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SYSTEMATIC REVIEW

The implications of Industry 4.0 on supply chains amid the COVID-19 pandemic: a systematic review [version 1; peer review: 2 approved with reservations, 1 not approved]

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Abstract

Background: COVID-19 has caused significant disruptions in supply chains. It has increased the demand for products and decreased the supply of raw materials. This has interrupted many production processes. The emerging technologies of Industry 4.0 have the potential to streamline supply chains by improving time-sensitive customized solutions during this emergency.

Purpose: This research examines the effects of the epidemic on supply chains and how these effects are reduced through Industry 4.0 technology.

Design/methodology/approach: An extensive literature review using the "Preferred Reporting Items for Systematic Review and Meta-Analysis" method was carried out on the impact of the COVID-19 pandemic on supply chains and Industry 4.0 technologies. The study was undertaken by selecting keywords validated by experts and a search was conducted in the Scopus, ProQuest, and Google Scholar databases. Publications from the leading journals on these topics were selected. The bibliographical search resulted in 1484 articles followed by multiple layers of filtering. Finally, the most pertinent articles were selected for reviewing, and a total of 53 articles were analysed.

Findings: This study discusses the impact of COVID-19 on the supply chain and how the emerging technologies of Industry 4.0 can help manufacturers to ease the impact. These technologies will enhance the production system through the automation and optimization of production flow convergence, enabling efficiencies and improvements among the suppliers, manufacturers, and consumers in the COVID-19

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Approval Status

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situation.

Originality/value: The study summarizes the impact of the COVID-19 on supply chains and shows the potential of Industry 4.0 technologies to lessen the impact on manufacturing supply chains. This is valuable information for policymakers and practitioners so that they can get insights and take necessary actions.

Keywords

Industry 4.0, emerging technologies, supply chain, COVID 19, Systematic Literature Review

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Introduction

The COVID-19 pandemic has already had a crucial impact on human health as well as countries' economies. Supply chains in various industries have been under tremendous pressure to avoid considerable disruptions in their operations.³ COVID-19 has also affected every member of the supply chain process.^{56,58} The failure of many nations and businesses to deal with the COVID-19 pandemic is attributable to their supply chains and their inability to deliver products and services.⁶³ Supply chain issues, those associated with sourcing techniques, have created substantial disruptions in various supply chains. Lack of risk management, adoption of the single-sourcing strategy, and supplier delivery delays are examples.⁶⁴ These distractions have generated numerous lessons in understanding supply chain management, advising both researchers and practitioners to reconsider how supply chain strategies should address new disruptive threats.³ In this regard, the role of Industry 4.0 technologies in supply chain management and their revival during COVID-19 is explored in this article.

Industry 4.0 fosters decentralized manufacturing systems enabled by technological innovations.⁶⁵ The concept offers a business atmosphere that integrates humans, machines, equipment, and operational processes through Cyber-Physical Systems and the Internet.⁶⁶ Industry 4.0 integrates its emerging technologies into the entire organizational setting, facilitates automated and dynamic production systems,⁶⁷ significantly improves the quality of products and services by digitizing the operational activities.⁶⁸ However, the COVID-19 pandemic emerged when the supply chains had been called upon to transform and adapt the dynamics of Industry 4.0. Incorporating Industry 4.0 technologies has become a strategic imperative for supply chains to improve their competitiveness in the market.^{1,4} These technologies play a significant role in optimizing the performance of supply chain operations for better results.⁶ Many academics believe that Industry 4.0 technologies, such as the Internet of Things,^{5,9,37} big data,^{14,15,21,38} cloud computing,^{22,23} additive manufacturing,^{48,60} and blockchain,^{17,19,20} can encourage supply chains in times of crisis, and they call for more research in this area.^{43,45,69} Previous studies on epidemics did not address the employment of emerging technologies in the recovery process⁶¹ as well as the impact on commercial supply chains.⁷⁰ Consequently, it is unclear how a supply chain can utilise technologies to increase flexibility and response time.⁵⁸ This requires a holistic approach.⁷¹ Furthermore, existing literature lacks a comprehensive review on the role of new technologies in enabling supply chains, especially in emergencies such as the COVID-19 pandemic.^{3,58} Therefore, Chowdhury, Paul, Kaisar and Moktadir⁵⁸ and Frederico³ suggested looking into the role of emerging technologies of Industry 4.0 in regulating the effects of COVID-19. The current study has conducted a systematic literature review to close this gap. Also, the study assesses the overall role of Industry 4.0 technologies in developing a holistic supply chain framework and focuses on the potential applications of the emerging technologies to address pandemic-related supply chain problems.

Hence a comprehensive literature review was conducted on Industry 4.0 technologies, supply chain, and COVID-19 for exploratory analysis and a deeper understanding to answer the following research queries:

- Q1.** What are the most influential technologies of Industry 4.0 for creating more responsive and resilient supply chains in case of emergencies, such as the COVID-19 outbreak?
- Q2.** How can the technologies of Industry 4.0 enable supply chains to handle the effects of the COVID-19 outbreak and enhance the responsiveness of the supply chains?

Methods

The study employs systemic literature review (SLR) methodology to get a thorough insight into the relevance of Industry 4.0 technologies in the supply chain during COVID-19.

Researchers have recommended SLR as a comprehensive literature review framework.⁷² An overview of the SLR process⁷³ followed in this study is shown in [Table 1](#).

To create a repeatable and impartial search method, the researchers only referred to the most relevant publications connected to the topic. [Figure 1](#) illustrates the three categorical keywords used by the authors to find the most relevant publications. The study adopted the "Preferred Reporting Items for Systematic Review and Meta-analysis Protocols (PRISMA)" framework developed by Moher⁷⁴ and the flowchart is visualized in [Figure 2](#). The drafting process was utilised to extract the most relevant articles on the effect of COVID-19 on supply chains and the potential of the emerging technologies to resuscitate supply chains, as stated in the PRISMA standards.

Results

Fifty-three articles were included for the descriptive and thematic analysis. The reviewed publications showed that the emerging technologies play a significant role in rescuing the disrupted supply chains during the COVID-19 pandemic. The following sub-sections illustrate the descriptive analysis of the publications.

Table 1. Summary of the systematic literature review.

Phase 1	Research question
Formulating of the research questions	Q1. What are the most influential technologies of Industry 4.0 for creating more responsive and resilient supply chains in case of emergencies, such as the COVID-19 outbreak? Q2. How can the technologies of Industry 4.0 enable supply chains to handle the effects of the COVID-19 outbreak and enhance the responsiveness of the supply chains?
Phase 2 & Phase 3	Electronic databases
	Scopus (scopus.com), ProQuest (proquest.com), Google Scholar (scholar.google.com)
	Database setting Journal articles Book chapters Conference proceedings English language only
Search period	2016-2021
Method	PRISMA
Phase 4	Analysis segment
Assessment of findings	Iterative compilation of the documents
Phase 5	Synthesis segment
Reporting of findings	Emerged perspective and results are extracted from documents and discussion

Figure 1. Categorical keywords for literature search.

Type of publications

The descriptive findings of 53 articles are shown in the frequency analysis. **Figure 3** depicts a high-level representation of the results. Out of the 53 papers, 48 journals provide 90% of the articles, two conference papers and two book chapters account for 4% each of the total publications, and 2% are the culminating articles.

Year-wise distribution of the publications

The year-wise distribution of the articles is shown in **Figure 4**. The publication trend demonstrates an impressive growth in the literature, indicating that the topic is well recognised among academics.

Journal-wise distribution of the publications

Figure 5 presents the distribution of publications among the top seven journals. Sustainability (MDPI) tops with four articles, and benchmarking followed with three articles.

Contribution of the publishers

The contributions of different publishers are shown in **Figure 6**. Emerald has the most publications with fourteen papers, followed by MDPI and Elsevier with thirteen and nine articles, respectively. This indicates that the concept of Industry 4.0 and supply chains is widely covered.

Research method-wise distribution

The research method-wise distribution of the chosen 53 articles is shown in **Figure 7**. Empirical methodology tops with 15 papers, followed by general reviews and systematic literature reviews comprising 14 and 12 articles, respectively.

Figure 2. “Preferred Reporting Items for Systematic Review and Meta-analysis Protocols (PRISMA)”.

Figure 3. Types of publications.

Top cited publications

Figure 8 demonstrates the top-cited articles, and the publication by Hofmann, Sternberg, Chen, Pflaum and Prockl²⁴ leads the list with 1035 citations, followed by Queiroz and Wamba⁴⁴ and Ardito, Petruzzelli, Panniello and Garavelli⁴ with the second and third highest number of citations, 250 and 196, respectively.

Figure 4. Year-wise distribution of the publications.

Figure 5. Journal-wise distribution of the publications.

Figure 6. Contributing publisher.

Figure 7. Research method-wise distribution.

Figure 8. Top cited publications.

Figure 9. High contributing authors.

Figure 10. Country-wise distribution.

Figure 11. Sector-wise distribution

High-contributing authors

The list of high-contributing authors is shown in [Figure 9](#). Maciel M. Queiroz tops the list with three publications, followed by Hofmann, Erik; Pereira, Susana Carla Farias; and Sunil, Luthra and Ivanov, Dmitry with two publications each.

Country-wise publications

[Figure 10](#) shows that India tops the list with ten articles, followed by Australia and Brazil with four and three papers, respectively, then the USA, China and Spain, each with two articles.

Sector-wise distribution

[Figure 11](#) illustrates the sector-wise distribution, and the manufacturing supply chains accounts for 29 articles out of 53. Medical & pharmaceuticals, courier, and agri-food supply chains are reflected in each of the three articles.

Discussion

Supply chains have been significantly disrupted during COVID-19, and the fundamental concerns addressed primarily are demand instability and supply shocks.^{57,58,61,63,64,75–80} COVID-19 not only created havoc in demand and supply but also altered the spending patterns of consumers^{80,82} and led to inflation.^{76,79,83} The pandemic also caused reduced sales^{75,76,84,85} and business shutdowns^{61,78,84} with huge economic losses in various industries like cars, tourism, and transportation.^{58,82} This resulted in a shortage of workers^{78,85} and raw materials^{63,64,78} and a simultaneous massive failure of production capacity.^{75,84} This section discusses the recovery strategy for the disrupted supply chains during the

COVID-19 pandemic by deploying emerging technologies. The role of these technologies in reviving the supply chains is also underlined.

Recovery strategy through the employment of the emerging technologies

With Industry 4.0 technologies, the automated and digital supply chain can be the best solutions for recovering the disrupted supply chains during the COVID-19 pandemic. The role and function of disruptive technologies are essential.³⁻⁵

The literature review highlights the emerging technologies that may streamline supply chain resilience, resulting in increased robustness during an emergency or an unexpected and dynamic catastrophe. The results are summarized in Table 2.

The manufacturers and producers may adopt and execute emerging technologies such as the Internet of Things (IoT), big data, cloud computing, additive manufacturing, and blockchain to continue, rescue, and recover their supply chains that are affected by the pandemic. Management should dedicate more effort to an automated supply chain developed by the emerging technologies.

The role of the emerging technologies in supply chains

COVID-19 emphasises the whole production process and the structural factors that link Industry 4.0 technology, supply chains, and the COVID-19 pandemic. In this section, these factors are examined based on the reviews. Table 3 illustrates

Table 2. The emerging technologies in various supply chains.

Technologies	References
Internet of Things	1-36
Big data	1, 3-6, 8-11, 14-19, 21-25, 27-29, 31-36, 38-42
Cloud computing	1, 3, 4, 6, 9, 10, 12, 13, 16-20, 22-29, 32-35, 39, 40, 45, 46
Additive manufacturing	1, 3, 4, 8, 9, 16, 17, 22-24, 28, 29, 32-35, 39, 45, 47
Blockchain	1, 3, 12, 13, 16, 17, 19-21, 24, 27-29, 31, 33-35, 39, 40, 42

Table 3. The role of the emerging technologies in various supply chains.

Category	Advantages	Sources
Monitoring	Customers' demand management	1, 3-5, 8, 35, 37
	Supply management	36, 43, 44
	Sales and operations planning	16, 22, 39
	Product portfolio management	30, 48
	Risk management	17, 34, 44, 49
Integration	Integration across the inter-intra organisation boundaries	25, 50
	Information sharing among the supply chain members	51, 52
	Supplier and customer integration	10, 14, 17, 48
Responsiveness	Quick response to customer demand	4, 14, 40, 53
	Delivery in a timely manner	1, 14, 32, 54
Information sharing	Accessing real-time data by different members of the supply chain	12, 14, 15, 55
	Tracking logistics information	27, 59, 60
	Tracking and tracing warehousing information	29, 33, 61
Inventory management	Obtain a holistic view of inventory levels	19, 29, 62
Waste reduction	Real-time information sharing enables in waste reduction	1, 13, 17, 41, 55
Production efficiency	Utilization of all resources enables production efficiency	23, 26, 48

the role of the emerging technologies in reviving supply chains that favour long-term supply chain performance. The key approaches of the supply chains include real-time information and transparency to manage customer demand effectively,^{1,4} improved interaction with suppliers and vendors,^{10,52} and optimising the supply chain to satisfy the needs of the company.^{40,53} A supply network integrated with emerging technologies enables companies to build faster, flexible, accurate, and efficient supply chains.⁷ These approaches have a significant influence on supply chain resilience, leading to increased robustness in the face of an emergency or abrupt and large-scale calamities.²² These technologies will improve industrial processes across the horizontal value chain, including engineering, material utilisation, supply chain, and product life cycle management,^{33,60,86} along with opportunities such as improvements in operations, energy conservation, and logistic support.^{17,19,87} Productive competency,^{23,48} waste reduction,^{1,17} inventory management,^{19,25} information sharing with supply chain members,^{54,55} tracking and tracing warehouse inventory,^{29,88} and logistics information⁶⁰ are guaranteed by Industry 4.0 technologies.^{1,21,22} Via data sharing, these technologies facilitate a decrease in local and international bulk cargo transit, delivery mistakes, and needless waiting periods, as well as the prevention of products being damaged.^{23,48} The review indicates that Industry 4.0 technologies contribute to improving operations management^{4,5,7} and manufacturing processes creating customized products.⁸⁹

Limitations and future studies

The authors note several limitations in the study. First, the findings are derived considering English language-publications only, and those written in other languages are excluded. Future research may provide additional insights by reviewing the literature written in other languages. Second, the authors focus on the literature only in the context of Industry 4.0. Thus, the holistic view of Industry 4.0 has not been evaluated in this study. Furthermore, the study reviewed the role of the five major technologies such as IoT, big data, cloud computing, additive manufacturing, and blockchain and discussed how these technologies could be employed to revive the supply chains during emergencies. Future studies may include other emerging technologies such as artificial intelligence, robotics, augmented reality, and simulation/digital twins to get a broader range of findings. In spite of these constraints, the current study adds to the identification of significant technologies and their roles in supply chain management in the area of Industry 4.0.

Conclusion

Recent studies have emphasized the impact of individual technologies on the supply chain, such as IoT, big data, cloud computing, additive manufacturing, and blockchain, and how these technologies support companies in achieving competitive advantage. However, comparatively few studies have explored the influence of these technologies concurrently, particularly during an unexpected situation. The present study is based on these gaps and responds to the research questions using a systematic literature review. In answering the first research question, the study confirmed that most publications highlight IoT, big data, cloud computing, additive manufacturing, and blockchain (Table 2) that may assist in building resilient and robust supply chains, even in the COVID-19 era. Regarding the second research question, the literature indicates that the roles and functions (Table 3) played by these technologies lead to establishing integrated, flexible, robust, responsive, efficient, and competent supply chains. The study also reveals unexplored features of supply chains. Therefore, highlighting a discussion on implementing Industry 4.0 technologies in supply chain studies offers an interesting future research topic.

Data availability

Underlying data

All data underlying the results are available as part of the article and no additional source data are required.

Reporting guidelines

Figshare: PRISMA Checklist_The Implications of Industry 4.0 on Supply Chains Amid the Covid 19 Pandemic – A Systematic Literature Re.docx, <https://doi.org/10.6084/m9.figshare.16602356>.

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](#) (CC-BY 4.0).

Competing interests

No competing interests were disclosed.

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Version 1

Reviewer Report 15 November 2021

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Chetna Chauhan

Quantitative Techniques and Operations Management, FORE School of Management, New Delhi, Delhi, India

This article needs to address some important shortcomings before it can be accepted for indexing.

In Introduction the authors need to clearly state the rationale behind this study, i.e., why do they think that technologies can be useful in the covid time.

The method section also requires details. See papers on SLR methodology.

The authors review a huge set of 53 articles, but the discussion is very brief. The authors need to elaborate their discussion by highlighting the key themes and sub-themes. Include a section on gaps in the existing studies and future research directions, which is based on your review (see food waste papers by this reviewer: Chauhan *et al.* 2021a¹, Chauhan *et al.* 2021b²).

Language check is a must. There are typos and errors, for example, see figure 5 "nmber," etc.

Best of luck.

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Are the rationale for, and objectives of, the Systematic Review clearly stated?

Partly

Are sufficient details of the methods and analysis provided to allow replication by others?

Partly

Is the statistical analysis and its interpretation appropriate?

Not applicable

Are the conclusions drawn adequately supported by the results presented in the review?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Industry 4.0, Circular economy

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 30 Dec 2021

Mohammad Nurul Hassan Reza, Multimedia University, Cyberjaya, Malaysia

We would like to express our cordial thanks and gratitude to you for reviewing the manuscript. We believe that the revised version has addressed all the issues. Below are the response to the comments:

Reviewer's comments:

In Introduction the authors need to clearly state the rationale behind this study, i.e., why do they think that technologies can be useful in the covid time.

Author Response to Comments

Thank you very much for your suggestion. The introduction section is further explained to address this issue.

Reviewer's comments:

The method section also requires details. See papers on SLR methodology.

Author Response to Comments

Thank you very much for pointing this out. Due to the word limitation, we planned to make a short SLR using tables and figures to provide the relevant information. However, as the journal advised elaborating relevant sections to respond to the reviewers' comments, all of the methodological procedures are further explained, including the steps of the article selection process.

Reviewer's comments:

The authors review a huge set of 53 articles, but the discussion is very brief. The authors need to elaborate their discussion by highlighting the key themes and sub-themes.

Author Response to Comments

Thank you very much for your comments. Initially, we were bound to prepare a short SLR

due to the limitation of 2500 words. However, the journal has advised elaborating all the relevant sections to address the reviewers' comments.

In the revised version of the manuscript, the discussion section is now improved with two separate tables. Table 3 illustrates the reviewed literature where the potential advantages of Industry 4.0 technologies in supply chain resilience are identified. The reviewed articles are summarized in Table 4, including the technologies of Industry 4.0 that were the main focus of each study. The research area, methodological approach, and findings of each of the studies are also presented.

Additionally, categorical analysis is done with a framework illustrating the findings of the study and discussing the themes and sub-themes. In this section, the key enabling technologies of Industry 4.0 in establishing resilient supply chains and the potential advantages (clusters/themes) have been identified. The discussion on the sub-cluster/sub-theme of each cluster/theme is also added, answering the research questions of the study.

Reviewer's comments:

Include a section on gaps in the existing studies and future research directions, which is based on your review.

Author Response to Comments

Thank you very much for the suggestion. A section illustrating the research gaps identified in the reviewed literature and future directions is added.

Competing Interests: No competing interests were disclosed.

Reviewer Report 21 October 2021

<https://doi.org/10.5256/f1000research.76766.r96184>

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Lorenzo Ardito

Dipartimento di Meccanica Matematica, Management Ringgold Standard Institution, Politecnico di Bari, Bari, Italy

The study is more a bibliometric analysis than a systematic review. A systematic review paper includes a discussion of the articles selected. This article mainly provide some descriptive statistics.

From these statistics, it is hard to see answers about the two questions. That is, where can I see the "most influential technologies of Industry 4.0 for creating more responsive and resilient supply chains in case of emergencies, such as the COVID-19 outbreak"? Where did you explain "how can

the technologies of Industry 4.0 enable supply chains to handle the effects of the COVID-19 outbreak and enhance the responsiveness of the supply chains?" The article must answer these questions delving into the outcomes of the included papers.

Also, the covid pandemic started at the end of 2019. Why are articles published earlier included?

Are the rationale for, and objectives of, the Systematic Review clearly stated?

Partly

Are sufficient details of the methods and analysis provided to allow replication by others?

Partly

Is the statistical analysis and its interpretation appropriate?

No

Are the conclusions drawn adequately supported by the results presented in the review?

No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Innovation, digital transformation

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 30 Dec 2021

Mohammad Nurul Hassan Reza, Multimedia University, Cyberjaya, Malaysia

Reviewer's comments:

The study is more a bibliometric analysis than a systematic review. A systematic review paper includes a discussion of the articles selected. This article mainly provide some descriptive statistics.

From these statistics, it is hard to see answers about the two questions. That is, where can I see the "most influential technologies of Industry 4.0 for creating more responsive and resilient supply chains in case of emergencies, such as the COVID-19 outbreak"? Where did you explain "how can the technologies of Industry 4.0 enable supply chains to handle the effects of the COVID-19 outbreak and enhance the responsiveness of the supply chains?" The article must answer these questions delving into the outcomes of the included papers.

Author Response to Comments

Thank you very much for your comments. Initially, we were bound to prepare a short SLR due to the limitation of 2500 words. However, the journal has advised elaborating all the relevant sections to address the reviewers' comments. The revised version addressed all the concerns raised, and further explanation is added in the appropriate sections.

In the revised version of the manuscript, the discussion section is now improved with two separate tables. Table 3 illustrates the reviewed literature where the potential advantages of Industry 4.0 technologies in supply chain resilience are identified. The reviewed articles are summarized in Table 4, including the technologies of Industry 4.0 that were the main focus of each study. The research area, methodological approach, and findings of each of the studies are also presented.

Additionally, categorical analysis is done with a framework illustrating the findings of the study and answering the research questions. In this section, the key enabling technologies of Industry 4.0 in establishing resilient supply chains and the potential advantages (clusters) have been identified. The discussion on the sub-clusters of each cluster is also added, answering the second research question.

Reviewer's comments:

Also, the COVID pandemic started at the end of 2019. Why are articles published earlier included?

Author Response to Comments

Thank you very much for your suggestion. Initially, we included some papers published before 2019 as the focus of these papers was on Industry 4.0 relating to supply chain disruption. However, to avoid confusion, we have removed the articles published before 2019, and all the figures, tables, and discussions have been revised accordingly. Yet, the authors retained at least three articles focusing on general supply chain disruptions rather than COVID-19, published in 2019.

Thank you very much.

Competing Interests: No competing interests were disclosed.

Reviewer Report 12 October 2021

<https://doi.org/10.5256/f1000research.76766.r96185>

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Guilherme Brittes Benitez

Department of Industrial Engineering, Federal University of Rio Grande do Sul, Porto Alegre, Brazil

I had the opportunity to review the manuscript entitled "*The implications of Industry 4.0 on supply chains amid the COVID-19 pandemic: a systematic review*". The subject is timely and relevant and the authors did a nice job in their methodological procedures. However, further improvements are necessary for this version to be suitable for indexing.

Abstract:

"Purpose: This research examines the effects of the epidemic on supply chains and how these effects are reduced through Industry 4.0 technology." <- Industry 4.0 technologies

"Findings: This study discusses the impact of COVID-19 on the supply chain and how the emerging technologies of Industry 4.0 can help manufacturers to ease the impact." <- this is not a result, this is justificative of your research

"These technologies will enhance the production system through the automation and optimization of..."
<- "will" is quite odd here. Are you concluding this from the SLR or is this the main finding from your research?

Originality/value is quite weak. It looks like more a justificative than the real contribution from your work.

Introduction:

Overall, the introduction section is well written and the flow of information sounds good when reading the text. Congrats!

"In this regard, the role of Industry 4.0 technologies in supply chain management and their revival during COVID-19 is explored in this article." <- What do you mean by saying "their revival"? It seems out of context here.

Research method:

This section needs improvements. It is too superficial and the authors try to give all the explanations in Table 1 and Figures 1 and 2. This is not sufficient to explain all your methodological procedures. Please, better explain your steps when doing this SLR.

Why did you consider 2016, 2017, and 2018 in your research given the covid-19 pandemic started in December 2019? From the perspective proposed in the manuscript, you have at least 8 articles you should not include in your analysis.

You have to better justify why you considered before and pre-pandemic periods.

Results:

The bibliometric analysis is good. I enjoyed seeing how the authors give special attention to this point.

I believe the authors should explain all images in this section. Despite some images being easy to follow a critical analysis would enrich and benefit the manuscript.

Discussions:

I believe the authors mixed the results and discussions sections. Tables 2 and 3 certainly must be in the Results section and therefore they should be discussed in the discussions section.

I cannot see the link between Industry 4.0 technologies and each category and its respective advantages. If you create a new column explaining which technologies are related it certainly would help readers. Moreover, you should better present (discuss) these points in your results section.

Are the rationale for, and objectives of, the Systematic Review clearly stated?

Yes

Are sufficient details of the methods and analysis provided to allow replication by others?

Yes

Is the statistical analysis and its interpretation appropriate?

Not applicable

Are the conclusions drawn adequately supported by the results presented in the review?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Industry 4.0 and supply chain.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 30 Dec 2021

Mohammad Nurul Hassan Reza, Multimedia University, Cyberjaya, Malaysia

We would like to thank you for all the valuable comments. We believe that the revised manuscript has addressed all the concerns. Below are the response to the comments:

Reviewer's comments:

"Purpose: This research examines the effects of the epidemic on supply chains and how these effects are reduced through Industry 4.0 technology." <- Industry 4.0 technologies

Author Response to Comments

Thank you very much for addressing the typo. We have already done the correction.

Reviewer's comments:

"Findings: This study discusses the impact of COVID-19 on the supply chain and how the emerging technologies of Industry 4.0 can help manufacturers to ease the impact." <- this is not a result, this is justificative of your research.

Author Response to Comments

Thank you very much for pointing this out. The findings are revised as follows:

Findings: The findings of the study showed that the majority of the articles emphasized the digitalization of supply chain management, acknowledging the fundamentals, applications, and prospects, revealing the drivers and challenges of Industry 4.0 technologies to manage disruptions. Most of the authors identified IoT, big data, cloud computing, additive manufacturing, and blockchain to maintain the supply chain resilience.

Reviewer's comments:

"These technologies will enhance the production system through the automation and optimization of..." <- "will" is quite odd here. Are you concluding this from the SLR or is this the main finding from your research?

Author Response to Comments

Thank you very much for suggesting. We have revised the statement accordingly.

Reviewer's comments:

Originality/value is quite weak. It looks like more a justificative than the real contribution from your work.

Author Response to Comments

We have addressed this and revised it as follows:

Originality/value: Existing literature on epidemics lacks the basics and practices of utilizing Industry 4.0 technologies in the supply chain recovery process. To fill this research gap, the study summarizes the potential of Industry 4.0 technologies to lessen supply chain disruptions caused by COVID-19. The study findings are valuable for policymakers and practitioners and contribute to supply chain management studies.

Reviewer's comments:

"In this regard, the role of Industry 4.0 technologies in supply chain management and their revival during COVID-19 is explored in this article." <- What do you mean by saying "their revival"? It seems out of context here.

Author Response to Comments

Thank you very much for noticing this. We have already amended the statement.

Reviewer's comments:

This section needs improvements. It is too superficial and the authors try to give all the explanations in Table 1 and Figures 1 and 2. This is not sufficient to explain all your methodological procedures. Please, better explain your steps when doing this SLR.

Author Response to Comments

Thank you very much for your suggestion. Due to the word limitation, we planned to use tables and figures to provide some information. However, as the journal advised elaborating relevant sections to respond to the reviewers' comments, all of the methodological procedures are further explained, including the steps of the articles selection process.

Reviewer's comments:

Why did you consider 2016, 2017, and 2018 in your research given the covid-19 pandemic started in December 2019? From the perspective proposed in the manuscript, you have at least 8 articles you should not include in your analysis.

You have to better justify why you considered before and pre-pandemic periods.

Author Response to Comments

Thank you very much for your suggestion. Initially, we included some papers published before 2019 as the focus of these papers was on Industry 4.0 relating to supply chain disruption. However, to avoid confusion, we have removed the articles published before 2019, and all the figures, tables, and discussions have been revised accordingly.

Reviewer's comments:

The bibliometric analysis is good. I enjoyed seeing how the authors give special attention to this point.

I believe the authors should explain all images in this section. Despite some images being easy to follow a critical analysis would enrich and benefit the manuscript.

Author Response to Comments

Thank you very much for your suggestion. Due to the word limitation, we tried to briefly explain the graphs/images. However, as the journal advised to elaborate relevant sections suggested by the reviewers, further explanation is added for each graph/image in the bibliometric analysis.

Reviewer's comments:

I believe the authors mixed the results and discussions sections. Tables 2 and 3 certainly must be in the Results section and therefore they should be discussed in the discussions section.

Author Response to Comments

Thank you very much for addressing the issue. Tables 2 and 3 are updated and inserted in the results section. The core technologies of Industry 4.0 are identified in Table 2, followed by Table 3, demonstrating the advantages of employing these technologies in supply chains during disruptions.

Reviewer's comments:

I cannot see the link between Industry 4.0 technologies and each category and its respective advantages. If you create a new column explaining which technologies are related it certainly would help readers.

Moreover, you should better present (discuss) these points in your results section.

Author Response to Comments

Thank you very much for the suggestion. We have added Table 3 (Advantages of employing emerging technologies in supply chains.) and Table 4 (Summary of reviewed literature) to address the issue.

Furthermore, the categorical analysis is done where the prospects of Industry 4.0 technologies in supply chains are identified and classified into clusters and sub-clusters following a thorough interpretation of all the selected articles.

Competing Interests: No competing interests were disclosed.

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