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Research trends of supply chain management practice before and during pandemic: A bibliometric analysis

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ABSTRACT

The field of supply chain management has been undergoing numerous changes before and during the pandemic. Emerging areas have caught the attention of researchers across the globe. The purpose of this study is to provide a bibliometric review and analysis of the research trends on supply chain management practice (SCMP) in the pre-pandemic and mid-pandemic periods. We collect and filter data from the SCOPUS database and conduct bibliometric analysis. Before and during pandemic periods, 293 and 211 papers were selected, respectively, from 9,246 publications. The researcher utilizes VOS viewer software to analyze the findings by carrying out citation analysis and keyword analysis. The study reveals seven current research streams of high interest within SCMP: Big Data, Sustainable Supply Chain Management, Circular Economy, Industry 4.0, and Green Supply Chain. Supply chain management and sustainability are the most frequently occurring keywords. The most influential countries in pre-pandemic and mid-pandemic periods are USA and UK, respectively, with 59 and 37 publications. The Journal of Cleaner Production was the most significant source of publications. This study is among the few pieces of research revealing current SCMP research trends during the pandemic. By considering the current SCMP concepts, business and policy decision-makers can adopt the modern concepts of the field to identify new opportunities by expanding capabilities in big data analytics, sustainable development, and industry 4.0 technologies.

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Introduction

The research area of supply chain management came about as a field of crucial academic inquiry dating 1990s and has been growing exponentially since then (Chicksand et al., 2012). The initial development of the concept of mass production, catalyzed by subsequent innovations like the personal computer, grew the field immensely. Since then, more researchers have been entering this field and introducing more inter and trans-disciplinary studies.

The globalization and network interdependence of several companies have advanced in the recent age (George & Madhusudanan Pillai, 2019). The development of efficient systems like Enterprise Resource Planning (ERP) assists companies in managing their operations. Social media uptake in past decades is revolutionizing the field, and new technologies like Big Data are developing new practices in supply chain management by providing superior management capabilities to companies. As businesses continuously realize the potential of supply chain management, supply chain management practices are strongly connected to business profits, enabling companies to develop a competitive edge in the market space (Banerjee & Mishra, 2017). In a tightly competitive market area, researchers also find out that supply chain management plays a significant role in the survival of businesses.

Due to the emergence of such modernized technologies, their roles and influences on mechanisms of supply chain management practice are evident, for instance, digital transformations’ effect on supply chain integration. The performance of supply chains plays...
a role in the survivability of companies, and the awareness of research trends within supply chain management practices can assist managers in identifying new opportunities. Considering that today's business environment is rapidly changing and market instability is a real conundrum, especially during the pandemic, clarity in business strategies is essential for building supply chain strategies that are agile and sustainable (Shashi et al., 2020). Managers can gather future forecasts and hypotheses to expedite how industries and markets evolve. The benefits of this exercise are that companies can foresee threats that they could avoid and opportunities to tap into that could enable their survival in the long run.

The presence of studies unveiling literature on supply chain management practice is identifiable numerously. However, there is insufficient coverage of the comprehensive literature on trends impacting and associating with the area. The gap of the state-of-the-art comprehensive analysis of research trends needs coverage to provide a coherent understanding of the field's evolution. From a managerial view, this in-depth review offers businesses knowledge of such trends necessary to curve out supply chain strategies that are more proactive than reactive. In addition to enabling companies to build plans that respond to dynamic environments, the theoretical contribution lies in covering the literature analysis gap by listing emerging research and concepts in the field and their implications.

In this connection, this paper's motivation is to explore the current research in supply chain management practice from 2018-2019 (pre-pandemic) and 2019-2020 (mid-pandemic). Previous bibliometric studies focused on particular emerging aspects of supply chain management like green supply chain management (M. Feng et al., 2018; Rehman Khan et al., 2018) and big data analytics (Arunachalam et al., 2018; Lo et al., 2018). In this paper, the researchers comprehensively cover the field of supply chain management practice to provide more insights and gaps in the current condition of research in supply chain management practice.

The study aims to investigate the research trends on supply chain management practice, analyze the current concepts of supply chain management practice, and provide future roadmaps of this research field. This comparative study will compare pre-pandemic period data (2018-2019) and Mid-Pandemic data (2020-2021). The research structure is as follows. The first section, the introduction, comes before the literature review section discusses previous field studies. Research methods, in the third section, introduce the study methods. Section four on results and discussion provides bibliometric analysis. Limitations and implications, and conclusions follow in the fifth and sixth sections.

**Literature Review**

Supply chain management has become an integral part of the success of many businesses. Since the first industrial revolution, supply chain infrastructures growth has supported the rising demand for goods beyond borders. According to (Silva et al., 2020), supply chain management includes control and coordination of warehousing, assembly, manufacturing, and inventory control activities. The study by (Aslam et al., 2021) emphasizes that supply chain integration is the pillar or backbone of supply chain management. In this connection, the higher the degree of integration, the higher the operations performance due to the eradication of supplier inefficiencies, decline of demand uncertainties, and delay in changeovers.

In a bid to provide thorough reviews of supply chain management practice from the lens of Internet of Things studies, (Núñez-Merino et al., 2020) applied a bibliometric approach by identifying and assessing 807 publications from 2000-2020. The research results show that only three influential journals were published overwhelmingly in IoT, whereas fifteen authors are the most productive. In addition, IoT literature is engrained in RFID Technology, reverse logistics, industry 4.0 in vast industries. On the other hand, (Núñez-Merino et al., 2020) maps supply chain management literature based on information technologies from 1996 to 2019 derived from Scopus, Web of Science, and ABI/Inform. The researchers focused on lean supply chains and classified scholarly works in four research streams: obsolescence, maturity, emergence, and general outlook of information systems and digital technologies. Implications of the study have both academic usefulness and management angles necessary for practitioners.

Supply chain disruptions are explored extensively by (Xu et al., 2020) regarding their impact on supply chain performances. The bibliometric review of 1,310 articles from Web of Science outlines influential researchers and organizations in the field while undertaking keyword analysis and citation analysis using visualization techniques. Although the paper highlights that expert interview would be an additional data collection resource to the study, the findings contribute to the knowledge structure of supply chain disruptions significant to practitioners and researchers. In the same breadth, Artificial intelligence, singled out as part of the highly superior technologies shaping the world tomorrow, is under significant study as it's part of the technology disruptions in this era. (Toorajipour et al., 2021) reviews present literature on artificial intelligence (AI) to cite its contributions towards supply chain management practice. Four areas of AI are portrayed, including the most utilized AI tools in supply chains, the potential of AI tools for adoption in supply chain management, the present AI-enhanced subfields, and areas with the highest potential of improving subfields by AI.

The work of (Kumar & Kushwaha, 2015) conducted a comprehensive bibliometric analysis of supply chain management in ten years between 2004-2015. The paper gathered articles from the Emerald database and found out that the highest publishing country was the United Kingdom. Furthermore, there was a positive relationship between the citation of papers and author influence. In contrast, there was no correlation between the source of documents and the productivity of a country or an institution in the supply chain management field. However, this paper is limited since it utilized only data from google scholar.
(Y. Feng et al., 2017) investigated the scope of Corporate Social Responsibility in Supply Chain Management by analyzing 628 articles using a bibliometric approach. Sustainable development, social and economic impacts are highlighted widely in many papers by authors. This research is among the few studies that utilized documents from the Scopus database, considering it a larger publication engine than others.

From an environmental sustainability perspective, supply chain management literature has increased and drawn attention among researchers and practitioners. (Zhu & Wang, 2018) discusses supply chain management trends of environmental sustainability between 1998-2017. The authors conducted a bibliometric analysis and found six themes abstracted; green supplier assessment, sustainable supply chain management, green supplier management, green supplier selection, environmental purchasing, and green supply chain management. On the other hand, work by (Zhang et al., 2020) conducts a bibliometric analysis of sustainable supply chain management and big data from 2012-to 2019. Findings show China and US as the most influential publishing countries, western countries as the most collaborative in the field, and data science as a fast-growing area in the modernization of supply chain management.

As many researchers have focused on aspects of sustainability, there is a growing research trend on green supply chain management(Gong et al., 2019; Maditati et al., 2018). For instance, (Gong et al., 2019) analyze the evolution of Green Supply Chain Management(GSCM) from 2007-to 2018 using the Web Of Science database. The paper finds out that research on GSCM rapidly increases from 2013. The hot topics include green production and innovation, green supply chain management theory and methods, and sustainable supply chain environment and performance. On the other hand, (Maditati et al., 2018) collected articles from the Web Of Science (WOS) and analyzed structural relationships of GSCM factors, visualization operators, and performance metrics. There are six research streams: conceptual development, GSCM effect on firm performance, green and sustainable integration in supply chains, green supplier advancement, and GSCM execution drivers.

As most previous papers collected data before 2017, this research will cover recent field developments in the supply chain management practice from 2018-to 2020 (pre-and-mid pandemic). The research methodology will use a bibliometric approach using the Scopus engine, the largest database of peer-review literature. Furthermore, the researcher utilizes VOSS viewer software to develop network maps and further data analysis (Keyword and Citation Analysis).

**Research and Methodology**

**Bibliometric Analysis**

Literature reviews aim to consolidate and map an intellectual pool of data in a particular domain, thereby identifying gaps in research (Tranfield et al., 2003). This research applied a bibliometric method of research. Bibliometric analysis refers to an analytical process of evaluating a massive pool of scientific work and citations that reveal established and materializing research areas by using powerful instruments like network analysis (Mishra et al., 2017).

There are three reasons the researcher utilizes the bibliometric analysis approach. First, the bibliometric analysis uses computer algorithms and can handle numerous articles speedily. Secondly, the investigator can retrieve complete author metadata, journal name, research abstract, and keywords. Thirdly, bibliometric instruments like VOSS viewer and CiteSpace create a powerful interactive data visualization that ensures readers can easily understand the research topic (Zhu & Wang, 2018). Bibliometric analysis is a preferable choice as compared to content analysis. Content analysis frequently falls into limitations due to its reliance on subjective judgment, which causes misinterpretation. Furthermore, the bibliometric analysis method has firm underpinnings from the structure hole theory and impact theory (Burt, 2004).

The study collects data from the Scopus engine, the most extensive citation and abstract database containing peer-reviewed literature (Fahimnia et al., 2015). Bibliometric analysis frequently uses three sources of information; google scholar, Scopus, and Web of Science (WOS). Scopus and Web of Science cover highly peer-reviewed publications of high-impact factors. However, Web of Science has fewer collections of journals (Zhu & Wang, 2018). According to (Chicksand et al., 2012), the Scopus engine is a suitable source for peer-reviewed journals in the supply chain. Therefore, the Scopus engine is preferable to other data sources (Mishra et al., 2017).

VOSS viewer software conducts the retrieval and analysis of data. VOSS viewer is a tool for developing and visualizing bibliometric networks. Compared to other network visualization tools like CitNetExplorer and HistCite, VOSS viewer software provides basic functionality that many researchers can utilize efficiently and has a stronghold of analyzing significant network nodes (van Eck & Waltman, 2014).

**Data Collection**

Table 1 and figure 1 show the methodological stages of the study. It starts with a Scopus title search leading to 9,246 papers. The second step is limiting the period of publications (pre-pandemic/mid-pandemic). In pre-pandemic, we have 847 documents, while in mid-pandemic, 611 papers. Figure 1 Keyword selection was limited to supply chain management and supply chain management practices. The final choice of language resulted in 293 and 211 publications in pre-pandemic and mid-pandemic, respectively. Table 1 below illustrates the research methodology in both periods, whereas figure one displays the stage-by-stage filtering of documents.
Before analyzing findings, the data pool is exported in excel format (CSV) to VOS viewer software for developing visualization networks.

### Table 1: Pre-Pandemic and Mid-Pandemic Methodology

| Unit     | Pre-Pandemic (2018-2019)                                      | Mid-Pandemic (2020-2021)                                      |
|----------|----------------------------------------------------------------|----------------------------------------------------------------|
| Item of Analysis | Articles and article reviews                                  | Articles and article review                                    |
| Form of Analysis       | Quantitative Research                                         | Quantitative Research                                         |
| Duration of Analysis       | 2018-2019                                                      | 2020-2021                                                      |
| Search Engine          | Scopus                                                         | Scopus                                                         |
| Query-String           | Title-abs-key ( supply and chain and management and practice ) and ( limit-to ( pubyear , 2019 ) or limit-to ( pubyear , 2018 ) ) and ( limit-to ( subjarea , "busi" ) ) and ( limit-to ( doctype , "ar" ) or limit-to ( doctype , "re" ) ) and ( limit-to ( exactkeyword , "supply chain management" ) or limit-to ( exactkeyword , "supply chain management practices" ) ) and ( limit-to ( language , "english" ) ) and ( limit-to ( srctype , "j" ) ) | Title-abs-key (supply and chain and management and practice ) and ( limit-to ( pubyear , 2021 ) or limit-to ( pubyear , 2020 ) ) and ( limit-to ( subjarea , "busi" ) ) and ( limit-to ( doctype , "ar" ) or limit-to ( doctype , "re" ) ) and ( limit-to ( exactkeyword , "supply chain management" ) or limit-to ( exactkeyword , "supply chain management practices" ) ) and ( limit-to ( srctype , "j" ) ) and ( limit-to ( language , "english" ) ) |

**Source:** Research data (2021)

![Image 1](image1.png)

**Figure 1:** Methodological Steps; **Source:** Research data (2021)

### Result and Discussion

#### Publications by year

**Pre-Pandemic**

The amount of scientific literature produced in a period can assist in discovering patterns in research evolution and providing future implications (Zhang et al., 2020). In the pre-pandemic period (2018-2019), there was a total of 293 publications produced. In 2019, 161 papers were published compared to 132 in 2018, showing an increase of 29 publications. It means more scholars are investing more time in this research field.

![Image 2](image2.png)

**Figure 2:** Publications by year; **Source:** Research data (2021)
Mid-Pandemic Period

In the mid-pandemic period (2020-2021), there are 211 documents publications in supply chain management practice. Out of 211 publications, 155 papers appear in 2020, while 56 are in 2021. The author explains the low-performance score in 2021 is due to partial yearly coverage of data that was taking place in the first quarter of the year.

![Figure 3: Publications by year; Source: Research data (2021)]

Top Publishing Countries

Pre-Pandemic

In the pre-pandemic period (2018-2019), the most influential country in supply chain management practice is the United States with 59 publications, followed by United King and China with 49 and 36 papers. There is also a correlation between publication volume and citations, meaning the more the number of publications, the more expertise, and influence a country has.

| Rank | Country              | Publications | Citations |
|------|----------------------|--------------|-----------|
| 1    | United States        | 59           | 1384      |
| 2    | United Kingdom       | 49           | 1463      |
| 3    | China                | 36           | 953       |
| 4    | India                | 31           | 727       |
| 5    | Australia            | 22           | 331       |
| 6    | Malaysia             | 18           | 290       |
| 7    | France               | 15           | 405       |
| 8    | Indonesia            | 15           | 96        |
| 9    | Brazil               | 14           | 467       |
| 10   | Russian Federation   | 12           | 43        |

Source: Research data (2021)

Mid-Pandemic

In the mid-pandemic period (2020-2021), the top publishing country was the United Kingdom, with 37 research outputs. At the top position are China and the United States, with 35 publications each. India was the fourth most publishing country with 33 papers.

| Rank | Country             | Publications | Citations |
|------|---------------------|--------------|-----------|
| 1    | United Kingdom      | 37           | 299       |
| 2    | China               | 35           | 206       |
| 3    | United States       | 35           | 178       |
| 4    | India               | 33           | 210       |
| 5    | France              | 18           | 79        |
| 6    | Italy               | 16           | 104       |
| 7    | Australia           | 16           | 101       |
| 8    | Indonesia           | 15           | 6         |
| 9    | Germany             | 11           | 37        |
| 10   | Canada              | 7            | 32        |

Source: Research data (2021)

Top Publishing Journals

Pre-pandemic

The Journal of Cleaner Production was the most influential in 2018-2019, with 47 documents. The International Journal of Supply Chain Management and the International Journal of Production Economics produced 44 and 22 publications, making them the most influential.
Table 4: Top Publishing Journals

| Rank | Source                                           | Documents | Citations |
|------|--------------------------------------------------|-----------|-----------|
| 1    | Journal of Cleaner Production                    | 47        | 1762      |
| 2    | International Journal of Supply Chain Management | 44        | 78        |
| 3    | International Journal of Production Economics    | 22        | 568       |
| 4    | International Journal of Production Research     | 17        | 493       |
| 5    | Journal of Manufacturing Technology Management   | 13        | 353       |
| 6    | Business Strategy and the Environment            | 12        | 242       |
| 7    | Production Planning and Control                  | 10        | 234       |
| 8    | Supply Chain Management                          | 7         | 178       |
| 9    | International Journal of Operations and Production Management | 4 | 68 |
| 10   | Technological Forecasting and Social Change       | 4         | 256       |

Source: Research data (2021)

Mid Pandemic

In the mid-pandemic period (2020-2021), the Journal of Cleaner Production was the most influential in the research with 27 documents, followed by Business Strategy and the Environment with 18 papers and the International Journal of Production Economics with 16 publications.

Table 5: Top Publishing Journals

| Rank | Journal                                           | Documents | Citations |
|------|--------------------------------------------------|-----------|-----------|
| 1    | Journal of Cleaner Production                    | 27        | 250       |
| 2    | Business Strategy and The Environment            | 18        | 105       |
| 3    | International Journal of Production Economics    | 16        | 159       |
| 4    | Production Planning and Control                  | 12        | 66        |
| 5    | Transportation Research Part E: Logistics and Transportation Review | 11 | 41 |
| 6    | International Journal of Production Research     | 10        | 35        |
| 7    | Journal Of Manufacturing Technology Management   | 6         | 8         |
| 8    | Benchmarking                                     | 4         | 22        |
| 9    | Journal Of Business Research                     | 4         | 18        |
| 10   | Technological Forecasting and Social Change       | 4         | 11        |

Source: Research data (2021)

Citation Analysis

The sum of citations in a journal determines the importance of a field of research. Citation analysis assesses the level of citation occurrence in a publication (Mishra et al., 2017). According to (Pilkington & Meredith, 2009), citation analysis enables a researcher to understand how influential publications have evolved, the period they were published, and their relevance to current studies.

Pre-Pandemic

The pre-pandemic period in this research is from the 2018-2019 period. To generate the top-cited documents in VOSS viewer software, the researcher first retrieved the (CSV) Scopus Excel file by selecting "create a map using a bibliographic data" then clicking "read the data from bibliographic files." Thirdly, we select the Scopus file format tab to obtain the document before presenting a set of analyses to be taken. Citation analysis of documents leading to an initial list of 293 papers. The researcher puts a minimum of seventy-eight citations per document, resulting in 16 publications, as displayed in table 6.
Evaluation focus points are the main topics in the four clusters. Table 7 shows the research streams.

| Rank | Paper | Research Type | Gap & Future research | Contribution | Citations |
|------|-------|---------------|-----------------------|--------------|-----------|
| 1    | (El-Kassar & Singh, 2019) | Empirical; quantitative | Qualitative examination is needed | Proposes a GSCM model | 144 |
| 2    | (Nascimento et al., 2019) | Empirical; Qualitative | Results cannot be generalized; small sample size | Proposes a circular business model | 119 |
| 3    | (Mani et al., 2018) | Empirical; Qualitative | Cross-cultural perspective required | Building competitive, socially sustainable supply chains | 113 |
| 4    | (Arunachalam et al., 2018) | Bibliometric Review | No empirical proof to support the conceptual framework | Builds the capability maturity model | 106 |
| 5    | (Zaid et al., 2018) | Empirical; quantitative | Limited generalizability of the study | Improving sustainability performance through GSCM | 100 |
| 6    | (Koberg & Longoni, 2019) | Literature Review | Restricted keyword and result search | Improving sustainable outcomes of Global SC | 96 |
| 7    | (de Oliveira et al., 2018) | Bibliometric Review | Recent researchers from 2018 required | Conceptual map for GSCM analysis | 96 |
| 8    | (S. K. Singh & El-Kassar, 2019) | Empirical; Quantitative | Mixed method to widen research framework | Enhancing sustainable capabilities to improve sustainable performance | 89 |
| 9    | (Lo et al., 2018) | Empirical; Mixed method | Use of different MADM instruments for supplier choice | Creates a model for green supplier evaluation | 89 |
| 10   | (dos Santos et al., 2019) | Empirical; Mixed method | Extending other criteria for decision making | Develops a green supplier assessment criterion | 88 |
| 11   | (Rehman Khan et al., 2018) | General Method of Moments | Extending chosen researched countries; polluted logistics impacts | Reducing logistics anti-environmental effects and increasing exports | 83 |
| 12   | (Kusi-Sarpong et al., 2019) | Empirical; Mixed method | Limited study generalizability | It gives a sustainable framework of manufacturing supply chain innovation | 80 |
| 13   | (Herczeg et al., 2018) | Empirical; Qualitative | Temporal dimensions of industrial symbiosis | Organization and operational propositions for partnership | 80 |
| 14   | (Cole et al., 2019) | Review | Development of blockchain | Proposes six themes on the adoption of blockchain technology | 78 |
| 15   | (M. Feng et al., 2018) | Empirical; Quantitative | Limited Study generalizability; unidimensional and multidimensional GSCM construct effects on performance metrics | Creating a GSCM conceptual model | 78 |
| 16   | (Kaur et al., 2018) | Empirical; Qualitative | Limited DEMATEL respondents; Lacks study generalizability | Improving GSC practices by solving barriers | 78 |

**Source:** Research data (2021)

During the pre-pandemic period (2018-2019), there are 4 clusters formed from the top 16 cited publications after analysis by the VOS viewer application. Big data, green supply chain management, sustainable supply chain management, and green supplier evaluation focus points are the main topics in the four clusters. Table 7 shows the research streams and groups.

### Table 7: Top Cited Document Clusters

| Cluster | Authors | Main Topic Covered |
|---------|---------|--------------------|
| 1       | (de Oliveira et al., 2018), (M. Feng et al., 2018), (Herczeg et al., 2018), (Kaur et al., 2018), (Nascimento et al., 2019), (Zaid et al., 2018) | Green Supply Chain Management |
| 2       | (Cole et al., 2019), (Koberg & Longoni, 2019), (Mani et al., 2018), (Rehman Khan et al., 2018) | Sustainable Supply Chain Management |
| 3       | (Arunachalam et al., 2018), (El-Kassar & Singh, 2019), (S. K. Singh & El-Kassar, 2019) | Big Data |
| 4       | (dos Santos et al., 2019), (Kusi-Sarpong et al., 2019), (Lo et al., 2018) | Green Supply Chain Management (Including Supplier Evaluation) |

**Source:** Research data (2021)
Green Supply Chain Management
Green Supply Chain Management (GSCM) has been covered extensively in clusters one and four. Green supply chain management refers to the process of combining environmental awareness in supply chain management in activities such as product design, manufacturing processes, and proper management of a product after its obsolescence. Green supply chain management is a component of Sustainable supply chain management. (M. Feng et al., 2018) discusses that GSCM comprises internal and external environmental control practices that enhance the partnership between departments, customers, and suppliers.

Green supply chain management is a highly growing concept due to the rising awareness of the impacts of business practices on the environment and increasing customer expectations of product quality (Shahriarpour & Alam Tabriz, 2017). Researchers and organizations have also focused on implementation barriers and techniques for ensuring the success of GSCM (Kaur et al., 2018) as others try to align GSCM into their supply chain strategy to enable good financial performance (M. Feng et al., 2018). Considering that numerous organizations and customers are increasingly interested in adopting green supply chain management, scholars are continuously investigating different gaps and functions in the field (M. Feng et al., 2018; Zaid et al., 2018).

Sustainable supply chain management
According to (Koberg & Longoni, 2019), sustainable supply chain management refers to the coordination of material, capital, information, and the collaboration of companies along a supply chain with a reflection of the three sustainable development dimensions. Sustainable Supply Chain Management essentially means planning supply chains and making decisions according to the social, economic, and environmental parameters (Kusi-Sarpong et al., 2019). Reduce, reuse and recycle are still the slogans encompassing sustainable supply chain management on a cost-saving aspect of manufacturing firms (Su et al., 2016).

Sustainability is a hot topic among different fields, and more researchers are interested in sustainability literature to ensure competitive advantage. For instance, (Mani et al., 2018) focus on supplier social issues and metrics for enhancing social sustainability. The study emphasizes the positive influence of social sustainability practices on the performance of supply chains. On the other hand, (Koberg & Longoni, 2019) examines the hurdles of establishing sustainability in global supply chains. According to the research, global supply chains have difficulties maintaining sustainability performance while avoiding anti-social and anti-environmental results.

Big data
Big data refers to datasets whose size degree is beyond the capacities of the usual database tools that retrieve, store and evaluate data (Arunachalam et al., 2018). Big data is one of the transformative supply chain technologies of this era. The previous decade consisted of crucial information communication technologies like RFID and Enterprise Resource Planning. Big data analytics promises higher value extraction from data and fermenting organizational and technical core capabilities that improve performance (Arunachalam et al., 2018). It involves utilizing computer methods to analyze complex data to create meaningful information (Arunachalam et al., 2018). Big data can be valuable in enhancing managers to capture valuable insights instead of relying on intuitions. It also links to the success of other significant concepts like sustainability. According to (S. K. Singh & El-Kassar, 2019), higher sustainable performance results from the intersection of green human resource supply chain management, green supply chain management, and Big data management.

Mid-Pandemic
The mid-pandemic period in this research refers to the 2019-2020 period. To retrieve the top-cited documents in VOSS viewer software, the researcher first obtained the (CSV) Scopus Excel file by selecting “create a map using a bibliographic data” followed by clicking “read the data from bibliographic files.” Thirdly, we select the Scopus file format tab to obtain the document before presenting a set of analyses to be taken. Citation analysis of documents leading to an initial list of 211 papers. A minimum threshold of sixteen citations per document is input, resulting in fifteen publications, as displayed in the figure below.
This study finds three typical research streams from the most influential papers. These are circular economy, sustainable manufacturing, and industry 4.0. Table 9 shows the four clusters and documents within each group.

### Table 8: Top Cited Documents

| Rank | Paper | Research Type | Gap & Future Research | Contribution | Citations |
|------|-------|---------------|------------------------|--------------|-----------|
| 1    | (Yadav et al., 2020) | Empirical; Mixed Method | Large scale survey; Use Structural Modelling Technique | Sustainability adoption solutions | 55 |
| 2    | (Li et al., 2020) | Empirical; Quantitative | Limited data source; Individual industry testing | Creating innovative GSCM frameworks | 40 |
| 3    | (Yu et al., 2020) | Empirical; Quantitative | GHRM-GSCM impact on performance; Cross-country testing | Improving green supply chain | 31 |
| 4    | (Jia et al., 2020) | Literature review | Only one database used | Provides a conceptual model to enhance CE performance | 29 |
| 5    | (Kouhizadeh et al., 2021) | Empirical; Qualitative | Broader studies and stakeholder involvement | Adopting and implementing blockchain in sustainable supply chains | 27 |
| 6    | (Bhatt et al., 2020) | Bibliometric Analysis | Matthew’s effect on journals and article | Provides six dimensions of Sustainable Manufacturing | 22 |
| 7    | (Mani et al., 2020) | Empirical; Mixed study | Uses cross-sectional data only; Limited data generalizability | Supply chain social sustainability increases performance | 21 |
| 8    | (Hussain & Malik, 2020) | Empirical; Qualitative | Standard method bias on collecting data; Applying framework in different SCs | Provides firm actors and process facilitators enabling circular SCs | 20 |
| 9    | (Ecer & Pamucar, 2020) | Empirical; Qualitative | Limited data generalizability | Proposed model for assessing sustainable suppliers | 19 |
| 10   | (Zangiacomi et al., 2020) | Empirical; Qualitative | Effect and role of adopting more technologies | Gives guidelines on the most critical areas of adopting digital technologies | 19 |
| 11   | (Dey et al., 2020) | Empirical; Mixed Method | Stakeholder significance to CE implementation | Offers strategies, barriers, and competencies for successful CE implementation; SMEs | 17 |
| 12   | (Micheli et al., 2020) | Empirical; Quantitative | Limited data generalizability | Provides the drivers-practices and practices-performance of GSCM | 17 |
| 13   | (Rahman et al., 2020) | Empirical; Mixed Method | More empirical studies needed in different industries | Identifies barriers and solutions for GSCM implementation | 17 |
| 14   | (Beltagui et al., 2020) | Empirical; Simulation Model | Limited generalizability | SC innovation impacts on SC disruption; | 17 |
| 15   | (Karaosman et al., 2020) | Empirical; Qualitative | Limited generalizability of data | Showcases perspectives of supply chain sustainability and drawbacks | 16 |

This study finds three typical research streams from the most influential papers. These are circular economy, sustainable manufacturing, and industry 4.0. Table 9 shows the four clusters and documents within each group.

### Table 9: Top Cited Documents Clusters

| Cluster | Authors | Main Topics Covered |
|---------|---------|---------------------|
| 1       | (Dey et al., 2020), (Hussain & Malik, 2020), (Jia et al., 2020), (Kouhizadeh et al., 2021), (Micheli et al., 2020), (Rahman et al., 2020) | Circular Economy |
| 2       | (Beltagui et al., 2020), (Bhatt et al., 2020), (Karaosman et al., 2020), (Li et al., 2020), (Mani et al., 2020), (Yu et al., 2020) | Sustainable Manufacturing |
| 3       | (Ecer & Pamucar, 2020), (Yadav et al., 2020), (Zangiacomi et al., 2020) | Industry 4.0 |

Source: Research data (2021)

**Circular Economy**

According to (Jia et al., 2020), a circular economy is an industrial economy that seeks to advance sustainability by restoring designs or materials. Circular economy pops out from a regenerative and restorative perspective and expounds on the mantra: reuse, recycle.
and reduce (Ormazabal et al., 2016). According to (Dey et al., 2020), the mantra has five sub-fields. They include; taking (obtaining raw materials), making (raw material conversion), distributing (delivering finished goods), using (utility benefit), and recovering (reuse and recycle). The circular economy has had a share of relationships with supply chain management and has been crossing many intellectual discussions. First, the circular economy has a strong link with Sustainable Supply Chain Management (SSCM) concept. Its practices like reverse logistics and reuse, recycle and reduce practices are adopted by the former (Hussain & Malik, 2020). In this sense, the circular economy is well attached to sustainability as a whole, as explained in the work of (Dey et al., 2020), who explains the connection of Circular Economy (CE) to the sustainability performance of firms. The researcher elaborates on this phenomenon and includes the weight of SMEs in the discussion. It is noticeable that a chunk of research in the Circular economy has an aim and linkage with sustainability (Jia et al., 2020), and the two concepts are seemingly inseparable.

Sustainable Manufacturing

Sustainable manufacturing means producing products or services by applying sustainable economic and environmental operations (Bhatt et al., 2020). Sustainable manufacturing focuses on energy resource conservation (Bhatt et al., 2020) and the social sustainability of stakeholders in business processes. Traditional manufacturing is different from Sustainable Manufacturing. The former deals with an economic or value-adding angle, while the latter provides a complete approach (Akbar & Irohara, 2018). Sustainable manufacturing aims at achieving the sustainability paradigms; environment, social and economic (Akbar & Irohara, 2018) cumulatively. This research stream has gained spot-on manufacturing facilities and firms. Companies are increasingly negotiating ways of developing better sustainability performance. In the work of (Karaosman et al., 2020), Italian luxury supply chains focus on determining the sustainable lenses used when dealing with products. (Beltagui et al., 2020) investigates 3-D printing, otherwise known as additive manufacturing, on the innovation of social sustainability. This paper reveals that small innovative firms can adopt sustainability in strong supply chains to improve performance.

Industry 4.0

According to (dos Santos et al., 2019), industry 4.0 comprises several technologies that connect human actors, intelligent machines, and physical devices to automate operations, business value chains, and business models (dos Santos et al., 2019). Industry 4.0 aims at developing Smart Factories that deal with cyber-physical systems (Yadav et al., 2020). Furthermore, it can be a valuable part of solving sustainable supply chain management (Fatorachian & Kazemi, 2018). Due to the ever-changing environmental conditions, companies must adopt industry 4.0 to contribute solutions to SSCM implementation. Industry 4.0 technologies are revolutionizing the way businesses operate. Many previous works are mapping the progress of Industry 4.0; for example (Zangiacomi et al., 2020) discusses the digitalization path of manufacturing companies. Others like (Yadav et al., 2020) aim to use industry 4.0 as a force to achieve sustainability goals. As previously discussed, this study notices that past work combines sustainability with different concepts in influential publications.

Co-occurrence of Keywords

Keyword analysis involves the utilization of keywords within the study to form keyword network maps (Y. Feng et al., 2017). VOSS viewer software can extract keywords from abstracts and titles and analyze and rank them (Eck & Waltman, 2014). There exist three units of analysis; “all keywords,” “author keywords,” and “index keywords.” This study analyses all keywords in both pre-pandemic and mid-pandemic.

Pre-Pandemic

The researcher sets a minimum threshold of ten keyword occurrences to get a minimized list of the most popular words. Out of 1716 total keywords from the database, 21 met the standard, represented in figure 9. Same colored nodes belong to similar groups, while the size of the nodes reflects the frequency of the words. More frequently occurring words have larger nodes than the less popular keywords in the study. There are four clusters formed, as displayed in the figure.
Table 10: Most frequently used keywords

| Keyword                              | Frequency | Keyword                              | Frequency |
|--------------------------------------|-----------|--------------------------------------|-----------|
| Supply Chain Management              | 285       | Design/Methodology/Approach          | 18        |
| Sustainable Development              | 68        | Sustainable Supply Chain Management  | 17        |
| Sustainability                       | 39        | Logistics                            | 14        |
| Sustainable Supply Chains            | 37        | Supply Chain                         | 12        |
| Environmental Management             | 29        | Costs                                | 11        |
| Manufacture                          | 27        | Environmental Impact                 | 11        |
| Supply Chains                        | 26        | Commerce                             | 10        |
| Green Supply Chain Management        | 25        | Environmental Performance            | 10        |
| Decision Making                      | 22        | Product Design                       | 10        |
| Sales                                | 19        | Supply Chain Management Practices    | 10        |

Table 10 shows the most frequently occurring keywords in a research study during the pre-pandemic period. It can guide the researcher with knowledge of the general researched keywords. As can be seen, supply chain management is the most occurring keyword with 285 occurrences. According to table 10, some words are similar, for example, “sustainable development,” “sustainability,” and “sustainable supply chains.” We merge them into one word, “sustainability.” Therefore, the top keywords are “supply chain management,” “sustainability,” “environmental management,” “Manufacturing,” and “Green supply chain.” Supply chain management is the prominent keyword in this analysis attributed to its connection to the searched Scopus keywords. (A. Singh, 2016) shows that sustainability aspects of a supply chain like green supply chain management (Fahimnia et al., 2015) and sustainable supply chain management (Zhang et al., 2020) are rising fundamental parts of supply chain management. Sustainability research is widespread, and its intersection widens its promising applications with new emerging technologies like big data.

Mid-Pandemic

The researcher set a minimum of nine keyword occurrences to obtain the most popular words. Out of 1384 keywords, 23 in the database met the standard represented in figure 5. There are five clusters formed with the distinct color of nodes.
Figure 5: Co-Occurrence of keywords; Source: Research data (2021)

Table 11: Most Frequently used keywords

| Keyword                                | Occurrence | Keyword                  | Occurrence |
|----------------------------------------|------------|--------------------------|------------|
| Supply Chain Management                | 207        | Manufacture              | 12         |
| Sustainability                        | 43         | Manufacturing            | 12         |
| Sustainable Development                | 40         | Sales                    | 12         |
| Green Supply Chain Management          | 26         | Competition              | 11         |
| Supply Chains                         | 26         | Industry 4.0             | 11         |
| Sustainable Supply Chains              | 22         | Innovation               | 11         |
| Decision Making                       | 20         | Managers                 | 10         |
| Environmental Management               | 20         | Commerce                 | 9          |
| Surveys                                | 16         | Literature Review        | 9          |
| Design/Methodology/Approach            | 14         | Organizational Performance| 9          |
| **Circular Economy**                  | **13**     | **Systematic Review**    | **9**      |
| Supply Chain Management Practices      | 13         |

According to table 11, the Mid-Pandemic most occurring keywords are "supply chain management," "Sustainability," "Sustainable development," "sustainable supply chains," "green supply chain management," and "decision making." Once more, "Sustainability" could be used to merge other similar words like "sustainable development" and "sustainable supply chain." Like the pre-pandemic period, sustainability is highly popular among scholars, and they are highly accepting it in the field. "Decision making" appears in the top ten frequently occurring words because making rational decisions is crucial for businesses, as significant decisions will improve supply chain management performance (Zhang et al., 2020). Decision-making is also widely needed in other areas like circular economy (Jia et al., 2020) and sustainable manufacturing (Bhatt et al., 2020) to improve the sustainability of the supply chains. Supply Chain management remains the most prominent because of its connection to the initial Scopus search string.

Conclusion

This research is among the few studies covering research trends of supply chain management practice in the current pandemic. Previous bibliometric analysis on supply chain management has covered only data before 2017, thereby excluding the current conditions of supply chain management. Furthermore, most research has not covered data from the Scopus engine.

This research has responded to the aims of each of the authors. The current influential concepts of SCMP during the pre-pandemic are Green Supply Chain Management, Sustainable Supply Chain Management, and Big Data. In mid-pandemic, they include Circular Economy, Sustainable Manufacturing, and Industry 4.0. The trends in SCMP research indicate influential countries, journals, and papers. The USA and UK are the most influential countries in the pre-and-mid pandemic. Asian scholars are entering the European-dominated field, showing that the domain is slowly gaining interest among researchers in other parts of the world. The Journal of Cleaner Production is the most influential source, producing 47 and 27 documents consecutively in the pre-and-mid pandemic. Supply chain management, sustainability, and sustainable development are frequently occurring words. Academic researchers mostly carry out interdisciplinary studies. Researchers focus on developing, discussing, and testing theories while business decision-leaders confirm whether research findings achieve desired outcomes. One of the study's limitations is practitioners' narrow application of research. Dominant research areas like sustainability show that scholars are doing most of the work, but there is less application of the findings by practitioners. Governments and industries should incorporate modern concepts of supply chain management practice to test how applicable they are.
Secondly, we cannot ensure the reliability of current studies. Only a few prominent scholars from particular geographical segments conduct influential research. Western countries dominate recent research on supply chain management practices, while the rest of the world is left behind except China and India. Third, researchers of emergent themes like sustainability should consider using mixed methods to support their findings. Many researchers report weak arguments only utilizing a single approach only; quantitative or qualitative analysis. Fourthly, the broader inclusion of databases and enhancing more content analysis could broaden the findings of this research. Future research could include Web of Science and Google Scholar besides Scopus for an extensive bibliometric analysis. Furthermore, utilizing other network visualization tools like HistCite and CiteSpace could also offer deeper data analysis and insights relating to the subject area.

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