A Literature Review Based Bibliometric Analysis of Supply Chain Analytics

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1 Introduction

The use of analytics and advance data sciences has become essential for any organization to improve operational efficiency and productivity for competitive benefits [1]. Almost all the management streams that include production and operations management, sales management, marketing management, supply chain management (SCM), financial management, human resource management, and information technology management of an organization are using the approaches and tools of business analytics for optimizing the work efficiency and outcomes of the organization [2, 3]. Among all the management areas, supply chain management is a crucial area that directly impacts the performance of an organization. Any improvement in supply chain (SC) activities considerably enhances the organization's productivity and profitability, and supplements the interlinked supply chains of related organizations [4]. Because of it, research work based on the use of SC analytics in organizations is evolving with substantial swiftness. Various tools and processes of data analytics, business intelligence, expert systems, and qualitative and quantitative techniques are being developed and applied across multiple core domains of SCM. Research explorations are continuing in the SC analytics areas to improve the precision of supply chain decisions in planning, procurement, manufacturing, packaging, transportation, and after-sales management of an organization's products [5–8]. Because of a good focus on research ideas and academic works in and around SC analytics in recent times, there also arises a need for a systematic review of the literature to understand the research progression. Also, an estimation of research trends in SC analytics is

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required to understand the scope of future research work in the analytics and supply chain domain.

This paper attempts to provide a brief review of supply chain analytics outlining the challenges associated with SCM activities and the role of SC analytics. This paper briefly defines the basics of SC analytics and its functionality in accordance with the supply chain operations reference (SCOR) model. Further, the paper provides a short bibliographic study focusing on the last ten years (2010–2020) of research literature following the SCOPUS database. The paper will significantly contribute to the existing research literature of SC analytics. The research insights provided in this paper may aid academicians and researchers working in SC analytics areas to assess the research trends and key SC analytics areas for exploration.

2   Challenges Associated with Supply Chain Management

The supply chain of a product or service can be understood as a network of entities involved in the upward and downward flow of materials, machines, processes, finances, and information [9–11]. The management of activities across these supply chain entities is termed as supply chain management [12]. A similar definition of SCM is given by Stadtler in 2005, in which he referred to supply chain management as an upstream and downstream linkage of various organizations to manage processes and activities to add value in the product or services to meet the customer requirement [13]. So, the most critical issues associated with supply chain management are planning and designing the supply chain activities according to the needs of the consumers. Some other key issues related to supply chain management are (a) Competitiveness with the global market, (b) Selection of supply chain entities, (c) Optimization of network of organizations, (d) Process orientation and optimizations, (e) Technology challenges, (f) Minimization of production and delivery cost, and (g) Proper return management, [12, 13]. These issues raise the basic business challenges of how to meet the customer's satisfaction, how to optimize the process and flow of material, finance, and information within the supply chain, how to minimize the cost of production and delivery, and how to increase the profitability of the organization while maintaining the quality of product or services. Besides these challenges, several intermediate risks are also associated with the SCM, which poses a significant threat to the efficiency of the SC and the overall organization's performance [14]. These risks associated with SCM includes • cancellation or change of orders from the consumer side, • unavailability of workers, • machine or technological failure, • conflicting obligations from suppliers or other supply chain entities, • improper communications within SC entities, and various others [14, 15]. To manage these challenges and risks associated with SCM, there are several SCM processes over which SC analytics is used to observe, control, and improve the processes for optimized outcomes. Figure 1 shows a SC framework of an organization representing challenges and SCM processes. The following section discusses the role of SC analytics over these SCM processes.

Fig. 1 Supply chain framework for challenges and SC processes

3 Role of Analytics in Supply Chain Management

The role of SC analytics is to use the data-driven analytical tools to incorporate business intelligence into different processes of SCM to make optimal decisions in the flow of materials, information, and finances within the supply chain [11]. To meet the global competitiveness and the customer's demand, organizations induce analytical supply chain models that focus on reducing the cost and time of production and delivery. Because of it, the traditional supply chain converts into an integrated supply chain with business intelligence [16]. Supply chain integration can be considered as a multi-network business strategy to bring all the supply chain entities in synchronization with a common goal of improved response time, reduced production time with minimum costs, and waste generated in the overall value-added flow of materials [17, 18]. With the use of analytics and business intelligence tools, this transformation of supply chain occurs smoothly, addressing the challenges of business processes integration while meeting the strategic business objectives in accordance with the newly integrated supply chain processes. Optimally planned and executed decisions based on knowledge processing through SC analytics directly contribute to the bottom line of the integrated supply chain. SC analytics plays a significant role in substantially reducing procurement, transportation, inventory, and waste management costs within the supply chain while meeting the time and quality constraints [11].

With the use of SC analytics in the planning stage, organizations analyze the data of prospected customer's interests and purchasing patterns to develop a demand forecast model to predict the future demand of a product or service [19]. This demand forecast constitutes the basis of all other procurement, production, inventory, and logistics planning activities in the supply chain [20]. The use of SC analytics in the planning stage of SCM also helps to estimate the implementation gaps and the necessary arrangements required to meet these planning-to-execution gaps [21]. In the planning stage of SCM, SC analytics provides crucial information such as demand, production scheduling, inventory capabilities, delivery time, and various other details, which significantly helps activities of different stages of the supply chain [19, 20]. The procurement phase of SCM utilizes these data generated through SC analytics to assess the production requirements and, accordingly, the quality and quantity of raw materials required from the suppliers [22]. There is an adequate number of research articles available focusing on SC analytics for supplier selection and other decision-making approaches in the procurement process. The use of SC analytics is also a surplus in the production phase of SCM. Most of the production planning and scheduling decisions are based on the information from the data provided by SC analytics from the planning phase. SC analytics enables the decision-makers to optimize the production process by optimal capacity management, materials management, production scheduling, and sequencing of processes [23, 24]. With the concerns of logistics management also, organizations use SC analytics to find ways to mitigate the complex challenges associated with distribution and transportations. SC analytics aids in identifying correct transportation plans, distribution network, delivery lot size, vehicle routing, vehicle type, and cost and time-efficient delivery of goods [25–28].

On an all, SC analytics finds its practicability and applications in all the supply chain operation reference (SCOR) model phases. The well-known SCOR model was developed by the Supply Chain Council (SCC), which is a reputed non-profit organization that focuses on outlining essential processes of supply chain networks [29]. The SCOR model defines the five main supply chain management domains: 'plan,' 'source,' 'make,' 'deliver,' and 'return.' All the SCM processes, as described in Fig. 1, are incorporated with the SCOR model, and the role of SC analytics is functional over each of the management practices of the supply chain.

The role of SC analytics in the 'plan' phase includes demand forecasting, performance measurement of the supply chain, product development planning, inventory control, and capacity requirement planning. Several supply chain processes are associated with the planning phase of the SCOR model on which SC analytics are implemented for optimal planning and assessment [19–22]. These supply chain processes include consumer relationships management, consumer service management, product planning, demand and order management, and inventory management [12, 15]. In the 'source' phase of the SCOR model, the role of SC analytics revolves around supplier selection analytics, supplier performance evaluation, procurement plan, and spend analysis for sourcing materials and services [30–32]. The supply chain process of procurement management is associated with the 'source' phase of the SCOR model [12, 15]. The 'make' phase of the SCOR model is associated
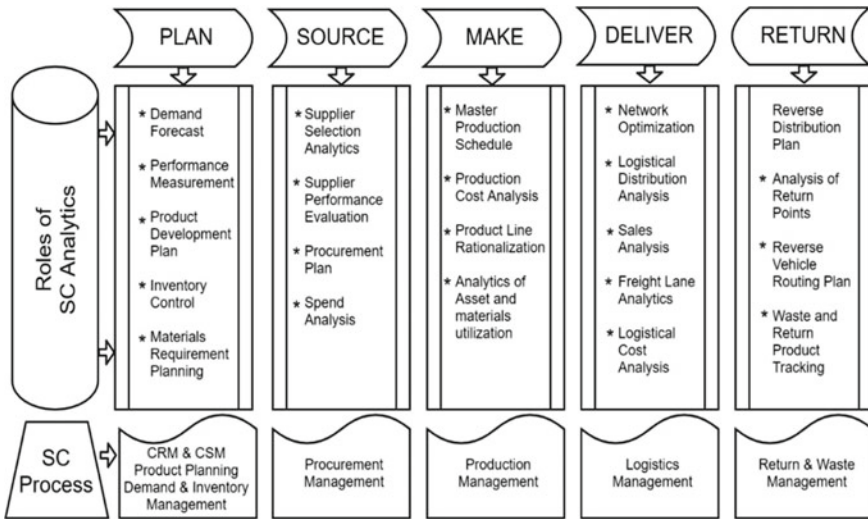
Fig. 2 A framework of SC analytics role in the SCOR model

with the production management process of SCM in which SC analytics is implemented for master production schedule, manufacturing cost analysis, product line rationalization, analysis of facility, materials, and asset utilization during production processes [23, 24, 33, 34]. Implementation of SC analytics in the 'delivery' phase of the SCOR model works on supply chain network optimization, logistical distribution analysis, sales analysis, freight lane analysis, transportation, and delivery cost assessments [27, 28]. In the 'return' phase of the SCOR model, SC analytics is utilized for reverse distribution plan, analysis of return points, reverse vehicle routing plan, and efficient waste and return product tracking [35]. The 'deliver' and 'return' phase of the SCOR model is managed in logistics management and return and waste management processes of SCM, respectively. The framework of the SC analytics role in the SCOR model is provided in Fig. 2.

4 Bibliometric Study of SC Analytics

In this section of the paper, a bibliometric study of SC analytics is provided. The research papers selected in the study are from the research literature published in the last ten years (2010–2020). In identifying the articles, dissertations, books, book chapters, conference proceedings, web and press articles, and blogs were avoided for the qualitative insights and metadata assessment.
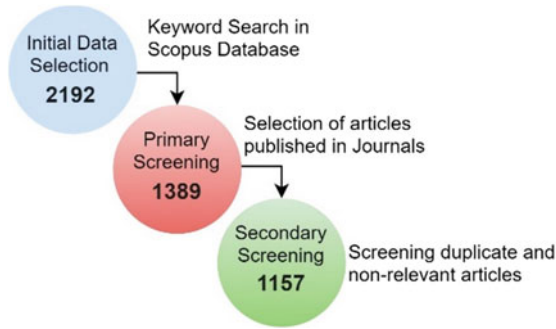
Fig. 3 Steps of article selection for bibliographic study

4.1   Selection of Research Articles

In the study, research papers were identified and selected following a three-step systematic process, as shown in Fig. 3. The first step determines initial data using the Scopus database for the last 10 years (2010–2020). In the initial search of research data, keywords like 'supply chain analytics,' big data analytics in the supply chain, business intelligence in the supply chain, 'analytics in supply and demand,' expert system in the supply chain, 'decision system in the supply chain,' 'quantitative techniques in the supply chain,' and other related keywords were used. The initial search was limited to the abstract, title, and keywords of the research articles. Through the initial search, 2192 articles were identified. In the second step, the primary screening of identified research articles was carried out. All the literature other than research papers published in journals were removed from the initially identified research articles in this screening. Through the primary screening, 1389 research papers on supply chain analytics were identified. In the last step of research article selection, secondary screening was carried out. All the duplicate entries and non-relevant articles were screened out from the selected research articles. A remaining of total of 1157 articles were selected for the bibliometric study.

4.2   Analysis and Discussion on the Bibliometric Study

The selected data for the bibliometric study of SC analytics is analyzed over yearly research trends, the research focus of various countries, different subject areas of SC implementations, most contributing journals and authors, and most influential published articles in the field of SC analytics.
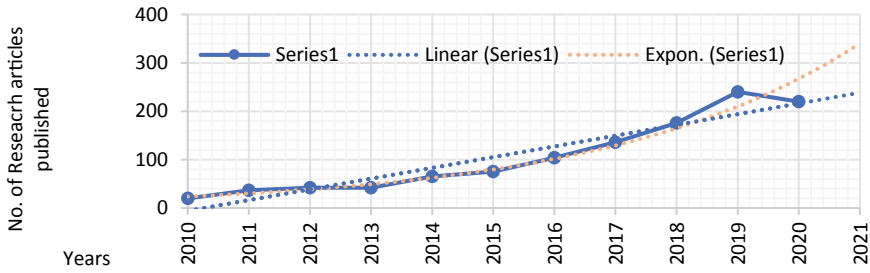
Fig. 4 Research trend for SC analytics

(I) Annual research trend for SC Analytics: The distribution of research articles published in journals in the last 10 years is provided in Fig. 4. The figure shows steady growth in articles published in journals in the previous decade with linear as well as exponential trend. From the year 2015, exponential growth can be observed in publications of articles in SC analytics. This exponential research trend proves the impact of analytics in SCM and the involvement of the researcher in exploring the analytics and data science areas to manage SC activities.

(II) The research focuses of countries in SC Analytics: Top 10 countries that have the most publication in SC analytics areas in the last 10 years is shown in Fig. 5. The USA, China, and India hold the top three ranks in the total number of published articles by countries with 327, 235, and 133 published articles, respectively. The top 10 list of countries in research publication in SC analytics holds a mix of developed and developing countries prove the seriousness of researchers towards SC analytics irrespective of geographical domain.

(III) Research in SC analytics in different subject areas: Although the implementation of SC analytics is evident in most subject areas, few disciplines dominate in the availability of research literature and scope of research work in SC analytics. The top 5 subject areas having the most published articles in SC analytics include business management, engineering, decision science, computer science, and social sciences, as shown in Fig. 6. As research can belong to more than one subject area,
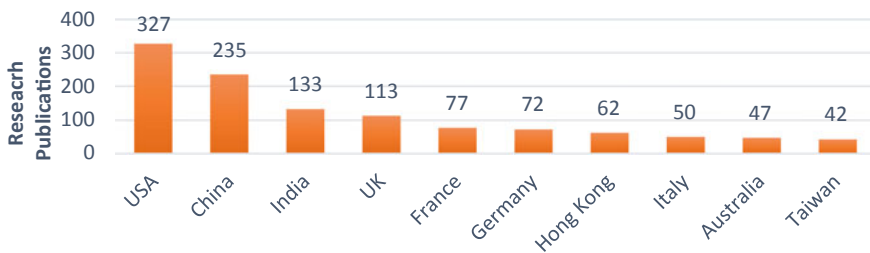

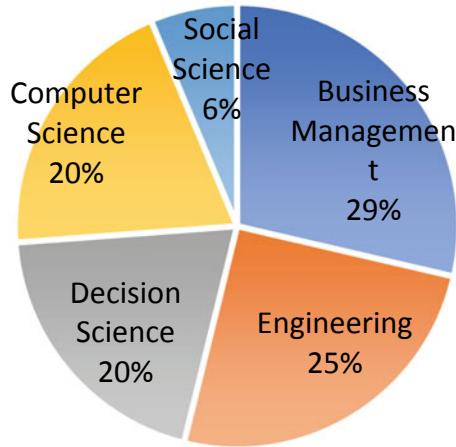**Fig. 5** Top 10 research publications by countries

Fig. 6 Percentage contribution of SC analytics research in subject areas

there are adequate publications in these subject areas with 573 publications in business management, 505 publications in engineering, 400 publications in decision science, 397 publications in computer science, and 127 publications in social science disciplines in last 10 years.

(IV) Contributions by journals and authors: Figures 7 and 8 show the list of top 5 authors and journals with maximum publications in areas of SC analytics in the last 10 years. All the top contributing journals are premier in operations and supply chain management and are also listed in the influential Web of Science database. The high publication count in these reputed journals can be considered a good measure for the scope of SC analytics in future research publications. Among the most contributions of authors in the SC analytics area, Gunashekaran, A. has a maximum number of 25 research articles. A good number of publications in the same SC analytics areas by authors show the possibility of multiple explorations of the research area along with the scope of multiple publications.
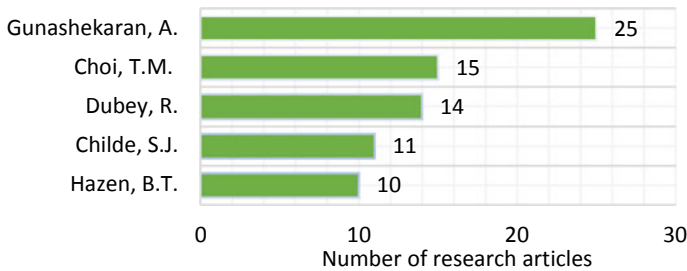

Fig. 7 Top 5 most contributing authors

Fig. 8 Top 5 most contributing journals

(V) Research articles by count of citation: In all the identified research publications of SC analytics in academic journals in the last 10 years, Table 1 provides the top 5 articles with the highest citation counts. In the last 10 years, the highest citation received on an article is 527, published in 2013, followed by the second article with 434 citations published in the year 2017.

(VI) Insights and future directions: The study provided a brief understanding of SC analytics, highlighting the challenges and integrating the usability of analytics in the SCOR model to meet the challenges. Further, the bibliometric study provided an overview of research publications in the area of SC analytics, the outcome of which shows a notable trend of inclusion of analytics and business intelligence in different business supply chain operations. The research publication trends of the last decade show significant growth in the SC analytics research literature. While the area of SC analytics is still novel, the rapid transformation of the traditional supply chain to an integrated supply chain has forced academicians and researchers to explore the role of SC analytics in different processes of SCM, which resulted in significant research publications in past years. Insights of the bibliometric study also substantiated that reputed journals are giving space for SC analytics-based research work. With possibilities of good citations, the scope of publication in reputed academic journals, and the integration of supply chain analytics in most subject disciplines, SC analytics has an enriched prospect in future explorations and studies. Under the future prospects, this research study can provide a basis for an extensive literature review for the SC analytics domain. The research study is limited to the research database of Scopus, and future work can include other reputed databases like Web of Science for a holistic review of SC analytics literature.

Table 1 Top 5 research articles by citation count

SN	Authors	Title	Year	Journal	Citation
1	Waller M.A. and Fawcett S.E	Data science, predictive analytics, and big data: A revolution that will transform supply chain design and management	2013	Journal of Business Logistics	527
2	Wolfert S. et al.	Big Data in Smart Farming—A review	2017	Agricultural Systems	434
3	Wang G. et al.	Big data analytics in logistics and supply chain management: Certain investigations for research and applications	2016	International Journal of Production Economics	401
4	Hazen B.T. et al.	Data quality for data science, predictive analytics, and big data in supply chain management: An introduction to the problem and suggestions for research and applications	2014	International Journal of Production Economics	351
5	Gunasekaran, A. et al.	Big data and predictive analytics for supply chain and organizational performance	2017	Journal of Business Research	238

5 Conclusion

This paper attempts to provide a brief review of SC analytics and provide a bibliometric study of past research for the last 10 years. The paper provided a supply chain framework of challenges associated with supply chain processes. The paper also discussed the role of SC analytics and mapped the different roles with the SCOR model. The paper provided another framework of SC analytics related to plan, source, make, deliver, and return phases of the SCOR model along with interrelation with different supply chain processes. The bibliometric study provided in the paper discusses the paradigms of trends, demography, research disciplines, and influential journals and publications associated with the literature of SC analytics. The paper is a short assessment of research literature on SC analytics, which is limited to data collection constraints. The study can be used in future work for a more comprehensive review of research literature on supply chain analytics.

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