Publisher
Vandana Publications
www.vandanapublications.com

International Journal of Engineering and Management Research

2025 Volume 15 Number 1 February

E-ISSN:2250-0758
P-ISSN:2394-6962

Research Article

Future Trends

A Review of Literature on Sustainable Supply Chain Management: Challenges and Solutions

Vasanthan A[1*], Amudha R[2]

DOI:10.5281/zenodo.14848112

[1*] Vasanthan A, Student, School of Management, Sastra Deemed University, Thanjavur, Tamil Nadu, India.

[2] Amudha R, Associate Professor, School of Management, Sastra Deemed University, Thanjavur, Tamil Nadu, India.

Sustainability in supply chain management is crucial approach that combine environmental social and the economic factor into supply chain operation. it increasingly identified as a essential component for achieving environmental, economic and social sustainability within organization. This review strengthens the research insights organised the challenges, factors affecting environment and future trends in sustainability in supply chain management adoption. This paper explores various dimension of sustainability in supply chain management and highlighting the above Research Insights that Shape its implementation. Additionally the route to achieving sustainability are highlighted through innovative structure, technological advancement and policy based solution. The key difficulties such as organizational barrier, financial constraints are analysed alongside possibly presented by industry 4.o, circular economy model and green logistics. Besides, policy and regulatory issue plays a vital role in molding the landscape of sustainability in supply chain management in many zones inadequate government support under vague regulations hinder companies efforts to accept sustainable practices. The paper is structured into several key sections: challenges and barriers of sustainability in supply chain management, environmental factors of sustainability in supply chain management, future trends in sustainability in supply chain management, achieving sustainability in supply chain management. The each section combine existing research and offers insights how these elements connect to Forster sustainability in supply chain.

Keywords: Sustainability in Supply Chain, Challenges and Barriers, Achieving Sustainability, Future Trends

Corresponding Author

Vasanthan A, Student, School of Management, Sastra Deemed University, Thanjavur, Tamil Nadu, India.
Email: 007vasanthan19@gmail.com

How to Cite this Article

Vasanthan A, Amudha R, A Review of Literature on Sustainable Supply Chain Management: Challenges and Solutions. int. j. eng. mgmt. res.. 2025;15(1):23-35.
Available From
https://ijemr.vandanapublications.com/index.php/j/article/view/1685

To Browse

Manuscript Received	Review Round 1	Review Round 2	Review Round 3	Accepted
2025-01-01	2025-01-17			2025-02-07

Conflict of Interest	Funding	Ethical Approval	Plagiarism X-checker	Note
None	Nil	Yes	3.32	

© 2025 by Vasanthan A, Amudha R and Published by Vandana Publications. This is an Open Access article licensed under a Creative Commons Attribution 4.0 International License https://creativecommons.org/licenses/by/4.0/ unported [CC BY 4.0].

1. Introduction

Sustainability in supply chain management is an emerging area of study, focusing upon environmental, social, and economic considerations in the operation of supply chains. The conventional technique of supply chain management was only focused on cost reduction and efficiency and gave a long-term perspective of sustainability. As globalization and industrialization further enlarge the adverse effect of conventional supply chain method on the environment, issues related to resource depletion, pollution and climatic alteration raise a great concern for shifting focus toward more environmental friendly practices. According to research findings, technology barriers are highlighted, which are further connected with implementation issues of modern treatments like block chain technology. while blockchain remains a highly potent tool for supplying transparency and trackability in a supply chain, its acceptance had been slow by issues about its costs, its complexity, as well as need for industrywide cooperation. Aside from that organizational challenges often came from resistance against change within some companies that never give a thrust on sustainability and lack the sufficient expertise to get new practices smoothly executed.

The environmental factors influencing sustainability in supply chain management are energy efficiency, circular economy principle, green logistics, water management, waste reduction strategies, and biodiversity consideration. All the above elements contribute to a more sustainable supply chain.

It reduces resource use and decreases the negative impact on the environment. For instance, the adoption of circular economy can significantly reduce the generation of waste while enhancing resource efficiency through recycling and reuse.

Emerging trends in sustainability in supply chain management indicates a growing consciousness of the needs for organizations to adopt practices that promote environmental management and social responsibility.

As organizations seek to achieve sustainability in their supply chain, they must identify emerging trends that will become the future of sustainable supply chain management.

This is probably going to promote further development in supply chain practices as business searches for ways of addressing carbon footprints while attaining the demand for sustainability sourced products. The digital transformation through technologies such as artificial intelligence and the industry 4.o will also enhance supply chain operations through better data analysis and decision-making.

Moreover, operation research can help firms develop metrics and measures for understanding performance in its supply chain. Such metrics let companies monitor a path toward some social sustainable objectives and adapt policies. Thus, operation research goes beyond the need to optimize operations in the supply chain to engender a more social responsibility type of commitment-ultimately promoting more sustainable supply chain practices which are also better balanced.

The concept of sustainability in supply chain management summarizes the meaning to an important review of how business should work in an increasingly interlinked world. Overcoming barriers or obstacles of sustainable adoption in maximizing technological progress and collaborative approach sets forward a way of resilient and responsible supply chains.

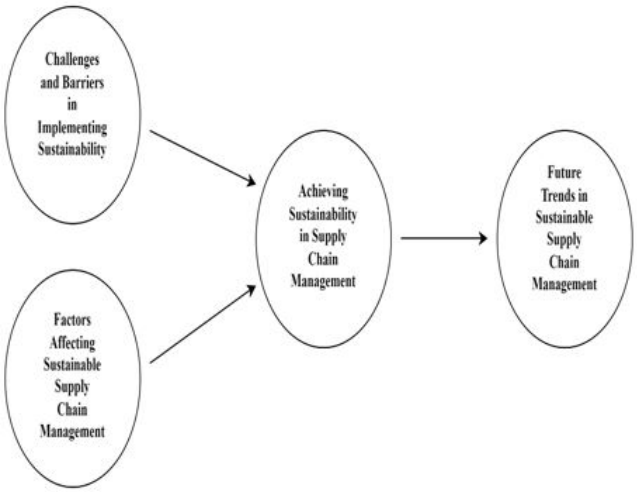
The review's objective is to provide an in-depth analysis of challenges, barriers, environmental factors, and future trends in sustainability in supply chain management. This paper is structured into the following sections: challenges and barriers, environmental factors influencing SSCM, emerging trends, achieving sustainability, and a concluding section emphasizing future research directions.

2. Methodology

This review paper "Challenges and Barriers in Implementing Sustainability in Supply Chain Management" utilizes systematic literature review. It will then help analyze any available research studies and break them into four themes that include: Challenges and Barriers, Factors Affecting Sustainable Supply Chain Management, Achieving Sustainability, and Future Trends. These four are guided by comprehensive reviews of ten peer-reviewed papers for research robustness to achieve the desired SSCM complexities.

Selection of Literature

The literature selection procedure started with the systematic search from academic databases; these include Scopus, Web of Science, and Google Scholar. The used keywords were, for example: "sustainable supply chain management," "challenges," "barriers," "factors that affect sustainability," and "trends in the future." Such a strategy attempted to capture appropriate articles published within the last ten years.



Review Process

The review process was segmented into the following:

Initial Screening: The titles and abstracts of the papers chosen for shortlisting were screened to see how relevant they were to the research focus.

Full-text Review: Full texts of selected articles were analyzed to seek detailed insights, methodologies, and findings.

Data Extraction: Key findings about challenges and barriers towards achieving sustainability and strategies for achieving such sustainability were extracted from each paper and categorized appropriately under the respective themes.

Thematic Categorization

Categorization of the literature into themes was based on a conceptual framework that is pertinent to the study objectives. There are four significant themes, arranged as follows:

1. Challenges and Barriers to Implementing Sustainability in Supply Chain Management. This theme summarizes technological, organizational, financial, and regulatory obstacles identified in multiple studies. Blockchain adoption and circular economy models presented challenges that would be considered sizeable.
2. Factors that influence sustainability practices in the supply chain, including stakeholder engagement, policy frameworks, and technological advancements.
3. How Sustainability Is Attained in Supply Chain Management: This section considers successful strategies and case studies of different industries that can be useful for best practice organizations to attain sustainability.
4. Future Trends in Sustainable Supply Chain Management: It presents the future of trends and practices related to industries and Industry 4.0 technologies shaping supply chains of tomorrow.

Synthesis Process

An integrated process of summarizing findings from the reviewed literature derives insights into how challenges and barriers affect achieving sustainability in supply chain management. A thematic approach has been applied to identify patterns, similarities, and differences between studies. A comparative analysis has also been conducted to better evaluate how these different industries and businesses handle similar sustainability challenges. Such an approach allowed for the gaining of a more informed understanding of the interrelationships between barriers and strategies toward sustainability.

This systematic review methodology is to be used to explore the challenges and barriers associated with the implementation of sustainability in supply chain management by categorizing literature under key themes and rigorous selection criteria. Therefore, this paper aims to provide valuable insights into effective strategies to enhance sustainability within supply chains and identify future research directions that may further advance this critical field.

3. Challenges and Barriers in Implementing Sustainability in Supply Chain Management

It highlights a review of many studies based on explorative analysis of complexities around sustainable practices of supply chains.

Kouhizadeh et al. (2021) investigate the barriers to the adoption of blockchain technology in sustainable supply chains using a technology-organization-environment structure. Key barriers are identified such as technological and supply are identified such

As technological and supply chain problems by conducting a detailed literature review and expert inputs that are then further analyzed using the Decision-Making Trial and Evaluation Laboratory (DEMATEL) tool. The outcome is that academics and practitioners find the technological barrier as a strong obstacle to adopting blockchain. This research supports understanding the challenges related to the adoption of blockchain in sustainable supply chains.[i]

Mangla et al. (2018) pays attention to the CSC model in the developing world particularly India. Based on literature review and specialist review, 16 barriers to adopting CSC have been identified through evaluation using an integrated Interpretive Structural Modelling - MICMAC approach. The core challenges are that of governing policies and technological capability that hampers the switch from linear models to circular ones. This study is important because it highlights the economic and environmental benefits of overcoming such barriers to help implement CSC.[ii]

Tseng et al. (2019) have conducted a literature review on GSCM from 1998 to 2017, reviewing 880 papers from the Scopus and ISI Web of Science databases. It establishes a declining trend of research focused on drivers and barriers while finding a rise in mathematical optimization models in an effort to enhance environmental outcomes. It identifies important authors and institutions within the field and develops a conceptual model for GSCM that guides future research efforts. The paper identifies that further investigation is needed in the social aspects of sustainability, which have been neglected the most.[iii]

Álvarez Jaramillo et al. (2019) analyze the 50 high-impact sustainability articles on issues faced by the SMEs within the sustainability. They identify a total of 175 barriers broken down by sectors, sustainability resource, and factor type. Similar issues include access to resources; initial costs or expenses to deliver sustainability practices. This basic evaluation becomes a base for future qualitative and quantitative research of sustainability obstacles specific to SMEs and offers valuable observations for practitioners targeting to lead these challenges.[iv]

Luthra and Mangla (2018) assess the challenges Industry 4.0 projects face in promoting supply chain sustainability within developing markets like India. They narrow down 18 significant barriers into organizational, technological, strategic, and legal dimensions using an extensive literature review and responses to the questionnaire of Indian manufacturers. The study reveals that effective strategies are required to address these problems for the successful implementation of Industry 4.0 in sustainable supply chains.[v]

Barbosa-Póvoa et al. in 2018 investigated the usage of OR approaches for sustainable supply chains, including 220 documents to analyze the trends with regard to levels of decision making and sustainability practices. They have found that primarily optimization models in most cases focus upon economic and environmental sustainability aspects only but fail to maintain social sustainability, and this study discusses the prevailing literature gaps to clearly define what sustainability is inside OR methodologies suggesting further research prospects with social values included.[vi]

Yadav et al. (2020) create the framework through which the addressing of SSCM challenges, with Industry 4.0 and circular economy solutions, based on an automotive case study. They found 28 challenges for SSCM and recommend 22 solution actions from a hybrid Best Worst Method-ELECTRE approach for ranking. The key highlights from managerial, organizational, and economic challenges through suggested solution actions for SSCM adoption.[vii]

Kumar et al. (2021) study major barriers to the adoption of Industry 4.0 and circular economy models in agricultural supply chains in India. Through this literature review and expert interaction, they identify eleven key barriers modeled using an integrated ISM-ANP approach. The study points out government support as a significant barrier while giving insights into planned execution aspects for stakeholders involved in agricultural supply chains.[viii]

Younis et al. (2016) talk about the impact of implementing GSCM practices on the performance of the company across economic, environmental, and social outcomes. The relevance of integrating GSCM practices into corporate strategies in improving overall measures of performance is thereby established while meaningful insight into how these practices create competitive advantage is portrayed.[ix]

Yildiz Çankaya and Sezen (2019) analyze the results of eight dimensions of GSCM, such as green purchasing and green manufacturing, on corporate sustainability performance across economic, environmental, and social spheres. Their results bring out the relationship of these factors in achieving holistic sustainability goals within organizations while providing observational evidence to support the implementation of GSCM practices. [x]

These papers collectively provide a solid foundation from which to base an understanding of the diverse issues associated with supply chain management concerning sustainability across all contexts, touching on technological breakthroughs such as blockchain and Industry 4.0, among other things while addressing the needs of SMEs and developing nations in their integration into the circular economy. However, there are some gaps in terms of multidisciplinary approaches that include social aspects into frameworks on sustainability and long-term studies that evaluate how applied practices impact industries in the long term. In addition, there is a need for exploration to create more holistic strategies that can therefore be able to address the emerging issues of sustainability in global supply chains.

4. Factors Affecting Sustainable Supply Chain Management

The existing literature on SSCM shows that research is multifaceted as well, encompassing all kinds of factors influencing the sustainability of most industries.

Centobelli, Cerchione, and Esposito (2018) demonstrates an elaborative systematic review of energy effectiveness and environmental sustainability in supply chain management. It has reviewed 122 refereed articles for working out the research trends as well as gaps in it. The research shows growing interest but there are still very significant gaps of knowledge regarding the effect of energy efficiency on supply chain performance and sustainability supporting technologies.[xi]

Agrawal et al. (2023) focused on the critical success factors (CSFs) that lead to the acceptance of sustainable green supply chain management (SGSCM) practices by the brass manufacturing industry in India.

From the empirical survey of 189 administrative professionals, nine CSFs were established, and among them, the most important is the involvement of top management. Though this research is well aligned with existing literature on SGSCM, it fails to provide rankings on these factors. The results bring to the fore reverse logistics management as critical for effective adoption of SGSCM.[xii]

Irani et al. (2017) investigate the role of knowledge management in supporting green supply chain collaboration (GrSCC). They propose a model that identifies significant factors influencing GrSCC using vague cognitive mapping techniques. The research points out that although KM has improved corporate efficiency across sectors, there is still limited research on its implementation in green supply chains.[xiii]

Peprah, Opoku-Fofie, and Nduro (2016) study factors that influence green supply chain management in the mining sector of Ghana. A qualitative analysis by the researchers indicates that the procurement methods decrease the environmental effects but are hindered by the lack of understanding and knowledge regarding green supply chains. The findings are significant as it identifies crucial barriers such as high costs related to environmental programs and inefficient control systems.[xiv]

Andalib Ardakani and Soltanmohammadi (2019) examine drivers of sustainable supply chain management through a theoretical framework of 6 hypotheses. Their work comprises an 18-item survey administered to 91 industry experts, with findings assessed using partial least squares path modeling. Results indicate that green product development has a positive influence on social concerns by enhancing the management of environmental performance.[xv]

Tippayawong et al. (2016) emphasized the performance of the operation of green supply chain management for the auto parts industry of Thailand. A model for GSPM is presented to combine a variety of concepts for efficiency in 5 main areas and 28 sub-factors. Through their component analysis, 3 critical areas emerged: green procurement, transportation, and manufacturing; reverse logistics; and eco-design. This research focusing on critical factors that promote operational efficiency. [xvi]

Hussain, Khan, and Al-Aomar (2016) address sustainability in service industries in the Arab world, where research lags behind production industries. The information collected from prominent industries in Abu Dhabi. This research uncovers numerous relevant aspects contributing to sustainable supply chain management practices and offers dependable gauges for the practitioners. The research work improve insight into the sustainability challenges that are unique to service industries in emerging areas.[xvii]

Khan et al. (2018) examine the nexus between green logistics operations, energy demand, economic growth, and environmental sustainability over 43 countries by using panel Generalized Method of Moments evaluates. According to their results, supply chain activities significantly account for energy use and greenhouse gas emissions while suggesting that renewable sources of energy could mitigate these impacts.[xviii]

Tumpa et al. (2019) conduct an extensive review of the barriers to green supply chain management adoption in the textile industry of Bangladesh. The authors identify 15 barriers based on a survey of 30 practitioners, among which weak customer demand and monetary constraints are deemed critical barriers for the adoption of sustainable practices. The study is relevant for developing government policies.[xix]

Kaur and Awasthi (2018) suggest a classification framework of the barriers to sustainable supply chain management based on a literature review. They classified barriers into 6 categories associated with processes, stakeholders, areas of sustainability, corporate structure, psychological factors, and technological barriers. This classification helps decision-makers highlight steps to attain sustainability.[xx]

These 10 papers jointly help in the understanding of sustainable supply chain management by dealing with several dimensions including key drivers, knowledge management roles, operational performance metrics, geographical obstacles, and industry or economy-specific barriers. Although they provide necessary insights into already existing problems and suggest structures of development, drawbacks like limited scope or sample sizes highlight the further need for such research to take into account many sectors and regional zones in an effort to make comprehensive approaches that can enhance the sustainability of a supply chain.

5. Achieving Sustainability in Supply Chain Management

It offers in-depth analysis on the different works concerning the different facets of issues faced by the supply chain due to sustainability

Kamble, Gunasekaran, and Gawankar (2020) discuss key challenges in the agri-food supply chain - the industrialization gaps, managerial inefficiencies, and information discrepancies. They are of the view that sustainable agriculture has to ensure all the above societal, environmental, and economic requirements while implementing innovative technologies of IoT, blockchain, and big data to formulate a data- based supply chain scenario. This article provides a review of 84 academic journals on the need for better supply chain visibility and resource allocation to build data analytics capabilities. The authors present a framework to help guide practitioners in developing robust data-driven agri-food supply chains.[xxi]

Govindan (2018) identifies the issue of how sustainability can be obtained in SCP for food supply chains. Coordination between the parties involved in a chain needs to be improved in order to implement SCP. In the paper, a conceptual framework is presented by focusing on stakeholder theory for SCP. Using various theories such as institutional theory and dynamic capability theory, indicators and barriers in SCP are revealed. The findings thus emphasize the significance of stakeholder coordination in minimizing food wastage and improving sustainability practices in the food industry.[xxii]

Hong and Guo (2019) investigate environmental sustainability in green product supply chains. Their research models three types of contracts: price-only, green-marketing cost-sharing, and two-part tariff contracts. The results are that cooperation among partners can bring about significant environmental improvements. The study provides insight into how consumer awareness of sustainability influences supply chain dynamics and highlights the need for careful contract design to balance profitability with environmental responsibility.[xxiii]

Miemczyk and Luzzini (2018) emphasize the interplay between sustainable supply chain strategies, practices, and performance outcomes,

Which incorporate risk management within their research framework. The authors claim that though sustainability priorities are related to the triple bottom line performance, still, there are very limited efforts made on existing frameworks for discussing risk management. This paper extends the knowledge regarding how risk management can positively enhance sustainability by evaluating product categories in terms of supply chain practices.[xxiv]

According to Wilhelm et al. (2016), "double agency" roles exist for first-tier suppliers in multi-tier supply chains as they interact with sustainability compliance. Their study is based on agency and institutional theories to derive an analysis of how lead firms' requirements regarding sustainability are met by first-tier suppliers who implement similar standards with their own suppliers. They identify the factors that influence these dual roles, namely, resource availability and lead firm power dynamics. Their findings are understanding of multi-tier sustainable supply chains and point to the need for incentives that are designed with the first tier of suppliers in mind.[xxv]

Rees (2021) asserts that the existing paradigm of expansionary economics is destructive ecologically, arguing instead for transformation to an ecological sustainability model. The paper insists that economic change has to respect the natural laws that determine energy and material-use patterns but favors smaller local-scale, integrated production units over large industrial-unit scales. It further claims that genuine sustainability can only be achieved by reassessing market mechanics with an ecological steady-state approach.[xxvi]

Karmaker et al. (2021) explore how the COVID-19 pandemic affects Bangladesh's sustainable supply chain practices using key drivers critical for resilience against disruptions. They critically identify relationships about drivers that critically affect sustainable supply chain performance at times of crises. The study has therefore highlighted the need for government and partners to invest in finances, which would address immediate shocks, yet advocate for policies that would concentrate on health protocols and automation.[xxvii]

Paulraj et al. (2017) investigate corporate motives for SSCM practice engagement through a multi-theoretical lens that includes instrumental, relational, and moral perspectives.

Empirical analysis reveals that relational and moral motives significantly drive SSCM engagement, with firms exhibiting high moral obligations outperforming those driven by amoral considerations. It therefore completes a gap in SSCM literature by relating the motives of firms to outcomes on performance and sheds insights that may benefit policymakers trying to promote responsible business practices.[xxviii]

Zhong et al. (2016) present an examination of Big Data's applications within the service and manufacturing sectors, and particularly how its implementation is set to change SCM. Challenges facing organizations as they adopt Big Data solutions are discussed. The authors, therefore, provide very useful insights into opportunities for improving decision-making with Big Data analytics across different regions, including North America, Europe, and Asia Pacific, for academia and practitioners interested in implementing effective Big Data strategies in SCM.[xxix]

In summary, sustainability issues within supply chains that address technological adoption, coordination between stakeholders, practices of managing risk, and motives of corporates, together with responses toward a crisis of such nature as COVID-19. Identifying various barriers to sustainable practices across diverse contexts, there are gaps in empirical research that focuses upon antecedents of SSCM engagement. Indeed, future research ought to bridge these gaps by exploring innovative methodologies that enhance our understanding of the drivers of sustainable practices in complex supply chain networks.

6. Future Trends in Sustainable Supply Chain Management

It gives an overall analysis of the changing landscape of the sustainable supply chain management landscape through empirical and conceptual studies of the past decade and beyond. It seeks to classify related trends, identify challenges, and possibly unveil future research directions in the field.

Khan et al. (2021) perform a meta-analysis of 362 research papers between the years 2004 and 2019 to find the drivers and barriers of sustainable supply chain management (SSCM).

It shows that the area is predominantly comprised of Multiple-Criteria Decision Making (MCDM) methods and level firm studies level to studies. The economic paper modeling current macro trends and gaps in the literature also provides a basic understanding of the foundation of research in this area for future work.[xxx]

De Oliveira et al. (2018) provide a systematic literature review on Green Supply Chain Management (GSCM) focusing on its financial impacts and the motivations to implement it over the past decade. From the analysis, it is revealed that the automotive, textile and electronics sectors are the popular contexts; used empirical research. This significant study concentration contributes of to research the from understanding developed of countries GSCM's and evolution at and the identifies same the time opportunities observe the underrepresentation for future research in the less explored regions.[xxxi]

Dubey et al. (2017) call for the adoption of Total Interpretive Structural Modeling (TISM) in studying SSCM drivers. They suggest that current literature lacks adequate methodological approaches towards SSCM which are dynamic. The authors fill the gap of the quantitative-qualitative divide in SSCM research by reviewing SSCM drivers systematically and putting forward TISM as a conceptual framework for SSCM drivers.[xxxii]

Bastas and Liyanage (2018) conducted a systematic review of integrating quality management with sustainability in supply chains. The authors highlighted the key themes and trends in establishing synergies between quality management and sustainability practices. The study concluded that the integration of sustainability into quality management is an emerging area that has tremendous scope for performance improvement across organizations.[xxxiii]

Chen et al. (2017) review literature on supply chain collaboration for sustainability. They find increasing attention to the economic and environmental metrics while leaving social concerns in the dark. Their systematic review of literature further identifies gaps about the dynamics of collaboration among other stakeholders than merely between suppliers and customers.[xxxiv]

Bag et al. (2021) investigate the effects of Industry 4.0 on the sustainability of the supply chain and identify critical enablers of this interaction.

It also proposes a research framework to fill the current theoretical gaps concerning the effect of Industry 4.0 technologies on sustainable supply chains. The paper bases its argument that technology is the most important field that can elevate sustainability practices in supply chains. [xxxv]

Lahane et al. (2020) present a state-of-the-art review on Circular Supply Chain Management (CSCM), scrutinizing 125 articles published in the last ten years. Advanced quantitative modeling approaches and innovative frameworks are suggested by the authors to explore critical success factors and barriers to the implementation of circular practices in supply chains.[xxxvi]

Min et al. (2019) reflect on the evolutionary history of supply chain management by critically reviewing the outstanding citation of their 2001 paper that has been published for the past two decades. Against the changing market and technology, the practice of SCM is discussed in terms of the new frameworks that are developed to maximize supply chain configurations and firm partnerships.[xxxvii]

Kamble et al. (2018) pay attention to how Industry 4.0 influences the sustainability factors in manufacturing companies by summarizing the existing knowledge on different Industry 4.0-related technologies. They then categorize these selected papers in terms of topics like human machine interaction and effects on sustainability in order to end with a holistic sustainable Industry 4.0 framework that integrates such components. [xxxviii]

Schniederjans et al. (2020) study supply chain digitization trends using literature review with complement textual analysis across media sources during 2010-2018. They pointed out the available opportunities to harness knowledge management toward better digital performance in supply chains and also underscored a prominent gap between what is published by academicians and what is put into practice by practitioners in the case of digitization.[xxxix]

In summary, these ten papers collectively contribute to the advancement of knowledge in sustainable supply chain management by covering up different aspects of technological integration, collaboration strategies and methodological approaches, while key issues were identified as significant gaps within further exploration needed within future research endeavors.

7. Critical Analysis

Evaluating SSCM indicates the multifaceted game of challenges, factors, and future trends related to the domain. One recent emphasis of most research studies focuses on the integration of blockchain technology into the operations, which vows to enhance the effectiveness and openness of supply chains. It notes that the introduction of blockchain technology is Halted by technological, organizational, and environmental constraints; the researchers and practitioners point to Supply chain issues as a very significant source of hindrances. This Gap is critical because it highlights a difference in how diverse stakeholders perceive and respond to such Challenges. In addition, the Review of the circular supply chain (CSC) model Suggests that while the developed countries have already put into place the Infrastructure for Effective implementation, multiple barriers establish the differences and do not allow development in the developing countries. 16 barriers identified as specific to CSC adoption in India have Shown an urgent requirement for Tailored plans in order to Encourage sustainable practices in Emerging economies. In addition, literature reviews are found to experience a decline of research on the Influencers of GSCM and challenges whereas the number of mathematical optimization models intended to boost environmental efficiency keeps increasing. This calls for a total understanding of complete GSCM practices and thereby emphasizes the need to do more research on social dimensions of sustainability, which often get neglected. SME studies Researches into small and medium enterprises (SMEs) Reveals that the high startup costs and lack of resources have majorly Inhibited the sustainability practices, hence, suggesting the requirement of Structures that take these problems as priorities. Besides, Impact of Industry 4.0 technologies on sustainable practices Reveal the both Opportunities and challenges, while the organizational challenges ranked as a significant barrier to adopting these technologies. Generally, though huge strides have been taken in highlighting the challenges and enablers in SSCM, significant gaps are left out about long-term studies analyzing lasting effects and interdisciplinary approaches combining knowledge from different areas.

Future research will have to tackle these gaps through implementing comprehensive frameworks that cover various economic contexts, thus exploring interrelations between technological, organizational, and social factors in order to achieve successful sustainability in supply chain management.

8. Research Gap

The Current research about sustainable supply chain management (SSCM) reveals Numerous critical research gaps that merit further Investigation to Improve the understanding and implementation of sustainability Techniques across various industries. A very important gap in this respect is the Absence of long-term research that assesses the effects of sustainability actions over time- the long-term- which is important in determining whether the practices implemented are effective and sustainable. Most recent studies tend to focus on short-term results and overlook how such practices develop and affect supply chain patterns in the long term. Furthermore, there is a significant shortage of interdisciplinary approaches that integrate knowledge from technology, management practices, environmental science, and policy-making. This integration limits the depth of existing studies and hinders the establishment of strong frameworks that would do justice to the complex characteristics of sustainability challenges. In addition, when it comes to technological barriers for instance in a blockchain and also Industry 4.0. There are issues of inadequate investigation into their effective executions along different contexts specially in the development countries that also have limited resources in infrastructure. The Discrepancy between developed and developing nations in implementing supply chain (CSC) models also points out a critical gap; while developed nations have established governance structures, developing countries often lack the required support mechanism to facilitate similar changes. Furthermore, GSCM research has witnessed a recent decline in interest in drivers and barriers, even though the optimization models targeting better environmental performance are on the rise. This change evokes the Thorough understanding of GSCM practices and, therefore, necessitates further evidence-based studies in order to pinpoint the root causes that may either restrict or facilitate the adoption of sustainability practices across different fields.

More than this, the social aspects of sustainability are overlooked and instead focused on economic and environmental Factors, which point to the need for a study that Covers all three aspects of sustainability Thoroughly. Another relatively less studied area is the particular Barriers that face SMEs in the implementation of sustainability programs; even though some studies Mention that obstacles are high starting-up costs and limited resources, not much work frames these problems or offers Specific advice for the needs of SMEs. The last gap is that of regional variation. It remains somewhat under researched. it is necessary to understand regional drivers behind the adoption and effectiveness of SSCM approaches in order to increase substantially the relevance and validity of research findings. Closing these gaps may help achieve a more nuanced understanding of SSCM, which can then be translated into more efficient manufacturing lines for overcoming extant challenges and enhancing sustainability within various sectors across the globe.

9. Conclusion

The study on sustainable supply chain management (SSCM) has revealed a wide, diversified landscape explained by Major challenges, impactful factors, and the ever-changing trends which are indispensable to advancing sustainability practices across Different industries. The critical analysis conducted herein is comprehensive, bringing into the light how blockchain technology will help in increasing efficiency and transparency within the supply chains while highlighting the continuous challenges of its implementation in technological, organizational, and environmental contexts. These obstacles not only impede the quick adoption of blockchain but also signify a larger divide in the understanding of scholars and practitioners in the challenges surrounding sustainability initiatives. In addition, the Study on CSC models Reveal a great divergence between developed and developing countries; the former are blessed with an existing regulatory system and technological setup, while the latter Face extreme challenges that Cause them to be further behind in development toward sustainable practices.

The specificities of the problems identify challenges facing the adoption of CSC in countries such as India, giving evidence of the need for specific strategies that can be used to drive economic development and environmental sustainability. Further, the literature review on GSCM reveals a disturbing trend in research concentrated on identifying drivers and barriers to sustainability, even as models of optimization abound with a view to improving environmental performance. This gap shows an Essential requirement for more in-depth analyses that take into account the economic and social dimensions of sustainability within GSCM frameworks. The SMEs face greater difficulties, since high initial costs and resource shortages Substantially hinder their capacity to adopt sustainable practices. The targeted frameworks may help in addressing these difficulties so that SMEs can better contribute to sustainability goals. In addition, the impact of Industry 4.0 technologies on sustainable supply chains is both an opportunity and a challenge; whereas these technologies promote innovation, the organizational challenges remain a Major obstacle to their adoption. Common themes across various studies are that there is a need for supportive regulatory frameworks that Enable sustainability programs in supply chains, but varied outlooks on which Challenges are the most critical underline the complexity of SSCM research. Conclusion: Significant progress has been made to date in the identification of the Difficulties linked with implementing sustainability within supply chain management-from blockchain technology adoption to circular economy implementations; however, there are significant gaps concerning the interplay of these barriers across different fields. Future studies must use an interdisciplinary approach with information drawn from technology, management practices, environmental science, and policy-making that addresses regional differences in the challenges of sustainability. Longitudinal studies Assessing the long-term impacts of conducted sustainability activities could further expand this area by Providing better insight into Successful strategies to overcome current challenges in sustainable supply chain management around the world. The above gaps are to be addressed to promote a more sustainable future for supply chain management and allow firms to manage profitability with sustainable practices and social responsibility.

References

[I] Kouhizadeh, Mahtab, Sara Saberi, & Joseph Sarkis. (2021). Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers. *International Journal of Production Economics, 231*,

[Ii] Mangla, S. K., Luthra, S., Mishra, N., Singh, A., Rana, N. P., Dora, M., & Dwivedi, Y. (2018). Barriers to effective circular supply chain management in a developing country context. *Production Planning & Control*, *29*(6), 551-569.

[Iii] Tseng, M. L., Islam, M. S., Karia, N., Fauzi, F. A., & Afrin, S. (2019). A literature review on green supply chain management: Trends and future challenges. *Resources, Conservation and Recycling*, *141*, 145-162.

[Iv] Álvarez Jaramillo J, Zartha Sossa JW, Orozco Mendoza GL. Barriers to sustainability for small and medium enterprises in the framework of sustainable development—Literature review. *Business Strategy and the Environment, 28*(4), 512-24.

[V] Luthra, Sunil, & Sachin Kumar Mangla. (2018). Evaluating challenges to Industry 4.0 initiatives for supply chain sustainability in emerging economies. *Process Safety and Environmental Protection,* 117, 168-179.

[Vi] Barbosa-Póvoa, Ana Paula, Cátia da Silva, & Ana Carvalho. (2018). Opportunities and challenges in sustainable supply chain: An operations research perspective. *European Journal of Operational Research,* 268(2), 399-431.

[Vii] Yadav, Gunjan, et al. (2020). A framework to overcome sustainable supply chain challenges through solution measures of industry 4.0 and circular economy: An automotive case. *Journal of Cleaner Production, 254*,

[Viii] Kumar, Shashank, Rakesh D. Raut, Kirti Nayal, Sascha Kraus, Vinay Surendra Yadav, & Balkrishna E. Narkhede. (2021). To identify industry 4.0 and circular economy adoption barriers in the agriculture supply chain by using ISM-ANP. *Journal of Cleaner Production, 293*,

[Ix] Younis, Hassan, Balan Sundarakani, & Prakash Vel. (2016). The impact of implementing green supply chain management practices on corporate performance. *Competitiveness Review,* 26(3), 216-245.

[X] Yildiz Çankaya, Sibel, & Bulent Sezen. (2019). Effects of green supply chain management practices on sustainability performance. *Journal of Manufacturing Technology Management, 30*(1), 98-121.

[Xi] Centobelli, P., Cerchione, R., & Esposito, E. (2018). Environmental sustainability and energy-efficient supply chain management: A review of research trends and proposed guidelines. *Energies*, *11*(2), 275.

[Xii] Agrawal, V., Mohanty, R. P., Agarwal, S., Dixit, J. K., & Agrawal, A. M. (2023). Analyzing critical success factors for sustainable green supply chain management. *Environment, Development and Sustainability*, *25*(8), 8233-8258.

[Xiii] Irani, Zahir, et al. (2017). Enabling sustainable energy futures: factors influencing green supply chain collaboration. *Production Planning & Control, 28*(6-8), 684-705.

[Xiv] Peprah, J. A., Opoku-Fofie, I., & Nduro, K. (2016). Factors influencing green supply chain in the mining sector in Ghana. *European Journal of Logistics, Purchasing and Supply Chain Management*, *4*(1), 32-50.

[Xv] Andalib Ardakani, D., & Soltanmohammadi, A. (2019). Investigating and analysing the factors affecting the development of sustainable supply chain model in the industrial sectors. *Corporate Social Responsibility and Environmental Management*, *26*(1), 199-212.

[Xvi] Tippayawong, K. Y., Niyomyat, N., Sopadang, A., & Ramingwong, S. (2016). Factors affecting green supply chain operational performance of the thai auto parts industry. *Sustainability*, *8*(11), 1161.

[Xvii] Hussain, M., Khan, M., & Al-Aomar, R. (2016). A framework for supply chain sustainability in service industry with confirmatory factor analysis. *Renewable and Sustainable Energy Reviews*, *55*, 1301-1312.

[Xviii] Khan, S. A. R., Zhang, Y., Anees, M., Golpîra, H., Lahmar, A., & Qianli, D. (2018). Green supply chain management, economic growth and environment: A GMM based evidence. *Journal of Cleaner Production*, *185*, 588-599.

[Xix] Tumpa, T. J., Ali, S. M., Rahman, M. H., Paul, S. K., Chowdhury, P., & Khan, S. A. R. (2019). Barriers to green supply chain management:

An emerging economy context. *Journal of Cleaner Production*, *236*, 117617.

[Xx] Kaur, J., & Awasthi, A. (2018). A systematic literature review on barriers in green supply chain management. *International Journal of Logistics Systems and Management*, *30*(3), 330-348.

[Xxi] Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2020). Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications. *International Journal of Production Economics*, *219*, 179-194.

[Xxii] Govindan, Kannan. (2018). Sustainable consumption and production in the food supply chain: A conceptual framework. *International Journal of Production Economics, 195*, 419-431.

[Xxiii] Hong, Zhaofu, & Xiaolong Guo. (2019). Green product supply chain contracts considering environmental responsibilities. *Omega, 83*, 155-166.

[Xxiv] Miemczyk, Joe, & Davide Luzzini. (2018). Achieving triple bottom line sustainability in supply chains: The role of environmental, social and risk assessment practices. *International Journal of Operations & Production Management, 39*(2), 238-259.

[Xxv] Wilhelm, Miriam M., et al. "Sustainability in multi-tier supply chains: Understanding the double agency role of the first-tier supplier. *Journal of Operations Management, 41*, 42-60.

[Xxvi] Rees, William E. (2021). Achieving sustainability: Reform or transformation?. The Earthscan reader in sustainable cities. *Routledge*, 22-52.

[Xxvii] Karmaker, C. L., Ahmed, T., Ahmed, S., Ali, S. M., Moktadir, M. A., & Kabir, G. (2021). Improving supply chain sustainability in the context of COVID-19 pandemic in an emerging economy: Exploring drivers using an integrated model. *Sustainable production and consumption*, *26*, 411-427.

[Xxviii] Paulraj, A., Chen, I. J., & Blome, C. (2017). Motives and performance outcomes of sustainable supply chain management practices: A multi-theoretical perspective. *Journal of Business Ethics*, *145*, 239-258.

[Xxix] Zhong, Ray Y., et al. (2016). Big Data for supply chain management in the service and manufacturing sectors: Challenges, opportunities, and future perspectives. *Computers & Industrial Engineering, 101*, 572-591.

[Xxx] Khan, Syed Abdul Rehman, et al. (2021). A state-of-the-art review and meta-analysis on sustainable supply chain management: Future research directions. *Journal of Cleaner Production, 278,* 123357.

[Xxxi] de Oliveira, Ualison Rébula, Luciano Souza Espindola, Isabele Rocha da Silva, Iaslin Nostório da Silva, & Henrique Martins Rocha. (2018). A systematic literature review on green supply chain management: Research implications and future perspectives. *Journal of Cleaner Production, 187,* 537-561.

[Xxxii] Dubey, Rameshwar, Angappa Gunasekaran, Thanos Papadopoulos, Stephen J. Childe, K. T. Shibin, & Samuel Fosso Wamba. (2017). Sustainable supply chain management: framework and further research directions. *Journal of Cleaner Production, 142*, 1119-1130.

[Xxxiii] Bastas, Ali, & Kapila Liyanage. (2018). Sustainable supply chain quality management: A systematic review. *Journal of Cleaner Production, 181*, 726-744.

[Xxxiv] Chen, Lujie, et al. (2017). Supply chain collaboration for sustainability: A literature review and future research agenda. *International Journal of Production Economics, 194*, 73-87.

[Xxxv] Bag, S., Telukdarie, A., Pretorius, J. C., & Gupta, S. (2021). Industry 4.0 and supply chain sustainability: framework and future research directions. *Benchmarking: An International Journal*, *28*(5), 1410-1450.

[Xxxvi] Lahane, S., Kant, R., & Shankar, R. (2020). Circular supply chain management: A state-of-art review and future opportunities. *Journal of Cleaner Production*, *258*, 120859.

[Xxxvii] Min, S., Zacharia, Z. G., & Smith, C. D. (2019). Defining supply chain management: In the past, present, and future. *Journal of Business Logistics*, *40*(1), 44-55.

[Xxxviii] Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2018). Sustainable Industry 4.0 framework:

A systematic literature review identifying the current trends and future perspectives. *Process Safety and Environmental Protection*, *117*, 408-425.

[Xxxix] Schniederjans, D. G., Curado, C., & Khalajhedayati, M. (2020). Supply chain digitisation trends: An integration of knowledge management. *International Journal of Production Economics*, *220*, 107439.

Disclaimer / Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Journals and/or the editor(s). Journals and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.