Analyzing the Implications of COVID-19 on Supply Chain Quality Management

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ABSTRACT

Purpose - Supply Chain Management (SCM) is one of the most important parts of business, which includes supply chain quality management (SCQM) and supply chain risk management (SCRM). One of the consequences of an epidemic outbreak can be a lack of reliable data and difficulty in accessing this information, which can simultaneously disrupt supply and demand. Because epidemics of infectious diseases such as Covid-19 cause many deaths worldwide. Therefore, in order to effectively control these epidemics and also to prevent the failure of health systems and laboratory services, having a quality management program and supply chain risk management seems to be essential. The main purpose of this article is to carefully review the studies that have analyzed the results of SCQM, SCRM techniques of different countries and industries in response to the COVID-19 crisis.

Design/methodology/approach - In this research, studies pursue and assess the problems and solutions based on a systematic literature review analysis.

Findings - By considering the researches which have been done related to disruptions of COVID-19, – important disruptions and risk management plans are mentioned to provide a better comprehension of this issue.

Research limitations/implications - Since this global pandemic is a completely new issue, analyzing and gathering reliable statics from companies was very a complicated task. In a different circumstance, exploring hidden disruptions costs and other related issues is continuing since thspread of this disease is not finished yet. Therefore, access to the related data for experts is limited that leads to publishing fewer case studies researches in this filed.

Originality/value – In this paper, the implication of the pandemic situation (COVID-19) is investigated for SCQM.

Keywords: Supply Chain Quality Management, COVID -19, Global Pandemic, Disruptions.

Paper type: Literature review

INTRODUCTION

In the competitive marketplace, supply chain management (SCM) is one of the significant parts of all business processes. Moreover, SCM involves challenges such as developing trust and collaboration among supply chain partners, identifying best practices that can facilitate supply chain process alignment and integration, and successfully implementing the latest collaborative information systems and Internet technologies that drive efficiencies, performance, and quality throughout the supply chain (Robinson and Malhotra, 2005).

Most companies expend specific plans to protect their strategic mission against unexpected problems during the supply chain process. By understanding the different dimensions of the interconnectedness of supply chain risks, decision-makers can create a coherence plan to reduce effective risks. Regarding the recent increasingly complex environment, Supply Chain Risk Management (SCRM) can adjust to improve financial performance and competitive advantage (Hauer, 2003). Risk management strategies are provided and important experiences to strategy selection that should be analyzed. Moreover, they argued that three moderators in the process of risk management are playing an important role which is team composition, supply chain complexity and inter-organizational learning (Manuj and Mentzer, 2008). The supply chain risks affect global supply chain decisions in different aspects; consumer-facing changes, converting the source of components that create the same functionality, and some changes that affect operational capabilities. Manuj and Mentzer (2008) identified that risk management in global supply chains leads to a reduction in loss, probability, speed, the frequency which harms the quality of the production process. In terms of supply chain perspective, the unreliable conditions or disruptions affect the flows of information, inbound materials, and products even by producer or supplier. In simple terms, supply chain risks refer to the possibility and effect of a lack of reality in the production plan which is dependent on demand and supply (Jüttner, Peck and Christopher, 2003). The term of risk sources could be organizational, environmental or supply chain-related variables that cannot be expected with certainty and that impact on the supply chain outcomes. SCRM is focused on supply chain outcome variables like quality or cost in different forms that the variance becomes visible that leads to managers to generate immediate plans and actions to overcome barriers. It should mention that one of the weakest faults in supply chain performance can happen in case when the facility recovery at different echelons in the supply chain is aligned in time. Meanwhile, the most negative effect on the performance is generated when long facility and demand disruptions downstream level regardless of the disruption period at the upstream level.

The consideration about the time of starting and the percentage of supply which is based on the origin region of factories is important, but the scale of the ripple effect should be analyzed precisely. Lücker et al. (2019), claimed that the observation of the simultaneous disruptions in demand and supply may have a positive effect on the Supply Chain performance as a reaction to an epidemic eruption. To some extent, these visions are partially in line and extending the existing body of knowledge on linked disruption in supply chain risk management.

One of the important reasons that decision-makers should handle is related to the lack of reliable data and the difficulty to achieve relevant data sets. Prasad et al. (2018) stated that the increasing capabilities for and consideration of data collection and retrieval provides the possibility to have usable big data for required operations. They added that in the humanitarian supply chain context different value stream plans require a wide range of data attributes which is based on their specific features. The simulation experiments can be one the practical tool to analyze the timing of the restarting firm´s activities at different stages become the main factor that determines the pandemic outbreak effects on the supply chain performance.

However, some factors such as lead-time, speed of epidemic propagation and downstream or upstream disruption in the supply chain process should be considered (Anparasan and Lejeune, 2018) Since Covid-19 is infectious diseases that cause a major of mortality, it is vital to have a plan of supply chain risk management to provide effective control with the quality management in the situation from the consequences of these disruptions. Accessible resources such as essential medical supplies and well-trained personnel need to be deployed quickly and to be managed in combination with available data and financial resources for containing the epidemic before it will expose more locations and people.

The main purpose of this article is to carefully review the studies that have analyzed the results of SCQM, SCRM techniques of different countries and industries in response to the crisis caused by COVID-19.

Supply Chain and Quality Management:

The emerging of quality management and SCM in manufacturing and services go back to the early 1970s (Shewhart and Deming, 1986). Robinson & Malhotra (2005) claimed that several research studies considered the different aspects of quality management within a supply chain perspective. Moreover, they examine that SCQM is one of the integrations of the business process in all organizations to evaluate and improve the products and services, as well as create value and satisfaction for end clients in the marketplace. Kuei et al. (2011) stated that empirical studies the reports from firms illustrates maintaining close relationships with suppliers tend to have the ability to

produce high-quality products. They designed and validated a global SCQM model through an empirical case study, strongly suggesting future research to incorporate sustainability dimensions into future SCQM modeling studies.

If the manufacturer knows that his purchasing order is being outsourced to the mainland of producers, the supply risk management strategies would have a different vision. In fact, suppliers often provide clear information about product quality risk than the main firm, since the private knowledge of suppliers is linked to the state of operations, quality in production and input sources (Tse and Tan, 2012).

Quality infrastructure and standards are important in ensuring the availability of key medical devices, diagnostic tests and personal protective equipment. “It is now very obvious that laboratory services by ensuring the accuracy and quality of laboratory-developed tests will increasingly provide an essential contribution to the diagnostic reasoning, managed care, and therapeutic monitoring the vast majority of human diseases” (United Nations, 2020).

Management of Pandemic Situation:

One of the outstanding risks for the supply chain process is pandemic diseases such as SARS and Covid-19. The coronavirus disrupts both demand and supply. Many companies believe that they have been suffering from a shortage of materials from suppliers especially those located in china and demand disruption in Europe which was seriously affected by Covid-19.

In these kinds of unstable situations, companies should make a specific plan to outbreak unexpected disorders. Ivanov (2020) argues that the plan of risk management should cover the following questions; how long SCQM can sustain a disruption, how long does it take. For a company to recover after an epidemic outbreak, which supply chain policy like the accepting the temporal shortages or reacting situational by changing the operation policies during the epidemic disease time, could be the most efficient solution to overcome with disruptions at a different stage of this complex situation. He stated that one of the case studies which were affected by SARS (Severe Acute Respiratory) and it caused negative subsequence into a wide range of industries sections in different counties. Singapore experienced it as the largest known outbreak of this virus in 2003, hit this country. The SARS virus infected around 8,500 people worldwide and caused around 800 deaths. The SARS epidemic brought about far-reaching public health economic consequences for the whole country.

As a positive aspect of an effective response to this issue, the outbreak was eventually limited via a series of risk-mitigating indexes illustrated by the Singapore government and practical participation of all Singaporeans. It should mention that this kind of risk-mitigating measures, depending on the

public´s compliance, were swiftly adjusted to address the volatile conditions –such as when more epidemiological cases were unclear (Lai and Tan, 2015).

RESEARCH METHODOLOGY

This research study will pursue and assess based on a systematic literature review analysis. The question of this research is "What are the main implications and challenges of Covid-19 on SCQM?" The systematic literature review conducted in this research has as its main objective of the most recent relevant and significant research of Covid-19 and similar pandemic situation to provide a framework of implications and challenges to SCQM. A five-step process is considered in this research after defined aspects for this paper, the selection of the articles was specified. Figure. 1 presents a schematic overview of the research methodology. The first step examined the research questions based on the research gap found by literate review. These keywords were searched in all databases considering related literature. The third step is related to the screening process which after analyzing the titles of all resulting papers from the initial search, in a first iteration, only seventeen papers were identified. However, in the fourth step after critically reading the identified nine papers entirely in a second iteration. Finally, in the fifth step, six papers relevant to this research were determined the relevant literature for this critical review paper. The limited number of relevant papers and this new pandemic situation indicate the novelty of the topic. The analysis and synthesis of the results were undertaken breaking down each study in the year of publication and special notes. Finally, a discussion section regarding the main findings was undertaken and a novel comprehensive framework was proposed as a result of this review analysis.

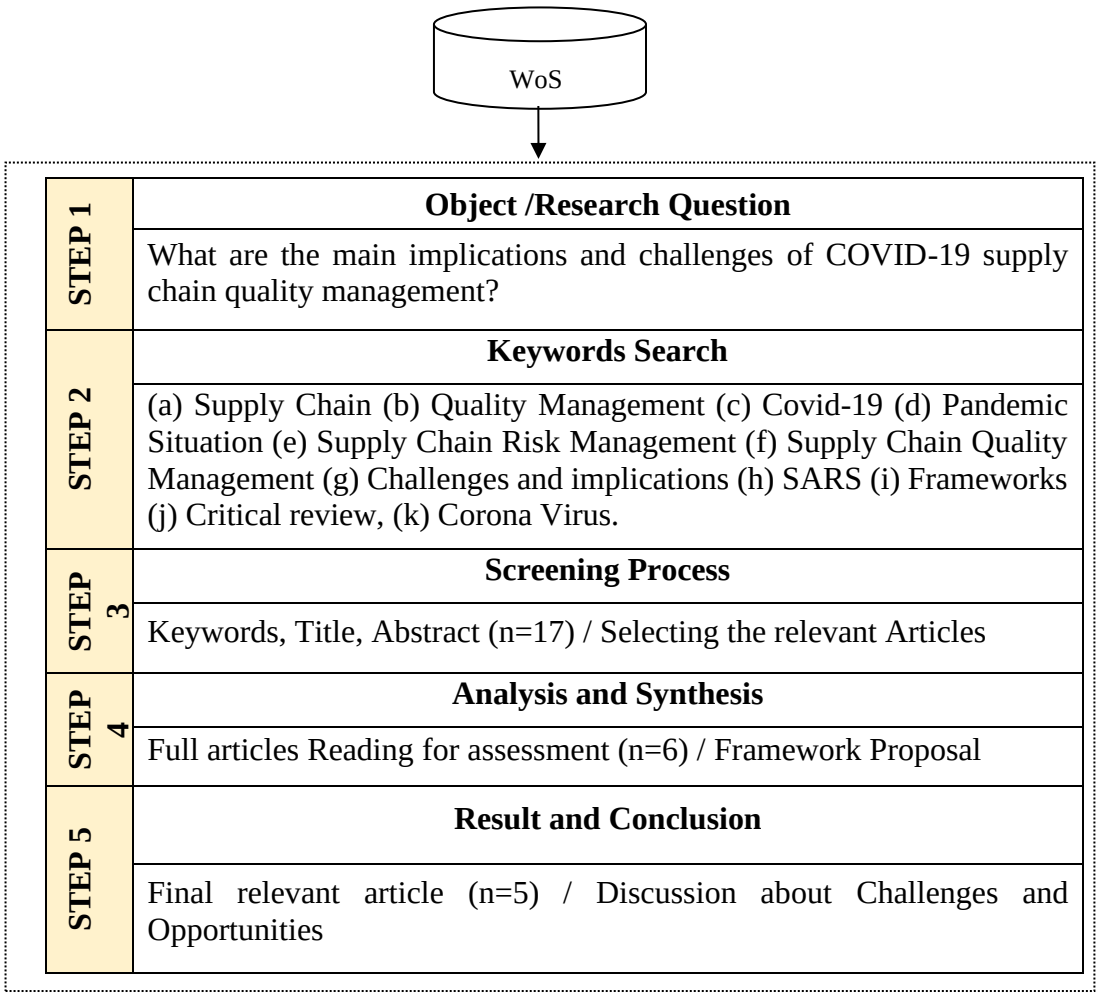


Figure 1- Schematic for Methodology adopted in this Paper.

RESULTS AND DISCUSSION

The studies illustrate that clear situation of supply chain disruption some statistics of Covid-19 pandemic problem which are presented in the following:

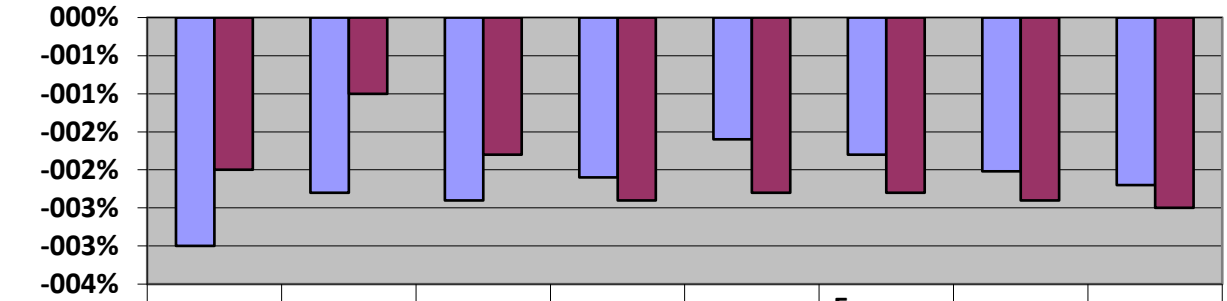
"Maersk" one of the biggest logistics companies in the world, has had to decline many of container ships, while that chines factories have been operating 50-60 % of their capacity. On the other hand, shipping goods to Europe from Asia through seas takes about five weeks, therefore goods belong to previous orders are still getting to ports that lead to over inventory costs. The international chamber of shipping states that Covid-19 is led to losing $350m a week. Companies have been forced to reduce 350 000 containers and it was 49% fewer sailing by container ships from China during mid-January and mid-February (Baldwin & Mauro, 2020; Chetty, Friedman, Hendren, & Stepner, 2020)

Simultaneously, ports and terminals are facing the same time an outstanding drop in income, mostly from extra costs in yard congestion due to buildup of empty containers and requests from companies to waive storage costs based on these special situations. In other sections like airlines industries, the worrying statistic is clear; IATA (International air transfer association) estimates that the aviation

industry could face a loss of 29 million US dollars of passenger revenues (Iacus, Natale, Santamaria, Spyratos, & Vespe, 2020)

To reduce and reduce the impacts of COVID-19, lockdown is mostly linked to the number of countries striking restrictions since the losses are more sensitive to the duration of lockdown than its strictness. Meanwhile, a longer containment that can eliminate the disease imposes a smaller loss than shorter ones, on the other hand in the earlier stage, minor lockdown can minimize overall losses. (Guan *et al.*, 2020) state that a ´go-slow´´ approach to lifting restrictions may reduce overall damages if further lockdown won't be required. Base on this strategy, this difficult situation of the global supply chain will expand value losses through the direct effects of COVID-19. Therefore, risk management as a public requires that collective efforts and support to lower-capacity zones is a noticeable effort.

To provide more details of the effects of Covid-19 on industries of different countries figure.2 and figure.3 are illustrated.



	China	Japan	Korea	Best of developing asia	United States	European Union+Uk	Latin America	World Total
GDP	-003%	-002%	-002%	-002%	-002%	-002%	-002%	-002%
EXPORT	-002%	-001%	-002%	-002%	-002%	-002%	-002%	-003%

Figure 2 - Effects of Covid19 on GDP and Export adopted by (Maliszewska, Mattoo and Mensbrgghe, 2020).

Maliszewska, Mattoo and Mensbrgghe (2020) argue that exports at a worldwide level will be decreased around 2.5%. China, as a world´s factory, suffers a decline in the production process in different sectors because of the underutilization of labor and capital. Moreover, the increase in trade costs leads to the import budgets for all countries affected global exports. It is shown that China is dealing with a contraction in export by 3.7%. Vietnam faced a decline in its total exports by only 1% since it has a chance to an extent from the gap left by reducing Chinese esports. Other countries in East Asia and Pacific region have been affected by decreasing the export such as Hon Kong SAR,

China suffering the noticeable percentage (5.2%), followed by the Lao People´s Democratic Republic (3.6 %), Cambodia (3.9 %) and Singapore (4.4 %).

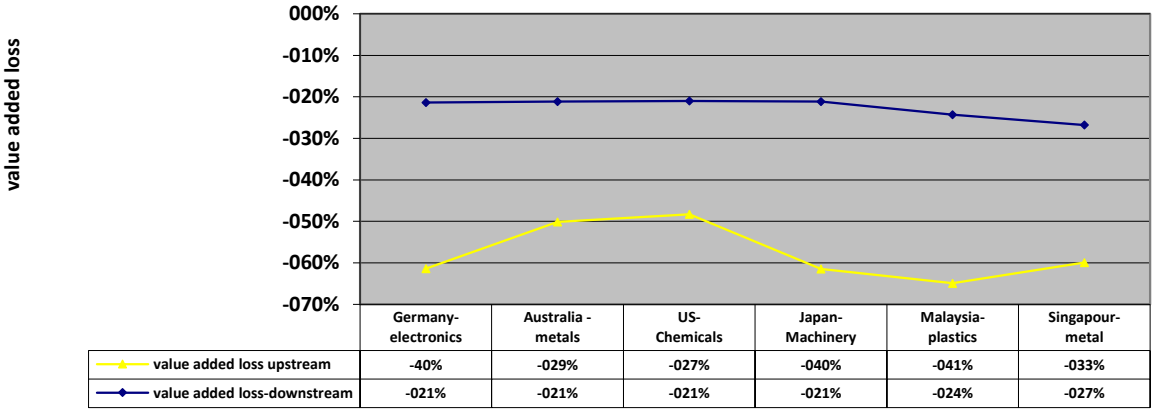


figure 3 - Impacts of Covid-19 adopted by (Guan et al., 2020).

The effect of disruption from different suppliers which are related to the German automobile industry is a suitable case to review the effects of disruption which is caused by Covid-19. Since this problem has massive impacts on different industries all around the world, therefore highly specialized suppliers that make a short-term substitution to recover deviation in different aspects of productions. As Fig.2 shows, some Value-add loses percentage that has affected from electronics suppliers on different European producers. According to theses statics among mentioned countries, Germany affected in major volume by -40% in the added value stream that results in a value-added loss in USA producers as upstream producers. In similar conditions, Malaysia lost 40 % of its value-added and has reciprocal around -24.3% on UK producers. According to ACAP (Automobile Association of Portugal) in March 2020 13,686 light passenger vehicles were produced which is 47.1 % is less than March 2019. It should mention that there is 18.3 % decrease in the total amount of all kinds of automobile productions in Portugal, regarding 77,204 units manufactured, with decreases to 20.5 %,4.5% and 36.4 % in the production of passenger cars, light commercial vehicles and heavy vehicles, respectively in comparison to the first quarter in 2019 (García-Olivares, Solé, Samsó, & Ballabrera-Poy, 2020)

In the recent decade, the nature of SCM dependencies has been changed sharply. Firms are encouraged to expand relationships with suppliers and customers to decrease disruptions during unexpected issues. Simultaneously, companies have also been adopted to follow Quality Management

(QM) tools and techniques if they wish to survive and remain validity and credibility of firms during the epidemic´s outbreak period (Dasaklis, Pappis and Rachaniotis, 2012).

To manage the disruption of this destructive phenomenon, certain control protocol should be stated for suppliers along with human resources and be available to be applied to reduce the containment effort. In terms of control of effects of Covid-19 on SC process, the establishment of an emergency supply chain as a plethora of logistics issues is increased regarding the management strategy adopted and the agent causing the unexpected effects. To have coherence supply chain quality strategies that be able to reduce effects of unexpected situations it should be noted that the ability to change production volumes rapidly, quality and long-term relationships with a different type of suppliers is an important issue. Besides, the quality flexibility and minimum order are two vital factors in terms of risk management for both producers and retailers. Due to demand uncertainty, a manufacturer would prefer contracts that would retailers to commit their orders, meanwhile, a retailer would prefer contracts that would allow them to adjust their orders when necessary (Tang, 2006). Regarding the lack of access to correct statics in results of Covid-19 on industries and economics, envisage model is proposed and configured based on the following assumption (Maliszewska, Mattoo and Mensbrgghe, 2020):

- Production elasticities have been reduced to around zero, therefore it is possible excess inputs in production.
- In order to get the strong relationship within global value chains, trade flexibility for products has been decreased from their standard values to illustrate the short-run inability to swap imported parts and final goods with products from other zones.
- Labor requirements are an important factor since the wages are deepened to demand and supply of labor.

In order to illustrate the importance of Quality Management role in responding to the impacts of Covid-19, figure 4 is illustrated .

Issues	**Plans**
The number of infected people increases exponentially, while adequate medical equipment is rare	Reliable results of medical laboratories by conducting tests to detect the virus.

Global trade contracts, while trade of medical equipment improves	Improving Trade Formalities as a vital role in remaining the availability of required medicines, medical products and protective tools
Businesses worldwide struggle to keep up the production of essential goods	Apply mandatory Standards to ensure that good produced in the response of Covid-19 such as masks, gloves to be fitted for people
Additional medical and perilous waste is generated	Standards help to manage increased dangerous waste by detect pollution levels
Millions of people around the world depend on global trade for their food requirements	Trade with global value chains to ensure the worldwide supply of required materials, while hygiene practices and food safety standards are an important factor to ensure global supply chain in food sectors.

figure 4 – Impacts of COVID -19 and responses

Since there is few of researches related to the COVID-19 and its effects on industries have been published and reliable statics from companies is not accessible which is based on companies' policies, it is suggested to mention solutions to the declined effects of this pandemic problem in a supply chain process. Hence, information from literature reviews and summaries of them in fig4 help to gather risk management techniques against to impacts of COVID-19.

CONCLUSIONS

The global pandemic like COVID-19 requires coherence urgent response from all departments of organizations and firms in all countries. The disruption impacts not just on public health but also on finance, trade, economic policies, and regulations. The goal of this paper is to carefully review the studies that have analyzed the results of SCQM, SCRM techniques of different countries and industries in response to the crisis caused by COVID-19. The reviewed literature that focuses on quality and risk management provides further insights on practices, performance measurement by relying on statistics. Since the effects of the pandemic problem on different aspects of industrial activities are not recognized completely so it is suggested that merging the TQM (total quality management) tools with formal process improvement methodologies can process-oriented could and lead to building the reliable path to for continual improvements in terms of quality of products and services. Since there is missing research on effects of Covid-19 on supply chain quality management

in more details, this paper suggests effective responses by reviewing similar cases, but it is vital for further research by using quality tools in more details and updated data in a specific area such as reviewing cooperation between suppliers and producers and propose a coherence model.

REFERENCES

Anparasan, A. A. and Lejeune, M. A. (2018) 'Data laboratory for supply chain response models during epidemic outbreaks', *Annals of Operations Research*. Springer US, 270(1–2), pp. 53–64. doi: 10.1007/s10479-017-2462-y.

Baldwin, R., & Mauro, B. W. d. (2020). Economics in the Time of COVID-19: CEPR Press.

Chetty, R., Friedman, J. N., Hendren, N., & Stepner, M. (2020). Real-time economics: A new platform to track the impacts of COVID-19 on people, businesses, and communities using private sector data. *NBER Working Paper, 27431*.

Dasaklis, T. K., Pappis, C. P. and Rachaniotis, N. P. (2012) 'Epidemics control and logistics operations: A review', *International Journal of Production Economics*. Elsevier, 139(2), pp. 393–410. doi: 10.1016/j.ijpe.2012.05.023.

Guan, D. *et al.* (2020) 'Global supply-chain effects of COVID-19 control measures', *Nature Human Behaviour*. doi: 10.1038/s41562-020-0896-8.

Hauer, L. M. (2003) 'RISK-ADJUSTED SUPPLY CHAIN MANAGEMENT', *Supply Chain Management Review*, 7(6), pp. 67–71.

Iacus, S. M., Natale, F., Santamaria, C., Spyratos, S., & Vespe, M. (2020). Estimating and projecting air passenger traffic during the COVID-19 coronavirus outbreak and its socio-economic impact. *Safety Science*, 104791.

Ivanov, D. (2020) 'Predicting the impacts of epidemic outbreaks on global supply chains: A simulation-based analysis on the coronavirus outbreak (COVID-19/SARS-CoV-2) case', *Transportation Research Part E: Logistics and Transportation Review*. Elsevier, 136(March), p. 101922. doi: 10.1016/j.tre.2020.101922.

Jüttner, U., Peck, H. and Christopher, M. (2003) 'Supply chain risk management: outlining an agenda for future research', *International Journal of Logistics Research and Applications*, 6(4), pp. 197–210. doi: 10.1080/1367556031000162701 6.

Kuei *et al.* (2011) 'Developing global supply chain quality management systems', *International Journal of Production Research*. Taylor & Francis Group, 49(15), pp. 4457–4481. doi:

10.1080/00207543.2010.501038.

Lai, A. Y. and Tan, S. L. (2015) 'Resilience and Recovery in Asian Disasters', *Resilience and Recovery in Asian Disasters*, pp. 309–336. doi: 10.1007/978-4-431-55022-8.

Lücker, F., Seifert, R. W. and Biçer, I. (2019) 'Roles of inventory and reserve capacity in mitigating supply chain disruption risk', *International Journal of Production Research*. Taylor & Francis, 57(4), pp. 1238–1249. doi: 10.1080/00207543.2018.1504173.

Maliszewska, M., Mattoo, A. and Mensbrgghe, D. (2020) 'The Potential Impact of COVID-19 on GDP and Trade A Preliminary Assessment', *Policy Research Working Paper*, 9211(April), pp. 1–24.

Manuj, I. and Mentzer, J. T. (2008) 'Global supply chain risk management strategies', *International Journal of Physical Distribution and Logistics Management*, 38(3), pp. 192–223. doi: 10.1108/09600030810866986.

García-Olivares, A., Solé, J., Samsó, R., & Ballabrera-Poy, J. (2020). Sustainable European Transport System in a 100% Renewable Economy. *Sustainability, 12*(12), 5091.

Prasad, S., Zakaria, R. and Altay, N. (2018) 'Big data in humanitarian supply chain networks: a resource dependence perspective', *Annals of Operations Research*. Springer US, 270(1–2), pp. 383–413. doi: 10.1007/s10479-016-2280-7.

Robinson, C. J. and Malhotra, M. K. (2005) 'Defining the concept of supply chain quality management and its relevance to academic and industrial practice', *International Journal of Production Economics*, 96(3), pp. 315–337. doi: 10.1016/j.ijpe.2004.06.055.

Shewhart, W. A. and Deming, W. E. (1986) *Statistical Method from the Viewpoint of Quality Control*. Dover Publications (Dover Books on Mathematics Series). Available at: https://books.google.pt/books?id=ALGbNNMdnHkC.

Tse, Y. K. and Tan, K. H. (2012) 'Managing product quality risk and visibility in multi-layer supply chain', *International Journal of Production Economics*. Elsevier, 139(1), pp. 49–57. doi: 10.1016/j.ijpe.2011.10.031.