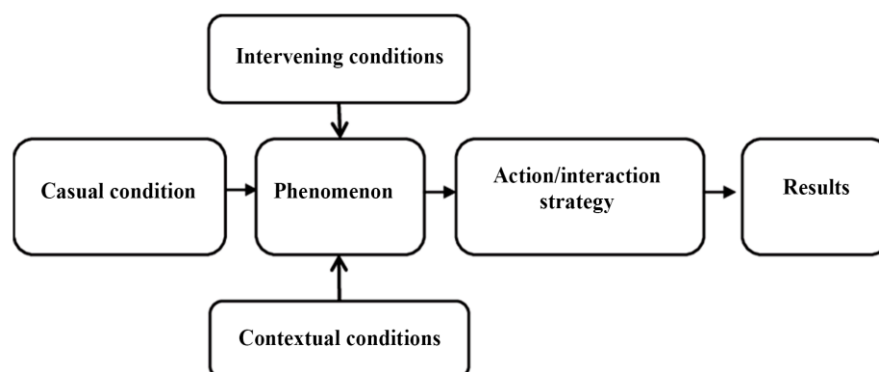


Figure 2. Paradigm framework

Source: https://www.researchgate.net/figure/Paradigm-model-of-Strauss-and-Corbin-Corbin-Strauss-2008_fig2_339544161

4. FINDINGS

4.1 Factors contributing to the emergence of different risk categories

The first step is to identify and point to personal protective equipment supply chain risks after an outbreak. It should be noted here that because of the mutual transformation between things, the risk mitigation strategy of one personal protective equipment company in the supply chain may be the "risk event" of another personal protective equipment company, so when making mitigation or avoiding its own company's risk strategy, to think from the perspective of taking the overall situation into consideration.

With so many associated risks and ways to mitigate them, policymakers must do two things when starting to build a supply chain risk management strategy for emergency or crisis conditions. First, they can unify thinking and build a consistent understanding of supply chain risk across the entire organizational group. Second, they need to examine how risk mitigation approaches can be tailored to the specific company's situation.

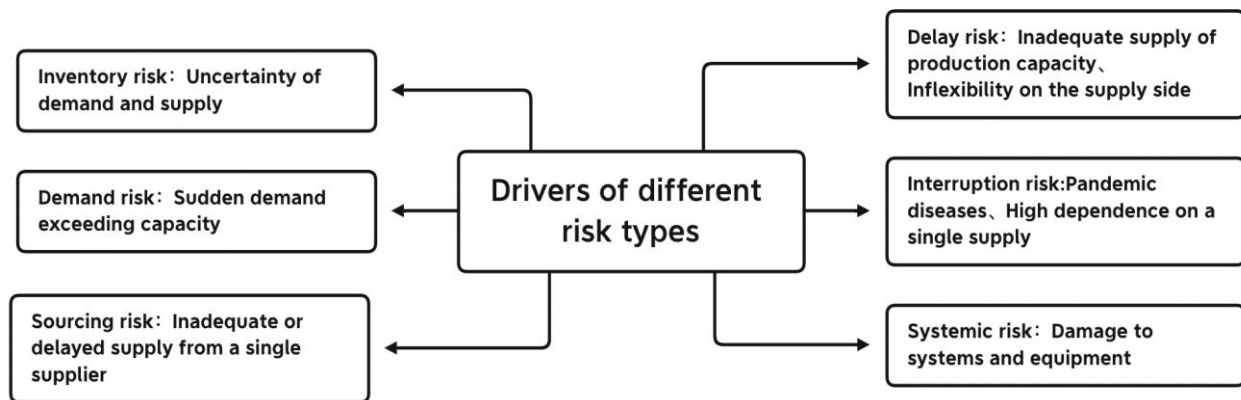


Figure 3. Drivers of different risk types

Source: Made by author

4.2 Collect and integrate the current status of the relevant personal protective equipment industry

The data analysis consists of two parts, the first part is to understand HANDANHY's business and supply chain risk management method situation. The second part expounds the supply chain risk management level of the other four companies. Data is collected from questionnaires, which are not systematic but informative.

To understand how various risks affect the supply chain of a selected personal protective equipment company, the answer is recorded on a scale from 1 (very low) to 10 (very high). To assess the current level of supply chain risk management adoption by personal protective equipment companies, a simple three-point scale of "high", "medium" or "low" was used. A higher score means a higher degree of supply chain risk affecting personal protective equipment companies during the pandemic. Data were recorded individually from each questionnaire.

Table 2. Current status of supply chain risk impact in personal protective equipment companies in the context of the pandemic

Risk type		Company			
		Principle & Will	Ansell	Xing Ye	Jin Yuan
Supply risk	Supply disruptions	7	8	5	7
	Capacity uncertainty	3	7	8	5
	Supplier defaults	3	2	1	4
	Price increases	5	5	4	5
	Unstable delivery	7	7	4	8
Process risk	Logistics delays	6	7	7	7
	Capacity constraints	1	2	1	2
	Production machine instability	1	1	2	1
	Labour shortages	1	2	1	1
	Factors that increase the cost of production processes	1	2	1	1
Demand risk	Uncertainty of product demand	7	5	4	6
	Uncertainty of market demand	5	4	6	6
	Uncertain price factors	1	2	2	3
	Market and marketing risks	5	4	5	7
Environmental risks (External factors)	Exchange rate fluctuation risk	1	2	2	3
	City blocking policy (COVID-19)	5	4	2	1

Source: Made by author

It is worth noting that the data shows that all personal protective equipment companies are facing the same phenomenon: the pandemic has affected the company's current supply chain. 60% of managers understand supply chain risk management but are not professional, no employees have supply chain risk management training, and there is no single department responsible for risk management in these companies' supply chains. Supply disruptions and logistical delays are major issues and risks during the post-pandemic supply chain period.

According to the investigation and consultation by mail, telephone, etc., the purchasing manager of Principle & Will described: "Our suppliers have different reasons for delaying delivery." Ansell company manager mentioned: "In order to avoid supply interruptions and long delivery times for our suppliers, we import mask moulding machines and produce masks locally, which enables us to provide customers with a stable supply capacity and improve service levels". Personal protective equipment companies use safety stocks to buffer supply disruptions, and Xing Ye did forecast three months and made order plans for the peak season, when there will be labor shortages and

undercapacity around peak seasons. "We have an annual plan and a three-month forecast," said Jin Yuan, the company manager. The surge in global personal protective equipment demand has led to large volumes of personal protective equipment being sourced from China and other East Asian countries.

4.3 The results obtained from the analysis

The data reveals a correlation between supply chain risk management supply capacity and demand and on-time delivery. As a result of the pandemic, the supply chain in the personal protective equipment industry has experienced the supply disruptions mentioned earlier. If there is only one downstream supplier, a high dependency on the supplier will lead to a high risk of disruption potential.

By introducing a multi-sourcing strategy, the high dependence on downstream suppliers will be reduced and greater flexibility will be gained in case of uncertainty. Multi-sourcing is the placing of purchase orders to different suppliers. For example, suppose a company purchases raw materials from three different suppliers (20% from supplier A, 40% from supplier B, 40% from supplier C). If supplier C faces disruptions due to uncertainty, the company will not completely shut down its operations as it can still source 60% of its raw materials. The impact of such a disruption would be lower if the company had a mitigation strategy to compensate for the 40% loss of raw materials due to the disruption at Supplier C (Zhao & Ye, 2022). Based on the above case study, the following six strategic outcomes can be derived.

- Using a multi-source strategy can mitigate supply chain risks to the personal protection industry in the event of an pandemic or outbreak

Multi-sourcing can increase supply chain capacity and bring more supply flexibility than using only one supplier, mitigating and reducing the risk of supply chain disruption. The size of the supplier's facility capacity should match the order forecast demand accordingly (Bidhandi & Yusuff, 2011). The advantage of single procurement is that it is more conducive to the integration of delivery resources, easier to obtain competitive prices, and more focused on connecting with the same supplier; multi-source procurement will increase the complexity of operations and deal with different suppliers. The cost will increase accordingly, but if there are alternative suppliers as backup resources, there are still other suppliers who can provide goods in a suitable time under other uncontrollable factors. In addition, under the pandemic, competitors in the personal protective equipment industry can share resources. In general, competitors usually do not share supply chain resources. However, sharing resources with competitors can improve the efficiency of all personal protective equipment companies when dealing with the uncertain supply and uncertain demand of the global health crisis.

Managers can evaluate suppliers based on their performance and select the best ones. This will help companies to reduce and mitigate the risk of uncertainty disruptions and is cost effective.

- Supply chain resource consolidation helps reduce supply chain risk to the personal protection industry in the event of an pandemic or outbreak

The application of supplier consolidation can help mitigate the risk of disruption, delay and capacity risk in the case observations above. As a result of the pandemic, coordination and adhesion between purchasers and suppliers in the personal protective equipment industry is lower than usual. For example, mask manufacturers, whether or not they are long-term relationship customers, are rejecting low-priced orders and retaining priority production for high-priced orders.

- Sales and operations planning improves the accuracy of personal protective equipment product forecasts, thereby reducing the risk of disruption during a pandemic

The personal protective equipment industry has seen disruptions in demand at various stages following the outbreak, and increasing capacity and inventory does help to meet demand, but costs can also increase. This is a trade-off for companies that have excess labour or capacity when demand drops. Sales and operations planning is a tactical tool to balance supply and demand,

keeping supply and demand in sync to mitigate the risk of shortages and redundancies. By applying sales and operations planning can help to reduce demand risk and inventory risk.

Demand cannot be easily predicted as the outbreak is a public health emergency. This is a challenge for the personal protective equipment supply chain to forecast accurately. Forecasting is therefore a key step in the execution of sales and operations plans. Demand is a continuous variable and is a major challenge for supply chains (Trkman & McCormack, 2009) and every estimate has a 'margin of error'. Forecasting a range of potential outcomes, rather than a single short-term demand figure, may be another good way to address uncertainty. A successful forecasting option is to rely on a collaborative forecasting effort with a team of supply chain members, rather than developing forecasts individually. At the same time, there is a need to capture forecast errors and adapt to changes accordingly, using buffer capacity or a certain level of stock if necessary. Integrated forecasting is more accurate, it provides a better way to check for observation errors and provides a good reference for forecasting forecasts for the next period. In the interviews, some companies do make forecasts but lack practical and professional tools to define them.

- Improved internal and external coordination and information sharing can reduce supply chain risks to the personal protection industry in the event of an pandemic or outbreak

After the outbreak of the pandemic, the operation of the personal protective equipment industry supply chain became irregular. The bullwhip effect is also asymmetric downstream and upstream information, increasing inventory holding costs and increasing delivery time. At the same time, the supply chain is dynamic, for example a supplier's available capacity may change from week to week if other customers have other orders. Companies share information such as demand, supply, inventory levels, batch production plans, etc. with upstream and downstream suppliers (Christopher & Peck, 2004). Will work better and respond faster in different disruption scenarios.

The HANDANHY company holds weekly meetings with customers and partners to exchange information, as this is a global collaboration across different countries and time zones. Judging from the survey, most companies' forecast data comes from the sales and marketing department, which means that in addition to historical data records, managers and decision makers also need the latest information as a reference. Without such cross-departmental and vertical meetings, supply chain managers can also make decisions. However, because accurate data and information are not captured, it can be misleading, putting the company at risk. Digitization is the new trend in information sharing. The greater the visibility into the supply chain, the more effective it is to reduce the risks associated with supply chain risk management. Flexibility then enhances the resilience of the personal protective equipment supply chain to mitigate risk (Tang & Tomlin, 2008).

- Working closely with logistics forwarders to increase freight capacity can reduce supply chain risks to the personal protection industry in the event of an pandemic or outbreak

If a personal protective equipment company has strong and robust logistics support, it will reduce the impact of disruptions. Agile logistics planning is essential in the supply chain. Carriers and freight forwarders should keep sailing schedules up to date and offer the best routes, especially during special times such as pandemics. Also, booking schedules need to be made available to freight forwarders two weeks or more in advance. Buyers can then decide which mode of transport to use and which route to choose based on real-time and accurate information. Companies can enter into strategic contracts with fixed sea freight rates for a certain period of time to hedge the risk of price increases and for better logistics network design. It can therefore help buyers mitigate the risk of delays and better cope with diversity scenarios and uncertainty disruptions.

- Digital management can reduce supply chain risks to the personal protection industry in the event of an pandemic or outbreak

With the development of digitalisation, technologies such as artificial intelligence, big data and blockchain are effectively assisting companies to strengthen their risk and early warning capabilities, and companies are now building digital risk management systems (Deloitte, 2022).

Technologies such as databases are used to monitor key internal and external indicators in real time, and functions such as big data are used to automatically analyse and assess supply chain risks in order to achieve real-time and efficient early warning of potential supply chains. This results in broader scanning, more accurate identification and better measures.

5. CONCLUSIONS

The purpose of this paper is to understand how companies are affected by different risk categories and to provide guidelines on how to mitigate risks during supply chain management in the event of an emergency crisis such as this outbreak. The six strategies above provide specific measures and actions to be taken to mitigate the risks. The analysis of the data, through exploring the main HANDANHY company and four other embedded case studies, has resulted in six testable measure results. Supply chain customer relationship management is a broad area and this paper does not delve into system and financial risk, but focuses only on procurement and operations.

This paper makes an important contribution to the supply chain risk management literature in a number of ways. Firstly, the source of supply chain risk is the global public crisis, which affects the entire global supply chain. Secondly, empirical research in the personal protective equipment industry on supply chain risk management has not been explored in depth. This study uses HANDANHY as a case study and a survey of four personal protective equipment companies to collect primary data. It explores how commercial personal protective equipment suppliers can manage risk during emergency crises such as pandemics and how personal protective equipment supply chains can be optimised to make them more resilient.

However, no specific solution has been found, and a combination of strategies is required to become more robust and resilient. As the personal protective equipment supply chain is a complex and dynamic process, managers and decision makers of personal protective equipment companies should consider and analyze all realities. Awareness of supply chain risk management and a respectful attitude of supply chain risk management to managers and decision makers are also needed. They can then make the right risk mitigation and reduction decisions, optimizing costs and benefits. This paper provides a reference for companies in the personal protective equipment industry to rethink their supply chain risk mitigation strategies and better deal with disruption risks caused by similar pandemic crises in the future.

ACKNOWLEDGMENT

This study was funded by the China Scholarship Council.

REFERENCES

- Bidhandi, H., M. & Yusuff, R., M. (2011). *Integrated supply chain planning under uncertainty using an improved stochastic approach*. Applied mathematical modelling, 35 (6), 2618-2630.
- Christopher, M. & Peck, H. (2004). *Building the resilient supply chain*. International journal of logistics management, 15 (2), 1-14.
- Graebner, M., E. & Eisenhardt, K., M. (2007). *Theory building from cases: opportunities and challenges*. Academy of management journal, 50 (1), 25-32.
- Ho, W., Zheng, T., Yildiz, H. & Talluri, S. (2015). *Supply chain risk management: a literature review*. International journal of production research, 53 (16), 5031-5069.
- Rothan, H. & Byrareddy, S. (2020). *The epidemiology and pathogenesis of coronavirus disease (COVID -19) outbreak*. Journal of autoimmunity, 109, 102433.

- Sanam, F., Sepehr, G., Reza, R. & Seyed, H., T. (2020). *Governmental origin: why NTBFs grow in a transitional economy*. Economic Research-Ekonomska Istraživanja, 33, 379-398. Retrieved 2022, from https://www.researchgate.net/figure/Paradigm-model-of-Strauss-and-Corbin-Corbin-Strauss-2008_fig2_339544161.
- Sohrabi, C., Alsafi, Z., O'Neill, N., Khan, M., Kerwan, A., Al-Jabir, A., Iosifidis, C. & Agha, R. (2020). *World health organization declares global emergency: a review of the 2019 novel coronavirus (COVID - 19)*. International journal of surgery, 76 (2), 71-71.
- Supply Chain Risk Management (n.d.). *In Google*. Retrieved 2022, from <https://www2.deloitte.com/content/dam/Deloitte/cn/Documents/strategy/deloitte-cn-con-supply-chain-risk-management-zh-200304.pdf>.
- Tang, C. & Tomlin, B. (2008). *The power of flexibility for mitigating supply chain risks*. International journal of production economics, 116 (1), 12-27.
- Trkman, P. & McCormack, K. (2009). *Supply chain risk in turbulent environments - a conceptual model for managing supply chain network risk*. International journal of production economics, 119 (2), 247-258.
- Vilko, J., Ritala, P. & Edelman, J. (2014). *On uncertainty in supply chain risk management*. The international journal of logistics management, 25 (1), 3-19.
- Wuttke, A., Blome, C. & Henke, M. (2013). *Focusing the financial flow of supply chains: An empirical investigation of financial supply chain management*. Int. J. production economics, 145 (2), 773-789.
- Zhao, L., M. & Ye, X., E. (2022). *PPE Supply Chain Risk Management Under Pandemic COVID-19: A Case Study of Company WK*. Supply Chain Management, 3, 38-55 Retrieved 2022 from <https://d.wanfangdata.com.cn/periodical/CiFQZXJpb2RpY2FsQ0hJTmV3UzIwMjIxMDI0MjAyMjEwMjQSDmd5GdsMjAyMjAyMDAzGggzZXdsYmw3bg==>.