The Important of Supply Chain Resilience During Covid-19 Pandemic For Enterprise Risk Management: A Systematic Literature Review

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Abstract. During the Covid-19 pandemic, supply chain resilience becomes promising possibilities to mitigate enterprise from disruption risk. For this reason, this paper comprehensively presents a systematic review of the recent technological progress in the presence of supply chain resilience while addressing the important link between supply chain risk and enterprise business. Practitioners and researchers can benefit from our survey since it introduces a structure analysis and recommendations as to which key drivers of the supply chain resilience can be used at different types of enterprises regarding the property of risk management. The implications and limitations of existing supply chain resilience literature are also discussed.

Keywords: Covid-19 pandemic, supply chain resilience, enterprise business, risk management, literature review.

1 Introduction

At the enterprise level, the Covid-19 pandemic has impacted disruptions in the nature of work. It is related to its influences on changing uncertainties demands, unavailability of transportation services, loss of key supplies, and unstable quality of supplies [1]. Therefore, an enterprise needs to overcome the disruption risks by enabling appropriate resilient approaches in the sector of supply chain management [2]. Managers of enterprises should pay attention to restructuring the global supply chains for the sake of pandemic disruption risk mitigation. To the best of our knowledge, it does not exist a detailed literature review that addresses the important link between supply chain risk and enterprise business in real world during the Covid-19 pandemic, whereas many applications of supply chain resilience using quantitative or qualitative research approach are conducted across the world. So, it is important to recognize the enablers of resilient supply chains in the 'new normal' setting that have led to the specific type of enterprises.

Enterprise Risk Management (ERM) aims management integrating to all risks faced by an enterprise including alignment of risk management with enterprise governance and overall strategy [3]. The topic of ERM covers internal control, internal audit and enterprise governance. As ERP also including SCM, then it provides SCRM. In SCRM literature, it covers risk identification, assessment, treatment, and monitoring [4]. Fan et. al. [4] review supply chain risk management in term of definition, theory, and research agenda. There are other literature reviews in SCRM such as trends and applications of SCRM towards resilience analytics [5], review of its phenomenon [6] and specific to quantitative modelling of SCRM [7].

ERM allows managers to shape the enterprise's overall current risk level based on a particular business process [8]. An enterprise needs to manage risk holistically to link risk management with the financial and business objectives of the firm [9]. A better understanding of the ERM during the Covid-19 pandemic may assist managers in changing to better mitigation in the special case of the pandemic disruptions. ERM has many domains such as risk management planning or strategy, marketing risk, production risk, human resource risk management, insurance risk management, and supply chain risk. The objective of this study is to extend the understanding of supply chain risk domain by providing a summary of empirical literature review in the last three years, or since the Covid-19 outbreak began around the world.

With the spirit of establishing resilient mitigation towards the pandemic disruption risk, research on SCR nowadays is rapidly increased [1], [10], [11]. Enterprise supply chain risk management can play a critical role in improving business performance from the moment a new product is conceived until its end of life [9]. This paper examines gap analysis of 31-selected high-quality journal papers, and then we considered five context variables; continental region of operation, enterprise type, SCR key driver, supply chain risk, and contribution to SCR knowledge. This study is important for researchers, practitioners, and decision-makers since the review introduces a structured analysis and recommendations as to which key drivers of the supply chain resilience can be used at different types of enterprises regarding the property of risk management.

The rest of this paper is organized as follows: Section 2 explains the technical review of the paper. Section 3 summarises insights on the supply chain risk and mitigation. Finally, section 4 provides the conclusion and direct future research.

2 Methodology

Kitchenham [12] proposes a systematic literature review by compiling; the research question, article selection and evaluation, exclusion and inclusion criteria, cross-checked and validation, and synthesis of the selected articles. Hence, for gaining a better insight, this paper adapts Kitchenham [12] literature review method, as shown in Figure 1.
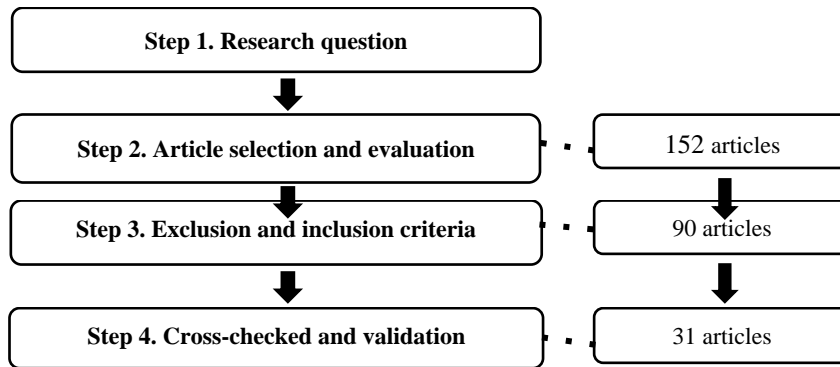
Fig. 1. The flowchart of literature-review methodology adapted from Kitchenham [12].

2.1 Research Question

Following the motivation of the existing works of literature, this study considers four research questions to guide our literature review studies and to synthesize the research findings:

- Which operation research approaches are most used?

- What types of enterprise have been considered when addressing supply chain resilience?

- What risk domains have been related in enterprise risk management?

- What have key drivers of supply chain resilience been suggested during Covid-19?

2.2 Article Selection and Evaluation

Firstly, to ensure the high quality of this review paper, peer-reviewed journal articles are performed on the Web of Science (WoS) database. The search process in the WoS database should be under the term of "supply chain resilience" and "Covid-19". After the process of selection and evaluation, the total selected articles are 152 as shown in Table 1 for details. These articles were available on the web for the authors through traditional search engines.

Table 1. Web of Science database in terms of 'Supply Chain Resilience' and 'Covid-19'.

Term	Science Direct	Taylor & Francis	IEEE *Xplore*	Springer Link	Emerald Insight	Wiley	MDPI
"Supply Chain Resilience" AND "Covid-19"	109	7	3	19	9	3	2

2.3 Exclusion and Inclusion Criteria

In addition, to ensure the articles were significant for the field, all the English language publications found should be under the listed inclusion and exclusion criteria in Table 2. Of the 152 publications from the WoS search, 90 publications met the requirements. The selected articles must be published within 2020-2022, which states the period time of the Covid-19 outbreak spreading across the world.

Table 2. Inclusion and exclusion criteria for the systematic literature-review.

Inclusion Criteria	Exclusion Criteria
Research journal articles	Proceeding papers
Empirical studies	Literature reviews, theories
Published from WoS database	Duplicated studies
Written in English	Non-English
Published within 2020-2022	Out of the period time

2.4 Cross-Checked and Validation

Finally, the 90 articles were screened for relevance, yielding 31 articles. This ensured that only publications that specifically address supply chain resilience were analyzed. Cross-checked and validation are needed to see how many articles have answered the research questions defined above. The 31 selected articles are the most relevant to this study, as shown in Table 3 along with the list of academic journal publishers.

Table 3. List of academic journal publishers.

Academic Journal Publication	WoS Database	Source
Trends in Food Science & Technology	ScienceDirect	[11]
The Journal of Production Economics	ScienceDirect	[13], [14]
Technological Forecasting & Social Change	ScienceDirect	[15]
Transportation Research	ScienceDirect	[16], [17]
Omega - International Journal of Management Science	ScienceDirect	[18]
Journal of International Management	ScienceDirect	[19]
Technology in Society	ScienceDirect	[20]
Journal of Purchasing & Supply Management	ScienceDirect	[21]
Research in Transportation Economics	ScienceDirect	[22], [23]
Computers & Industrial Engineering	ScienceDirect	[24]
Industrial Marketing Management	ScienceDirect	[25]
Agricultural Systems	ScienceDirect	[26]
Journal of Business Research	ScienceDirect	[27]
Engineering Management Review	IEEE *Xplore*	[28]
Transactions on Engineering Management	IEEE *Xplore*	[10]
Journal of Operation Management	Wiley	[29]
Applied Economic Perspectives and Polict	Wiley	[30]
Benchmarking: An International Journal	Emerald Insight	[31], [32]
Modern Supply Chain Research and Applications	Emerald Insight	[27]
Supply Chain Management: An International Journal	Emerald Insight	[33]
International Journal of Operations & Production Management	Emerald Insight	[34]
The International Journal of Logistics Management	Emerald Insight	[35], [36]
Operation Management Research	SpringerLink	[37]
Information Systems Frontiers	SpringerLink	[38]
International Journal of Production Research	Taylor & Francis	[39]
Sustainability	MDPI	[40]

The increase of development of related research in the last three years indicates that this research area got high attention from academicians for incoming research. Figure 2 shows an outstanding development of the reviewed publications from 2020 to 2021, while 2022 is still going on. It is expected more relevant studies to appear this year, especially from these journal publishers.
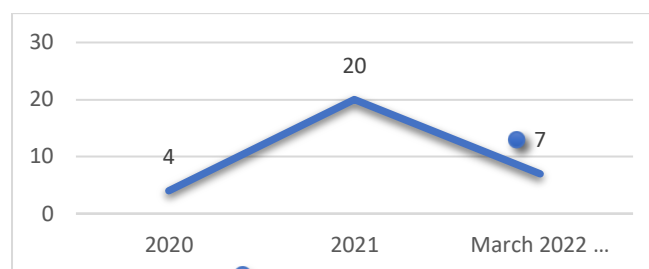

Fig. 2. Development of related research during Covid-19 outbreak.

2.5 Synthesis of the Selected Articles

At the last stage, we synthesize the selected articles to gain a deeper analysis. Table 4 highlights a summary of review findings emphasizing contribution to the SCR literature. This will bring a deeper analysis in the next section that should answer the defined research questions above. This sub-section is important due to understanding the essence of each article to be guidelines for authors in reviewing the whole literature review.

Table 4. Summary of the selected articles' synthesis.

No	Contribution to SCR Literature	Type of Enterprise	Source
1	AI-enabled framework	e-Commerce	[35]
2	Intelligent platform		[29]
3	Decision-making guideline	Food Industry	[11]
4	Innovation approach		[30]
5	Exploratory study of food supply chain		[32]
6	Positive deviance approach framework		[38]
7	Food supply chain framework		[25]
8	Conceptual model of dairy cattle farms		[26]
9	Operational capability framework		[37]
10	Scenario-based model of food retail		[16]
11	Conceptual model of food industry		[1]
12	Supply chain networks	Goods, Equipment and Retail	[36]
13	Supply chain risk management (SCRM) framework		[13]
14	Industry 4.0-enabled strategy		[15]
15	Scenario-based model of equipment company		[17]
16	Conceptual model of manufacturing firms		[34]
17	Multi-portfolio approach & scenario-based model		[18]
18	Conceptual model of retail company		[20]
19	Conceptual model of general companies		[31]
20	Capability and vulnerability framework		[27]
21	Best-practice framework		[28]
22	Conceptual model of logistics companies	Transportation and Logistics	[19]
23	Conceptual model of global supply chain		[14]
24	Economic risk and resilience efficiency metric		[23]
25	Conceptual model of medical devices	Medical and	[39]

26	Exploratory study of healthcare supply chain	Pharmaceutical	[33]
27	Supply chain capability framework		[10]
28	Technological integration tools		[40]
29	Novel flows of medical supplies		[21]
30	Healthcare supply chain framework		[22]
31	Multi-objective optimization framework		[24]

3 Result and Discussion

The research question in this review is addressed as defined in sub-section 2.1. In order to find the answer, this section considers; operation research approach, study location of the type of enterprise, supply chain risk domain, and resilient enabler of the supply chain. Overall, our review of empirical advances shows that there is a strong relation between enterprise business and supply chain risk in establishing a resilience from disruption risks of the Covid-19 pandemic.
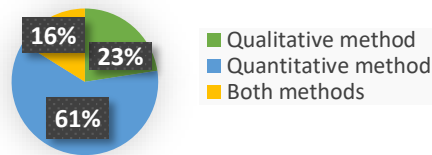
3.1 Operation Research Approach

Fig. 3. Research method used.

Based on our literature reviews, all studies have employed qualitative or quantitative methods to provide empirical evidence regarding supply chain resilience during the Covid-19 pandemic. As shown in Figure 3, most of the studies used survey method, followed by experimental method and both methods; 61%, 23%, and 16%, respectively. It indicates that this research area dominantly uses quantitative approach in collecting data.
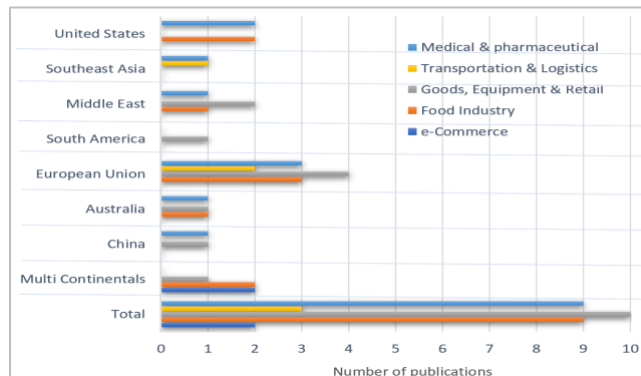
3.2 Study Location

Fig. 4. Regions of the empirical studies.

Due to enterprise business related to supply chain management, it is interesting to provide specific geographical regions or countries from the empirical studies. Figure 4 shows regions of application of supply chain resilience in different settings of the enterprise type. European union dominantly applied key drivers of resilience for specific supply chain context of medical and pharmaceutical, transportation and logistics, goods, equipment and retail, and food industry.

3.3 Supply Chain Risk

Literature reviews in Table 5 support the argument that specific enterprises with better supply chain risk are better positioned to become more resilient against disruption [36].

Table 5. Type of enterprise related to supply chain risk management.

Type of Enterprise	Risk Domain	Supply Chain Risk	Source
e-Commerce	Technology	Increase transparency across supply chain partners.	[35]
	Operational	Avoid supply chain disruption in a large-scale.	[29]
Food Industry	Operational	Optimize resource allocation of foods.	[11]
	Legal/regulatory	Respond to market demand and policy changes.	[30]
	Human capital	Utilize resources from external partners.	[32]
	Operational	Avoid demand-supply mismatch and unfair prices, and increase quality of data transparency.	[38]
	Human capital	Leverage dynamic capabilities and frugal innovation for reducing disruption.	[25]
	Strategy	Promote buffer and adaptive capacity at supply chain level.	[26]
	Operational	Minimize risk of reverse logistics.	[37]
	Technology	Efficient contingency plans to prevent or recover disruptions.	[16]
	Human capital	Balance between domestic and global business partners.	[1]
Goods, Equipment and Retail	Operational	Ensure an ease and effectiveness to access information.	[36]
	Human capital	Increase information process to deal with uncertainty.	[13]
	Financial	Provide short-and-long term risk mitigation.	[15]
	Operational	Mitigate inventory, lead-time and backup suppliers.	[17]
	Human capital	Increase risk perception of managers' motivation.	[34]
	Hazard	Recovery of supply chain under propagated regional disruption risks.	[18]
	Technology	Manage supply chain risk for large company.	[20]
	Operational	Minimize critical gap in high disruption context.	[31]
	Operational	Recovery after disruptions.	[27]
	Operational	Respond to manufacturing risk of high uncertainty, increasing propagation, and long-term disruption.	[28]
Transportation and Logistics	Human capital	Respond to unpredictable negative events.	[19]
	Operational	Decisive approach to respond to huge disruptions.	[14]
	Financial	Assess global supply chain in vulnerability level.	[23]
Medical and Pharmaceutical	Human capital	Increase awareness of severe shortages of medical products.	[39]
	Human capital	Recovery and future-readiness phases.	[33]
	Human capital	Manage disruption from supply-side, production-side, and demand-side.	[10]

|		
Technology	Assess impact of environmental uncertainty.	[40]
Operational	Improve medical supplies availability and enable higher supply security.	[21]
Operational	Reduce reliance on the design of the supply chain, and track the usage of necessary medical supplies.	[22]
Financial	Trade-off between cost minimization and service level maximization.	[24]

3.4 Key Drivers of Resilience in Supply Chain
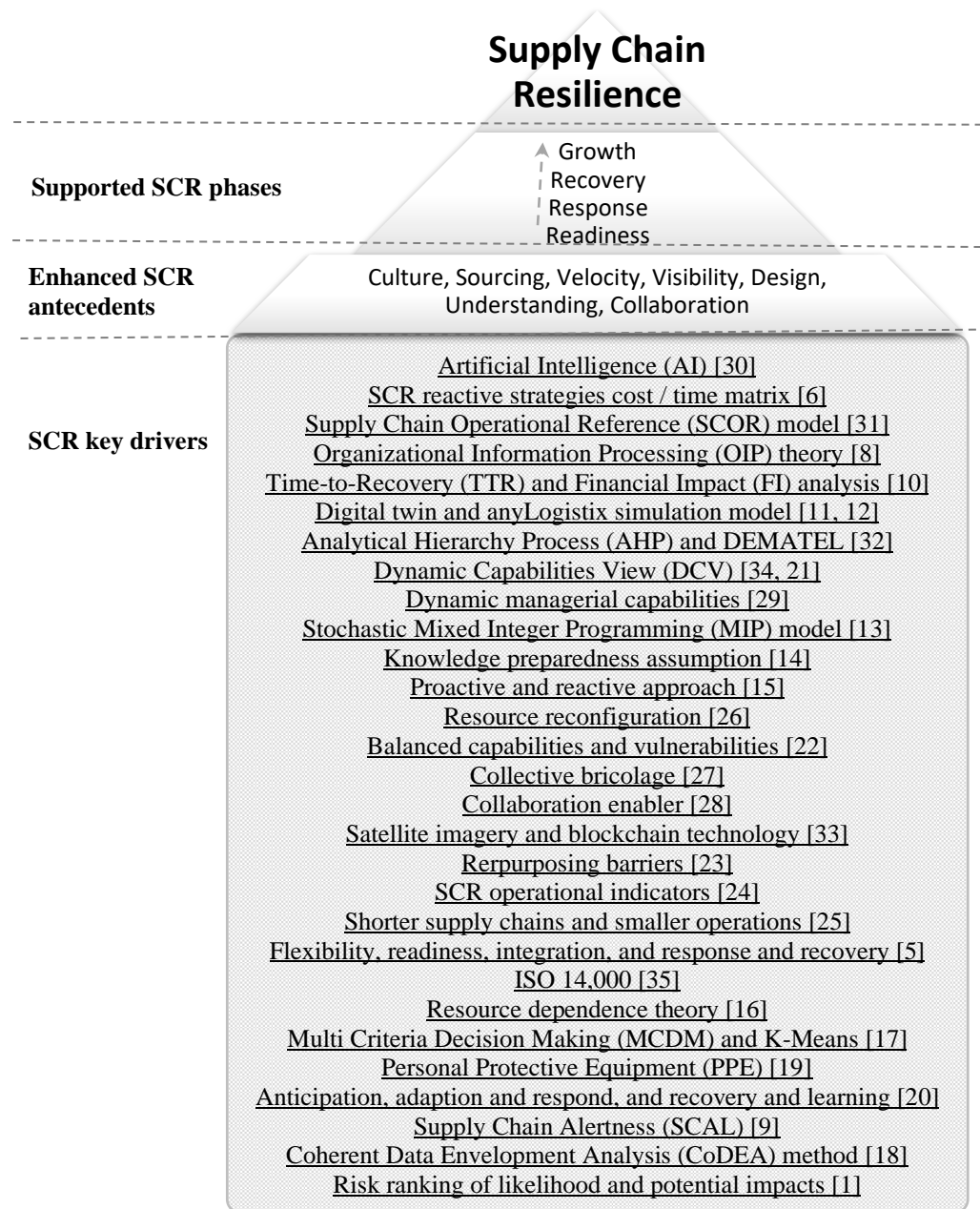
Fig. 5. Key drivers of SCR with framework adapted from [2].

Figure 5 shows a pyramidal SCR framework adapted from [2]. Spieske [2] introduced antecedents of SCR and phases in supporting SCR implementation. However, the literature review focuses only on Industry 4.0 (I4.0) enabler technologies. In this context, we elaborate I4.0 enabler with technologies-and-strategies used as key, so-called key drivers in enabling supply chain resilience. As we can see the list of enablers from Figure 5, we also address I4.0 enabler as key driver of SCR, that is, Artificial Intelligence [35] and Blockchain Technologies [38]. Therefore, our framework is summing up all current emerging technical progress for embracing the resiliency of supply chain network.

We figure out that key driver of SCR is from different sources of research domain such information system theory, soft computing, decision support system, industry 4.0, mathematics, financial analysis, learning system, behavioral organization, regulatory and policy, and international standardization. These SCR enablers then enhance SCR antecedents to facilitate achieving SCR phases; readiness, response, recovery, and growth [2]. Finally, the highlighted trends are under constraint of the Covid-19 pandemic. The critical foundation of resilience analytics is which SCR enablers are used for improving resilience altogether, mitigating disruption risks [5].

4 Conclusion

Embracing resilience in supply chain network is tremendously important in order to reduce or even to avoid disruption risks of the increase of uncertainty, magnitude, and unavailability demands from the Covid-19 pandemic [41]. This research reflects a wide view of the literature review about resilience key drivers of supply chain in the shape of Spieske [2] framework, while there is no such complete picture of predecessor literature review. Our pyramidal framework recognizes that the majority of reviewed articles have analyzed the relationship between type of enterprises and supply chain risk. Based on a systematic review setting, we selected 31 journal articles to be representative of our research question over the period 2020-2022.

4.1 Managerial Implications

Our SCR framework leads to practitioner and researcher implications. Firstly, the empirical findings are based on developed and productive countries. So, this review paper can serve researchers to conduct potential object locations and to explore research gap related to enterprise business and risk management. Secondly, the practitioners can leverage our framework to choose appropriate SCR enablers when noticing specific enterprise types. They can identify across continents what risk management advances influence to their firm performances.

4.2 Limitations and Future Research Directions

Limitation of this study could be that it only uses articles from Web of Science index. The findings might be better if one includes all the studies of all database index. Also, the methodology used for systematic literature review is only from one reference, whereas the existing review process methods could be more effective as it will enlarge the knowledge. Given the findings, the paper lists future research directions. We consider to manifest Artificial Intelligence analysis in the context of SCR regarding plenty of tools or methods of AI available. Also, the problem of SCR determinants on the example of developing countries is insufficiently

addressed, looking at majority empirical perspectives from productive countries. This study opens to academicians from interdisciplinary research areas to dig deeper by taking benefit from this literature review for future research.

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