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## Artificial intelligence applications for information management in sustainable supply chain management: A systematic review and future research agenda

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| A R T I C L E I N F O   | A B S T R A C T  |
|---|--|
| Keywords:<br>Supply chain<br>Artificial intelligence<br>Information management<br>Industry 4.0<br>Sustainability<br>Systematic review | In a Sustainable Supply Chain (SSC) context, information management offers a unique perspective on the digital economy and information management. Artificial intelligence (AI) is developing into a more robust digital field to facilitate quick information access and intelligent decisions in expanding commercial contexts. These days, Supply Chains (SC) would crumble without robust information systems. Applying AI and information management is crucial in determining the direction of sustainable supply chain management (SSCM). A systematic literature review (SLR) of the use of AI in SSCM is conducted in this research. The authors can identify crucial factors of the present literature using bibliometric and network analysis. AI is essential to the SSC to address sustainability challenges and manage the large volumes of data produced by numerous industrial processes. In the corpus of research that is already accessible, there is currently no comprehensive and bibliometric analysis of the potential for AI techniques for information management in SSC. Scientific publications were analysed from an objective point of view. Based on our results, we have drafted a proposal for an AI supply chain framework. Researchers, policymakers, and SCM practitioners may all benefit from the approach. This study is the first to analyse AI applications for information management in SSCM. In consideration of this, organizations are now |

analyse AI applications for information management in SSCM. In consideration of this, organizations are now exploring AI capabilities to improve operational efficiency and innovate their processes. This will assist industry people in understanding how AI methods support SC processes in their optimization to attain sustainability in SC practices.

## 1. Introduction

In today's rapidly shifting business environment, the complexities of SCM have increased with less precise demand and more risks associated with supply (Jamwal et al., 2021). The competitive nature of this domain needs an effective integration and coordination of end-to-end activities, from raw material sourcing to product distribution to end users. The effectiveness of SC operations is becoming more dependent on advanced information technologies, which, when used correctly, provide a considerable competitive advantage in today's rapid business environment. In recent years, SCs have shifted technologically, emphasizing the significance of managing information. Effective management and execution of information systems are essential for improving SC competencies and effectiveness. Implementing AI into existing information systems is critical (Cannas et al., 2024) (Alsadi et al., 2021; Yadav et al., 2024a). AI enhances and transforms operations

management in SC by giving novel solutions for complicated situations. Because of the growing awareness of environmental and social issues and the necessity for organizations to align with global sustainability goals, SSCM has become an essential field of research and practice. Among SSCM, integrating AI provides significant potential for improving information management practices and overall SC sustainability (Di Vaio et al., 2024).

This study's contemporary investigation of AI's transformational potential in SSCM makes it relevant. Strategies to incorporate sustainability into essential SC processes are desperately needed as companies work to meet the 2030 sustainability goals (Zamani et al., 2023). Conventional SC, which mainly depends on tangible assets like inventories and warehouses, is changing to become data-driven models that use AI to improve decision-making and procedures (Kar et al., 2022). Even though AI is widely acknowledged as necessary, more thorough and bibliometric assessments are still required to fully understand its

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potential in SSCM. Integrating AI into SC represents a paradigm shift in strategy and a technical advance (Varsha P S et al., 2024). Information management is crucial to achieving competitive advantage and sustainability in supply chain management, and this study looks into how AI may improve it (Oliveira & Handfield, 2019). However, despite the increasing attention to AI applications for SSCM, there still needs to be a significant gap in the literature concerning comprehensive and bibliometric assessments of AI research in this study area.

Even with AI's demonstrated benefits across several industries, more research has to be done on the optimal way to use it in SC management, especially when attaining sustainability. Previous research emphasizes AI's potential for conventional supply chain operations but needs a comprehensive bibliometric study that accounts for its effects on SSC (Sharma and Jayant, 2019). This disparity is notable considering the growing importance of SSCM in attaining global sustainability objectives. AI presents previously unexplored opportunities to improve SC sustainability and efficiency.

The current study fills this gap by performing a comprehensive assessment and providing a research plan for the future that will focus on AI applications for information management in SSCM. This study aims to present insights into current trends, research clusters, and potential opportunities for future investigation within this emerging discipline by synthesizing and analysing the available literature.

This study aims to achieve two primary goals. To fill the identified research gap, it initially attempted to perform a systematic evaluation and bibliometric analysis of the quantity of literature previously published about AI applications in SSCM. Secondly, the aim is to put forth a framework that clarifies the successful application of AI to enhance sustainability in SC processes.

To accomplish these goals, this study will investigate the following research questions (RQ):

RQ1.What are the current trends in AI research publications and the structure of their citations in the potential SCM area?

RQ2.What are the major research clusters in SSC and AI for information management?

RQ3.How can industries implement AI in the SC to improve their sustainability?

The remaining work is structured as follows: Literature reviews are



Fig. 1. PRISMA for SLR (Authors' work).

included in Section 2. Section 3 explains descriptive analysis. Section 4 discusses the suggested framework for AI in supply chain information management. The implications of the study are discussed in Section 5. Section 6 presents the current work's contributions, findings, limitations, and suggestions for future work.

#### 2. Literature review

We performed a systematic literature review and bibliometric analysis to address the study's research questions. This approach consisted of three significant steps: identifying, selecting, and evaluating appropriate study publications. The influence of studies has been studied over time using bibliometric analysis, a statistical assessment of articles.

This study examined the existing literature on sustainable supply chain SCCM and the possible roles of AI algorithms in this area. As part of our technique, we searched the Scopus database for phrases indicating different AI methodologies, as shown in Fig. 1. In addition, we looked for mentions of sustainable supply chain management in the titles, abstracts, and keywords of the retrieved studies. We thoroughly edited and reviewed all the identified review and technical papers to meet our research objectives. Our study used systematic literature review approaches and bibliometric analysis to investigate the relationship between AI applications and information management in SSCM.

This study conducts a Systematic Literature Review (SLR) to investigate how AI technologies are helping sustainable supply chains manage information. The SLR searched vital phrases such as "supply chain," AND " Artificial intelligence," AND " Sustainability," AND " Information management," AND " Industry 4.0" in scientific literature databases Scopus. The study used specified inclusion and exclusion criteria and a predefined review methodology to pick papers. After a careful review of full-text documents, 54 were selected for inclusion. Fig. 1 depicts the PRISMA diagram for the SLR process.

## 2.1. Conducting

The search was carried out in the Scopus database, which is known for its vast collection of scientific publications from reputable publishers such as Elsevier, Taylor & Francis, Inder Science, IGI Global, and Wiley, as well as contributions from IEEE, IOP Science, and Emerald. Only journal articles, conference papers, and books were considered sources to maintain study integrity, while items such as conference reviews, book reviews, and documents with ambiguous intentions were excluded.

When "Supply chain" and "Artificial Intelligence" were used in the first search, 154 results were found, most of which were book and conference reviews. Fifty-four pertinent papers were found when the search was refined using more focused terms, as Fig. 1 illustrates. These papers came from books, conferences, journals, and other sources. The selection process was completed by applying inclusion criteria to guarantee uniformity. The following conditions were used as inclusion criteria.

- a. Articles initially written and published in English
- b. Articles released before September 2022
- c. Include only articles that have been published in conference proceedings or peer-reviewed journals.
- d. Articles focusing on artificial intelligence and SSC.
- e. A short or long article form (not an editorial or abstract) is required.

#### 2.2. Supply chain and sustainability

In today's business environment, the importance of integrating supply chain operations with sustainability has grown. Companies are looking for new and creative ways to manage information, including AI for SC sustainability, to reduce their environmental impact, increase social responsibility, and maintain economic sustainability technologies present previously unheard-of possibilities for sustainability and process optimization in the supply chain (Awan et al., 2021). AI may improve sourcing, production, transportation, and distribution decision-making through advanced data analytics and predictive modelling, decreasing waste, resource consumption, and carbon emissions (Singh et al., 2023).

AI facilitates the gathering, examination, and understanding of enormous volumes of data from many sources along the SC in the context of information management. Customer feedback, supplier performance indicators, regulatory compliance data, and environmental impact evaluations are a few examples of this data. SC managers can discover chances to increase efficiency, obtain meaningful insights into areas for improvement, and reduce the risk of disruptions connected to sustainability by utilizing AI-powered algorithms (Trong & Kim, 2020).

Transparency and traceability in the SC are two critical areas where AI shines. Organizations can track the path of products from raw materials to final consumers by utilizing AI-driven data analytics and blockchain technologies. This reduces the possibility of counterfeit goods, ensures ethical sourcing practices, and promotes fair labour standards (Jamwal et al., 2021). It also helps with dynamic demand forecasting and inventory optimization, allowing businesses to minimize overstocking and underutilization of resources, which lowers waste and increases resource efficiency. Furthermore, by extending the lifespan of assets and equipment and reducing the need for frequent replacements, AI-powered predictive maintenance can lessen the environmental effect of manufacturing operations (Qi et al., 2023).

There is much promise for advancing sustainability goals when artificial intelligence is integrated into information management in the SC. Organizations may improve environmental stewardship, increase operational efficiency, and satisfy the changing demands of socially conscious stakeholders and customers by utilizing AI-driven insights. Though AI has many opportunities, its application necessitates strong governance structures, ethical considerations, and continual oversight to guarantee compliance with moral norms and environmental goals (Naz et al., 2022).

#### 2.3. Challenges to sustainable supply chain in adopting AI

Supply chain management will face several obstacles in implementing AI. The main obstacles businesses face while implementing AI for information management in SSCM are listed in Table 1. Every challenge outlines the difficulties and complications of incorporating AI technologies in supply chain processes as shown in Table 2.

The abovementioned issues emphasize the complexity of implementing artificial intelligence (AI) into supply chain information management to attain sustainability. This highlights the necessity of strategic planning, investment, and regular adaptability.

## 2.4. Application of AI technique in SCM

Supply chain management is significantly enhanced by implementing various AI tools for information management to attain sustainability. Machine learning lowers waste and overproduction by enhancing inventory optimization and demand forecasting (Jamwal et al., 2021). Analysing consumer feedback for long-term changes and managing supplier risk is made easier with the help of natural language processing. Order processing and compliance monitoring are streamlined by robotic process automation, which boosts productivity and uses fewer resources. Computer vision reduces waste and energy usage by optimizing warehouse operations and ensuring high-quality control. By improving maintenance forecasting and route optimization, predictive analytics reduces emissions (Awan et al., 2021).

Integrating AI with blockchain ensures ethical sourcing by offering fraud detection and traceability. Planning for the supply chain, energy use, and sustainable sourcing are all improved by deep learning and optimization algorithms. AI-powered IoT makes intelligent warehousing and real-time monitoring possible, reducing inefficiencies and maximizing resource use (Attri et al., 2024). These AI applications contribute

## Table 1

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## Table 2

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|--|---------|------------------------------|---------------------------|-------------------------|-------------------|---|----------------------|
| Back Quality and<br>integrationExcluding data<br>constratory, series<br>or and accuracy series<br>or   | No.     |                              |                           |                         | ML                | Demand Forecasting: ML algorithms       | (Aggarwal et al.,    |
| IntegrationSimulater, 2022;<br>various XC, platform.<br>Value et al., 2023;<br>Value et al., 2024;<br>Value et al., 2024;   | 1       | Data Quality and             | Ensuring data             | (AL-Khatib &            |                   | evaluate past sales information,        | 2024)                |
| and accurse across<br>various SC platforms<br>to provide et al., 2023;<br>to provide et al., 2024;<br>to provide   |         | Integration                  | consistency, cleanliness, | Shuhaiber, 2022;        |                   | industry patterns, and outside          |                      |
| High<br>High<br>EndpancemationValue et al., 2024cut and a label of al., 2024cut and all label of al  |         |                              | and accuracy across       | Osei et al., 2023;      |                   | variables to forecast future demand,    |                      |
| High<br>ImplementationAll infrastructure and<br>resisting devices(kalari et al., 2022;<br>resisting of non-<br>cossoversistical and stationsoversistical a   |         |                              | various SC platforms.     | Yadav et al., 2024b)    |                   | cutting down on waste and               |                      |
| Implementation<br>Casts<br>initial curved year<br>Technological<br>integration of AI with<br>regrammentation of AI with regrammentatio   | 2       | High                         | AI infrastructure and     | (Akbari et al., 2023;   |                   | overproduction.                         |                      |
| Costs         initial outputy of function         initial outputy of function         oversets of statistical and statistis statistis statistical and statistis statistical and statististic   |         | Implementation               | training demand a large   | Akram et al., 2024)     |                   | Inventory Optimization: With the use    |                      |
| Tochnological<br>Complexity<br>mercedures might be<br>packageners<br>and adversal<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packagenersIntegration of Al with<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packageners<br>packa  |         | Costs                        | initial outlay of funds   |                         |                   | of ML models, one can minimise          |                      |
| Complexity<br>production<br>production<br>production<br>production<br>matchinic deal production<br>production<br>matchinic deal production<br>production<br>matchinic deal production<br>matchinic deal production<br>match  | 2       | Technological                | Integration of AI with    | (Patidar et al. 2022)   |                   | overstock and stockout scenarios        |                      |
| Computery         procedures might be<br>challerging.         2022 (2011) Linking.         Control         Contro         Contro         Control <td>,</td> <td>Complexity</td> <td>current systems and</td> <td>Alameiah &amp; Vunus</td> <td></td> <td>maintain ideal inventory levels and</td> <td></td>  | ,       | Complexity                   | current systems and       | Alameiah & Vunus        |                   | maintain ideal inventory levels and     |                      |
| lack of Sillability lass.<br>Portice and ALL 2021<br>Excessive data usage that<br>Recessive data usage that  |         | complexity                   | procedures might be       | 2022)                   |                   | cut down on waste and surplus           |                      |
| Jack of Skilled         Columpting approximation         (Pino 4 Te Chanc, 2025)         Natural Language         Internations, Margament NJP         Values et al., 2022           Cybersterity Nike         Exercise data sage that 2023)         Calamed et al., 2023)         Processing         Internations, Margament NJP         Values et al., 2023           Cybersterity Nike         Exercise data sage that 2023)         Calamed et al., 2024)         <   |         |                              | shallon sins              | 2022)                   |                   | inventory                               |                      |
| Lak of VSLIP       Solid and AL       Create at a Column.       Solid and AL       Solid AL       Solid AL   |         | T1 C 01-:11- 4               | chanenging.               | (Harris & The Character | Notice 1 Forester | Inventory.                              | (1                   |
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| Cybersecurity Risks Excessive data asset at a 2023 Second of the former and the former asset at a 2023 Second of the former as a dedices at a second of the former asset at a 2023 Second of the former as a dedices at a 2023 Second of the former as a dedice at a 202   |         | workforce                    | SCM and AL                | 2024; Richey et al.,    | Processing        | technologies are used to evaluate       | Yadav et al., 2022a  |
| Cybersecurity Rises Excessive data uses in adde (Lastvord, 2024):<br>and other reposed for index in adde it in a   |         |                              |                           | 2023)                   |                   | textual data from social media, news,   |                      |
| makes one more grantacks.<br>suspeptible to<br>cyberritacks.<br>Data Privacy<br>Handing conductinal<br>concerns during conductinal<br>data with renstituty<br>with ministruty<br>resistance to<br>maplementing new<br>rechanologies and inertia.<br>Bithical and Lead<br>and addressing ethical<br>consequences of Al use<br>and addressing ethical<br>insteaming the legal<br>consequences of Al use<br>and addressing ethical<br>insteaming the legal<br>challengs.<br>therein all uses<br>consequences of Al use<br>and addressing ethical<br>insteaming the legal<br>challengs.<br>therein all uses<br>consequences of Al use<br>and addressing ethical<br>insteaming the legal<br>challengs.<br>therein all uses<br>challengs.<br>therein all uses<br>challengs.<br>therein all uses<br>challengs.<br>therein all uses<br>challengs.<br>therein all uses<br>consequences of Al use<br>and instructure after the<br>consequences of Al use<br>consequences of Al use<br>challengs.<br>therein all uses<br>challengs.<br>therein all uses<br>consequences of Al use<br>consequences of Al u   | 5       | Cybersecurity Risks          | Excessive data usage that | (Gaikwad, 2024;         |                   | and other reports in order to find      |                      |
| including support families in a susceptible to support of the supp   |         |                              | makes one more            | Zamani et al., 2023)    |                   | supply chain vulnerabilities            |                      |
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| Resistance to<br>Change     Organisational<br>miplementing new<br>technologies and intervia-<br>technologies and intervia-<br>sequences of A lue and<br>addressing ethical<br>issues     (Jule et al., 2022)     Robotic Process<br>Automation     gardadity gaids, NP<br>approaches<br>organ process customer reviews<br>and addressing ethical<br>issues     (Jule et al., 2022)       Scalability issues     Deploying AI     (Eidem & Riginal,<br>technologies over<br>intervational styphy<br>chains presents     Computer Vision<br>(Camerational intervase<br>efficiency by automating repetitive<br>chains presents     Computer Vision<br>(Camerational intervase<br>efficiency by automating repetitive<br>chains presents     Computer Vision<br>(Camerational intervase<br>efficiency by automating repetitive<br>chains presents     (Came et al., 2021)       Interoperability<br>Problems     Assumation<br>intergation of A systems<br>with various SC<br>with various SC   |         |                              | while following the law.  |                         |                   | improvement in product design,          |                      |
| Change       resistance to<br>implementing new<br>technologies and inertia.       Ine with statianability goals, NP<br>approaches process customer reviews<br>and comments.       (Aggarwal et al.,<br>2021)         Ethical and Legal       Manging the legal<br>and addressing ethical<br>issues       (Dubey et al., 2022)       Robotic Process<br>Automation       Orde Processing Automation: RPA<br>efficiency by automating: repetitive<br>operations like order entry and<br>invoking. This boxes resource<br>consumption.       (Aggarwal et al.,<br>2022)         Scalability issues       Deploying Al<br>technologies over<br>challenges.       (Gadema & Rajnal,<br>international supply<br>chains presents<br>challenges.       (Chen et al., 2021);<br>automating the tracking of<br>regulatory compliance.       Compliance Monitoring Every<br>sustationalishilty requirement may be<br>routinely met arcaking of<br>regulatory compliance.       (Chen et al., 2021);<br>automating the tracking of<br>regulatory compliance.       (Chen et al., 2022)         Lack of<br>subware.       Lack of industry norms<br>(Effabbodi et al.,<br>and insights produced);<br>AL       (Di Vaio et al., 2023);<br>2023; Richey et al.,<br>and insights produced);<br>AL       (Di Vaio et al., 2024);<br>2023; Richey et al.,<br>2023; Richey et al.,<br>2024; R   | ,       | Resistance to                | Organisational            | (Joel et al., 2024)     |                   | packaging, and delivery that are in     |                      |
| <ul> <li>implementing new technologies and inertia. Issues in the space of the</li></ul>  |         | Change                       | resistance to             |                         |                   | line with sustainability goals, NLP     |                      |
| technologies<br>Biblicia nal legal<br>Issuesand intervia.<br>consequences of Al use<br>and addressing ethical<br>issues.Debotic Processing Automation: RPA<br>2022)Conservice<br>AutomationConservice<br>and addressing ethical<br>issues.Conservice<br>and addressing ethical<br>and addressing ethical<br>addressing ethical<br>ad  |         | -                            | implementing new          |                         |                   | approaches process customer reviews     |                      |
| Ethical and LegalManaging'the legal(Oubey et al., 2022)Robotic ProcessOrder Processing Automation: RPA<br>and received processing Automation: RPA  |         |                              | technologies and inertia. |                         |                   | and comments.                           |                      |
| Issues     consequences of AI use<br>addressing ethical<br>issues.     Automation     may reduce errors and Increase<br>efficiency by summaring repearlow illuce order enrors and<br>involving. This lowers resource<br>consumption.     2023/1 Vadav et al.,<br>efficiency by summaring repearlow illuce order enrors and<br>involving. This lowers resource<br>consumption.     2023/1 Vadav et al.,<br>efficiency by summaring repearlow illuce order<br>consumption.     2023/1 Vadav et al.,<br>efficiency by summaring repearlow illuce order<br>consumption.     2023/1 Vadav et al.,<br>efficiency by summaring repearlow illuce order<br>consumption.     2023/1 Vadav et al.,<br>efficiency by summaring repearlow illuce order<br>consumption.     2023/1 Vadav et al.,<br>efficiency by summaring repearlow illuce order<br>consumption.     2023/1 Vadav et al.,<br>environmental<br>involving. The tracking of<br>repearlow illuce order<br>order interval order interval<br>software.     2023/1 Vadav et al.,<br>environmental<br>interval order interval<br>constraints resource<br>consumption.     2023/1 Vadav et al.,<br>environmental<br>interval order interval<br>constraints resource<br>consumption.     2023/1 Vadav et al.,<br>environment<br>interval order interval<br>constraints resource<br>equipment bracking of<br>repearlow illuce order interval<br>constraints resource<br>consumption.     2023/1 Vadav et al.,<br>environment<br>interval order interval<br>constraints resource<br>equipment bracking of<br>repearlow illuce order<br>interval order interval<br>constraints resource<br>equipment bracking that only superior     (Clean et al., 2022/1<br>Vadav et al., 2022       Wardhouse Management Wardhouse Nether<br>interval order interval order<br>infortation order or<br>eparties are done<br>environment<br>environment<br>effectively.     (Diver order interval<br>continuity and transportery<br>environment<br>environment<br>environment<br>environment<br>environment<br>environment<br>environment<br>envinterval and<br>environment<br>environment<br>environment<br>environm  | 3       | Ethical and Legal            | Managing the legal        | (Dubey et al., 2022)    | Robotic Process   | Order Processing Automation: RPA        | (Aggarwal et al.,    |
| interview     and addressing ethical<br>issues     issues     efficiency by automating repetitive<br>operations ilk corder entry and<br>invoicing. This lowers resource<br>continuous     2022)       Scalability Issues     Deploying AI<br>technologies over<br>intermational supply<br>chains presents<br>challenges.     (Kadema & Rajnai,<br>2022)     Compliance Maintering repetitive<br>operations ilk corder entry and<br>invoicing. This lowers resource<br>compliance Maintering to the<br>regulatory compliance.     Compliance Maintering to the<br>regulatory compliance.     Compliance Maintering to<br>regulatory compliance.       Lack of     Lack of industry norms<br>(Akhfar et al., 2023)     Computer Vision     Computer Vision     Chen et al., 2021;<br>regulatory compliance.     Chen et al., 2022;<br>regulatory compliance.     Chen et al., 2024;<br>regulatory compliance.     Chen et al., 2024;<br>regulator  |         | Issues                       | consequences of AI use    | ( , , , ,               | Automation        | may reduce errors and increase          | 2024 Yaday et al     |
| Scalability Issues       Intercoperability assues       Dephyring AI (Kadema & Rajnai, technologies over (Consumption).       Consumption.         Scalability Issues       Dephyring AI (Kadema & Rajnai, technologies over (Consumption).       Consumption.       Consumption.         Interoperability Assuring the smooth (Chen et al., 2021; interditing realisment may be challenges.       Interoperability (Chen et al., 2021; interditing realisment may be challenges.       Computer Vision       Quality Compliance.       (Chen et al., 2021; interditing realisment may be challenges.         Interoperability Assuring the smooth (Chen et al., 2021; integration of AI systems in group chains)       Interditing and checking and check in a statianability and infiguration of AI systems in group chains.       Computer Vision       Quality Control A Lenable Computer Vision       Unley et al., 2021; interdition of AI systems in group chains.         Reliability and confiring AI systems in (Muthusvamy & AI, and insights produced by 2023)       Computer Vision       Workouse Management. Warehouse on perations and layouts can be operations   |         | 155465                       | and addressing ethical    |                         | ratomation        | efficiency by automating repetitive     | 2021, Tudav et al.,  |
| Scalability IssueBoke.<br>International supply<br>chains presents<br>challenges.(Kadema & Rajnal,<br>technologies over<br>software.Outset Eurly and<br>invoicing. This lowers resource<br>consumption.Interoperability<br>ProblemsAssuring the smooth<br>integration of Al system<br>for the application of Al<br>insplication<br>for the application of Al<br>infrastructure affect the<br>environmental<br>Provinomental<br>Regulating how Al<br>(Di Vaio et al., 2021)Computer Vision<br>computer Vision<br>protective<br>and insplication of Al<br>infrastructure affect the<br>environmental<br>Productive and sustainable supply chain<br>operations and<br>infrastructure affect the<br>environmental<br>Regulating how Al<br>(Di Vaio et al., 2021)Computer Vision<br>computer Vision<br>computer Vision<br>products are distributed.<br>Dynamic Supply<br>Al.(Di Vaio et al., 2021)<br>computer Vision<br>computer Vision<br>comparison and insynuts can be<br>optimized with computer vision,<br>which also helps to save energy and<br>improvements(Chen et al., 2021)<br>computer Vision<br>products are distributed.<br>Dynamic Supply(Di Vaio et al., 2023)<br>(Chen et al., 2023)<br>(Chen et al., 2023)<br>(Computer Vision,<br>Which also helps to save energy and<br>improve space usage.<br>Al.(Chen et al., 2021)<br>(Conduction and insprove space usage.<br>(Conduction and insprove space usage.<br>and insprove conduction acces.(Conduction and and<br>products are distributed.<br>Dynamic SupplyVendor and Parture<br>Collaboration<br>engagement with outside<br>partners are done<br>effectively.(Muthanswamy & Ali,<br>products and pro-<br>ectively.Prodictive analytics<br>can lower consumers and appendicts from point of origin to<br>point of destination, improving<br>transparency and guaranteeing show of the<br>and usagement with outside <br< td=""><td></td><td></td><td>issues</td><td></td><td></td><td>operations like order entry and</td><td>20220)</td></br<>  |         |                              | issues                    |                         |                   | operations like order entry and         | 20220)               |
| statisticity sever       Delapolyng Ar       Constantive (2024; Singh et al.,<br>international supply<br>chains presents<br>challenges.       2023)         interoperability       Statistic presents<br>challenges.       Compliance Monitoring: Every<br>sustainability requirement may be<br>cruitinely met across the SC by<br>automating the tracking of<br>regulatory compliance.       (Chen et al., 2021;<br>automating the tracking of<br>regulatory compliance.       (Chen et al., 2021;<br>bubey et al., 2022)         Lack of       Lack of industry norms<br>insymply chain.       (Khitar et al., 2022;<br>bubey et al., 2022)       Computer Vision<br>inspectors, which minimises waste<br>by guarantecing that only superior<br>products are distributed.       (Chen et al., 2021;<br>bubey et al., 2022;<br>automating supply chain.         Trust       confidence in decisions<br>and insights produced by<br>Al.       (Di Vaio et al., 2024)       (Warbouse Mangement: Warehouse<br>automating supply chain<br>circumstances.       (Godarzian et al.,<br>2023)         Dynamic Supply       Molifying Al systems in<br>drifting supply chain<br>circumstances.       (Di Vaio et al., 2024)       Maintegration<br>automatics for the application of Al<br>infing supply chain<br>circumstances.       (Godarzian et al.,<br>2024)         Vendor and Partner<br>Collaboration<br>exchange and<br>effectively.       Continuous<br>paratress are done<br>effectively.       (Di Main et  |         | Scalability Issues           | Deploying AI              | (Vadena & Painai        |                   | invoicing. This lowers resource         |                      |
| intermotogies over additional products of the application of the appli   | ,       | Scalability issues           | technologies even         | (Kauella & Kajilai,     |                   | involcing. This lowers resource         |                      |
| chains presents<br>chains present<br>chains presents<br>chains presents  |         |                              | technologies over         | 2024; Siligii et al.,   |                   | Consumption.                            |                      |
| chans presents challenges.<br>Interoperability Assuring the smooth (Chen et al., 2021;<br>Problems integration of Al systems and the set of the systems and the sy   |         |                              | international supply      | 2023)                   |                   | Compliance Monitoring: Every            |                      |
| challenges.routinely met across the SC byInteroperabilityIntegration of Al systemsHendriksen, 2023;<br>transaction of Al systemsFourbourd and the systems and decisionComputer VisionComputer VisionChallenges (Chen et al., 2021)<br>regulatory compliance.Chen et al., 2021,<br>transaction and insights protection of Al<br>in supply chains.Computer VisionChen et al., 2023;<br>vision systems may detect flaws in<br>inspectors, which minimises wate<br>by guaranteeing that only superior<br>pretring that only superior<br>optimised with computer vision,<br>systems and insights produced by<br>and insights produced by<br>AL.Chen et al., 2021;<br>Dubey et al., 2022;<br>Dubey et al., 2023;<br>Warehouse Management: Warehouse<br>optimised with computer vision,<br>optimised with computer vision,<br>systems and insights produced by<br>and insights produced b   |         |                              | chains presents           |                         |                   | sustainability requirement may be       |                      |
| Interoperability       Assuming the smooth<br>intergration of XI systems<br>with various SC<br>software.       (Chen et al., 2023;<br>Nayal et al., 2021)       automating the tracking of<br>regulatory compliance.       (Chen et al., 2021;<br>Validory compliance.         Lack of       Lack of industry norms<br>is splity chain<br>and insights produced by<br>AL       (Akhtar et al., 2023)       Computer Vision       Quality Control: Al-enabled computer<br>by guaranteeing that only superior<br>products are distributed.       (Due et al., 2023)         Reliability and<br>impact       Fostering stakeholder<br>operations and<br>inspectors, which minimises waste<br>by guaranteeing memt. Warehouse<br>and insights produced by<br>AL       (Di Vaio et al., 2024)       Warehouse Management. Warehouse<br>operations and lanyouts can be<br>optimised with computer vision,<br>which also helps to save energy and<br>improve space usage.       (Goodarzian et al.,<br>2023; Patidar et al.,<br>2023; Patidar et al.,<br>2023)         Dynamic Supply<br>Vendor and Partner<br>Collaboration<br>eragement with outside<br>engagement withous<br>legacy Sc systems.       (Muthuswany & Ali,<br>2023)       Predictive<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:<br>Analytics:   |         |                              | challenges.               |                         |                   | routinely met across the SC by          |                      |
| Problemsintegration of Al systems<br>software.Hedriksen, 2023;<br>software.regulatory compliance.<br>regulatory compliance.(Chen et al., 2021;<br>Dubey et al., 2022)Lack of<br>Standardization<br>for the application of Al<br>in supply chains(Akhtar et al., 2023)Computer Vision<br>items more precisely than human<br>inspectors, which minimises waste<br>by guaranteeing that only superior<br>porties and insights produced by<br>Al.(Cisfahbodi et al.,<br>2023); Richey et al.,<br>2023)Computer Vision<br>items more precisely than human<br>inspectors, which uses more<br>precisely than human<br>inspectors, which uses more<br>porties and site transpectors, which uses<br>operations and<br>infrastructure affect the<br>ervironmental(Cisfahbodi et al.,<br>2023); Richey et al., 2024)Warehouse Management: Warehouse<br>optics and insights produced by<br>apply Al.(Cisfahbodi et al.,<br>2023); Richey et al., 2024)(Ciodarzian et al.,<br>2023); Richey et al., 2024)Dynamic Supply<br>Collaio EnvironmentRegulating how Al<br>infrastructure affect the<br>ervironment(Di Vaio et al., 2024)Predictive<br>Analytics:<br>Analytics:Maintennee Prediction: Al foresees<br>(and upment treakdowns hofer the<br>maintenance that prolongs gear life<br>and uses fever resources and<br>downtime.(Ciodarzian et al.,<br>2023);<br>Richey et al., 2024)Vendor and Partner<br>CollaborationMaking sure that data<br>eragement with outside<br>eragement with outside<br>eragement with outside<br>eragewent with  | 0       | Interoperability             | Assuring the smooth       | (Chen et al., 2021;     |                   | automating the tracking of              |                      |
| with various SC<br>software.Nayal et al., 2021)Computer Vision<br>variant system sary deter flaws in<br>urision systems may deter flaws in<br>urision systems are necessary.(Chen et al., 2021)<br>variant system sary deter flaws in<br>urision systems are necessary.(Chen et al., 2021)<br>variant system sary deter flaws in<br>urision systems are necessary.(Chen et al., 2021)<br>variant system sary deter flaws in<br>urision systems are necessary.(Chen et al., 2021)<br>variant system sary deter flaws in<br>urision systems are necessary.(Chen et al., 2021)<br>variant system sary deter flaws in<br>urision systems are necessary.(Chen et al., 2021)<br>variant system sary deter flaws in<br>urision systems are addition and<br>and insights produced by<br>AI.(Esfahbodi et al.,<br>2023; Richey et al.,<br>2023; Patidar et al.,<br>2024)(Codarzian et al.,<br>2024)Vendor and Partner<br>Collaboration<br>exchang and<br>eragement with outside<br>partners are done<br>effectively.(Challenges in combining<br>exchange and<br>erasparency and director outs,<br>and uses fewer resources and<br>commodities from point of origin to<br>point of destination, improving<br>transparency and guaranteeing SSC<br>practices.(Colimarha et al.,<br>2024) </td <td></td> <td>Problems</td> <td>integration of AI systems</td> <td>Hendriksen, 2023;</td> <td></td> <td>regulatory compliance.</td> <td></td>   |         | Problems                     | integration of AI systems | Hendriksen, 2023;       |                   | regulatory compliance.                  |                      |
| software.<br>Lack of<br>Lack of<br>L   |         |                              | with various SC           | Nayal et al., 2021)     | Computer Vision   | Quality Control: AI-enabled computer    | (Chen et al., 2021;  |
| Lack ofLack of industry norms<br>for the application of AI<br>in supply chains.(Akhar et al., 2023)items more precisely than human<br>inspectors, which minimises waste<br>by guaranteeing that only superior<br>products are distributed.Reliability andFostering stakeholder(Esfahbodi et al.,<br>2023) (Ichey et al.,<br>2023)products are distributed.Trustconfidence in decisions<br>and insights produced by<br>AI.2023) (Ichey et al.,<br>2023)operations and layouts can be<br>improves space usage.Inpactoperations and<br>improves space usage.minimisee space usage.<br>Modifying AI systems in<br>shifting supply chain<br>shifting supply chain(Muthuswamy & Ali,<br>2023) Tabler et al.,<br>2023) Tabler et al.,<br>2023) Tabler et al.,<br>2023)Predictive<br>Analytics:(Goodarzian et al.,<br>2023; Tablaer et al.,<br>2023) Tabler et al.,<br>2023) Tabler et al.,<br>2023) Tabler et al.,<br>2023)Predictive<br>Analytics:<br>equipment breakdowns before they<br>and uses fewer resources and<br>downtime.(Goodarzian et al.,<br>2024)Vendor and Partner<br>CollaborationMaking sure that data<br>erfectively.(Atadoga et al., 2024)Roure Optimization: By optimising<br>delivery routes, predictive analytics<br>can lower emissions and fuel usage.(Abaleu et al., 2024)Integration with<br>Challenges in combining<br>UpdatingCantinuous supervision,<br>erfectively.(Odimarha et al.,<br>2024)Al IntegrationIntegration with<br>Challenges in combining<br>UpdatingCantinuous supervision,<br>and preservation, and<br>systems are necessary.(Odimarha et al.,<br>2024)Predictive,<br>and uses for ordining and<br>preservation, and<br>systems are necessary.Deep learnin  |         |                              | software.                 |                         |                   | vision systems may detect flaws in      | Dubey et al., 2022)  |
| Standardization       for the application of AI       in supply chains.       in supply chains.       products are distributed.         Reliability and       Fostering stakeholder       (Esfahbodi et al., 2023; Richey et al., 2023; Richey et al., 2023)       warehouse Management: Warehouse Management: Warehouse Management: Warehouse and poptimised with computer vision, AI.         Environmental       Regulating how AI       (Di Vaio et al., 2024)       which also helps to save energy and improves space usage.       (Goodarzian et al., 2023)         Dynamic Supply       operations and avoits of the application of AI environment.       predictive       Maintenance Prediction: AI foresces (Goodarzian et al., 2024)       (Goodarzian et al., 2023)         Dynamic Supply       Modifying AI systems in (Muthuswamy & Ali, bappen, enabling proactive analytics:       and uses fever resources and cover emissions and fuel usage.       (Goodarzian et al., 2024)         Collaboration       exchange and ender endoge endoge endoge and maintenance that prolongs gear life and uses fever resources and cover emissions and fuel usage.       (Atadoga et al., 2024)       Route Optimization: By optimising delivery routes, predictive analytics: can lower emissions and fuel usage.       (Atadoga et al., 2024)         Legacy Systems       Al with antiquated or legacy SC systems.       (Odimarcha et al., 2024)       Fraud Detection: AI systems are able to identify irregularities and possible fraud in thransactons, guaranteeing moral sourcing and lowering the possibility of counterfieting.       (Odimarcha et al., 2024)  | 11      | Lack of                      | Lack of industry norms    | (Akhtar et al., 2023)   |                   | items more precisely than human         |                      |
| In supply chains.by guaranteeing that only superiorReliability and<br>TrustFostering stakeholder<br>confidence in decision<br>and insights produced by<br>AL(Eisfahodi et al.,<br>2023; Richey et al.,<br>2023)products are distributed.TrustConfidence in decisions<br>and insights produced by<br>AL2023; Richey et al.,<br>2023)operations and layouts can be<br>optimised with computer vision,<br>improves space usage.(Goodarzian et al.,<br>2023; Patidar et al.,<br>2023; Thakur et al.,<br>2024)(Goodarzian et al.,<br>2023; 2024)(Goodarzian et al.,<br>2023; 2024)Vendor and Partner<br>Collaboration<br>engagement with outside<br>partners are done<br>effectively.(Cannas et al., 2024)Route Optimization: By optimising<br>delivery routes, predictive analytics<br>can lower emissions and fuel usage.<br>Provide real-time tracking of<br>to provide real-time tracking of<br>to i destify transparency and guaranteeing SSC<br>practices.(Abaku et al., 2024)Vendor and Partner<br>Legacy Systems.(Odimarha et al.,<br>2024)(Odimarha et al.,<br>2024)Forad Detection: Al systems are able<br>to i destify counterfeiting.<br>Supply Chain Planning in order to<br>possibility of coun   |         | Standardization              | for the application of AI |                         |                   | inspectors, which minimises waste       |                      |
| Reliability and<br>TrustFostering stakeholder<br>confidence in decisions<br>and insight produced by<br>AL.Cashabodi et al.,<br>2023; Richey et al.,<br>2023; Richey et al.,<br>2023)products are distributed.(Warehouse Management: Warehouse<br>operations and layouts can be<br>optimised with computer vision,<br>which also helps to save energy and<br>improves space usage.(Goodarzian et al.,<br>2023; Patidar et al.,<br>2023; Takker et al.,<br>analytics:predictive<br>Maintenance Prediction: AI forseese<br>and improves space usage.(Goodarzian et al.,<br>2023; Patidar et al.,<br>2023; Patidar et al.,<br>2023;<br>2023)Dynamic SupplyModifying AI systems in<br>response to quickly<br>exchange and<br>engagement with outside<br>partners are done<br>effectively.Muthuswamy & Ali,<br>2023; Thakur et al.,<br>2023; Thakur et al.,<br>2023;<br>2023)Predictive<br>happen, enabling proactive<br>maintenance that prolongs gear life<br>and uses fewer resources and<br>downtime.(Goodarzian et al.,<br>2024)Vendor and Partner<br>CollaborationMaking sure that data<br>engagement with outside<br>partners are done<br>effectively.(Cannas et al., 2024)<br>(Cannas et al., 2024)Blockchain with<br>AI Integration<br>AI Integration<br>to provide real-time tracking of<br>commodities from point of origin to<br>point of destination, improving<br>to origin to<br>possibility of counterfeiting.<br>Supply Chain noming: nad possible<br>fraud in transactions, guaranteeing<br>moral sourcing and lowering the<br>possibility of counterfeiting.<br>Supply Chain Planning: In order to<br>e sustainability by utilizing these AI techniques, which can reduce(Odimarha et al.,<br>2024) </td <td></td> <td></td> <td>in supply chains.</td> <td></td> <td></td> <td>by guaranteeing that only superior</td> <td></td>   |         |                              | in supply chains.         |                         |                   | by guaranteeing that only superior      |                      |
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| and insights produced by<br>Al.2023)operations and layouts can be<br>optimised with computer vision,<br>which also helps to save energy and<br>improves space usage.(Di Vaio et al., 2024)operations and<br>improves space usage.(Godarzian et al.,<br>2023)(Godarzian et al.,<br>2023)Dynamic SupplyModifying AI systems in<br>environment.(Muthuswamy & Ali,<br>2023)Predictive<br>Analytics:Maintenance Prediction: AI foresees<br>equipment breakdowns before they<br>happen, enabling proactive<br>maintenance that prolongs gear life<br>and uses fewer resources and<br>downtime.(Godarzian et al.,<br>2023)2023;<br>Paidar et al.Vendor and Partner<br>CollaborationMaking sure that data<br>ergagement with outside<br>ergagement with outside<br>partners are done<br>legacy SC systems.<br>Continuous<br>Updating(Cannas et al., 2024)Biockchain with<br>AI Integration of AI<br>systems are necessary.(Odimarha et al.,<br>2024)Not et al., 2024)(Abaku et al., 2024)there effective and sustimable supply chain operations.<br>SCCM may significantly improve information<br>e sustainability by utilizing these AI techniques, which can reduceDeep Learning:<  |         | Trust                        | confidence in decisions   | 2023; Richey et al.,    |                   | Warehouse Management: Warehouse         |                      |
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| Legacy Systems AI with antiquated or<br>legacy SC systems.<br>Continuous Continuous supervision, (Odimarha et al.,<br>Monitoring and<br>Updating modernization of AI<br>systems are necessary.<br>Commodifies from point of origin to<br>point of destination, improving<br>transparency and guaranteeing SSC<br>practices.<br>Fraud Detection: AI systems are able<br>to identify irregularities and possible<br>fraud in transactions, guaranteeing<br>moral sourcing and lowering the<br>possibility of counterfeiting.<br>SCM may significantly improve information management and pro-<br>e sustainability by utilizing these AI techniques, which can reduce   | 6       | Integration with             | Challenges in combining   | (Cannas et al. 2024)    |                   | to provide real-time tracking of        |                      |
| Legacy SC systems.       point of destination, improving         Continuous       Continuous supervision, (Odimarha et al.,         Monitoring and       preservation, and       2024)         Updating       modernization of AI         systems are necessary.       Fraud Detection: AI systems are able         to identify irregularities and possible         fraud in transactions, guaranteeing         more effective and sustainable supply chain operations.         SCM may significantly improve information management and pro-         e sustainability by utilizing these AI techniques, which can reduce  | -       | Legacy Systems               | AI with antiquated or     | (                       |                   | commodities from point of origin to     |                      |
| Continuous       Continuous supervision, (Odimarha et al., Monitoring and preservation, and 2024)       practices.         Updating       modernization of AI systems are necessary.       Fraud Detection: AI systems are able to identify irregularities and possible fraud in transactions, guaranteeing moral sourcing and lowering the possibility of counterfeiting.         SCM may significantly improve information management and proe e sustainability by utilizing these AI techniques, which can reduce       Deep Learning:       Supply Chain Planning: In order to (Odimarha et al., enhance SC planning and decision 2024)  |         | Legacy Officing              | legacy SC systems         |                         |                   | point of destination improving          |                      |
| Continuous supervision, Continuous supervision, Monitoring and preservation, and 2024)       Continuous supervision, Continuous supervision, Continuous supervision, and 2024)       practices.         Updating       modernization of AI systems are necessary.       Fraud Detection: AI systems are able to identify irregularities and possible fraud in transactions, guaranteeing moral sourcing and lowering the possibility of counterfeiting.         SCM may significantly improve information management and proe e sustainability by utilizing these AI techniques, which can reduce       Deep Learning:       Supply Chain operations.         Deep Learning:       Supply Chain and decision operations.       Deep Learning:       Supply Chain and decision operations.  | 7       | Continuous                   | Continuous supervisio-    | (Odimarha et al         |                   | transparency and guarantaging SSC       |                      |
| Importance and preservation, and preservation, and processing and preservation, and processing and procesing and processing andecessing and processing and procesing and p  | ./      | Continuous<br>Monitoring and | continuous supervision,   | (Ouimarna et al.,       |                   | prostions                               |                      |
| opdating       modernization of AI<br>systems are necessary.       Fraid Detection: AI systems are able         to identify irregularities and possible       fraud in transactions, guaranteeing<br>moral sourcing and lowering the         possibility of counterfeiting.       possibility of counterfeiting.         SCM may significantly improve information management and pro-<br>e sustainability by utilizing these AI techniques, which can reduce       Deep Learning:       Supply Chain Planning: In order to<br>enhance SC planning and decision-<br>sping recordures and achieve more       (Odimarha et al.,<br>2024)   |         | wonitoring and               | preservation, and         | 2024)                   |                   | practices.                              |                      |
| systems are necessary. to identify irregularities and possible fraud in transactions, guaranteeing moral sourcing and lowering the possibility of counterfeiting. SecM may significantly improve information management and pro- e sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques, which can reduce be sustainability by utilizing these AI techniques are a subscript.   |         | Updating                     | modernization of AI       |                         |                   | Fraud Detection: AI systems are able    |                      |
| fraud in transactions, guaranteeing<br>more effective and sustainable supply chain operations.<br>SCM may significantly improve information management and pro-<br>e sustainability by utilizing these AI techniques, which can reduce<br>e sustainability by utilizing these AI techniques, which can reduce  |         |                              | systems are necessary.    |                         |                   | to identify irregularities and possible |                      |
| nore effective and sustainable supply chain operations.<br>SCM may significantly improve information management and pro-<br>e sustainability by utilizing these AI techniques, which can reduce<br>e sustainability by utilizing these are techniques, which can reduce<br>moral sourcing and lowering the<br>possibility of counterfeiting.<br>Deep Learning:<br>Deep Learn   |         |                              |                           |                         |                   | fraud in transactions, guaranteeing     |                      |
| nore effective and sustainable supply chain operations.possibility of counterfeiting.SCM may significantly improve information management and pro-<br>e sustainability by utilizing these AI techniques, which can reduceDeep Learning:Supply Chain Planning: In order to<br>enhance SC planning and decision-<br>2024)  |         |                              |                           |                         |                   | moral sourcing and lowering the         |                      |
| SCM may significantly improve information management and pro-<br>e sustainability by utilizing these AI techniques, which can reduce   | more    | effective and sustai         | inable supply chain one   | erations.               |                   | possibility of counterfeiting.          |                      |
| e sustainability by utilizing these AI techniques, which can reduce  | SCM     | may cignificantle            | improve information -     | anagement and me        | Deep Learning:    | Supply Chain Planning: In order to      | (Odimarha et al      |
| e sustainability by utilizing these AI techniques, which can reduce  | SCIVI   | may significantly I          |                           | anagement and pro-      | 1 0.              | enhance SC planning and decision-       | 2024)                |
| DUAKING OTHER AND ALTHREE DUTE   | ote sus | tainability by utili         | zing these AI technique   | es, which can reduce    |                   | making procedures and achieve more      |                      |

(continued on next page)

sustainable resource utilisation, deep learning models evaluate large and

waste, maximize resource utilization, and boost overall efficiency.

#### Table 2 (continued)

| Technique                   | Applications  | Refs.   |
|-----------------------------|---|---|
|                             | complicated information.<br>Energy Consumption Optimization:<br>Energy efficiency in production and<br>transportation can be maximised via<br>deep learning algorithms, promoting<br>sustainability in general.   |   |
| Agent-Based<br>Modeling     | Simulating Supply Chain Scenarios: AI-<br>powered simulations are able to<br>simulate various supply chain<br>situations, forecast results, and<br>determine the most environmentally<br>friendly choices.<br><i>Collaborative Logistics</i> : Through the<br>optimisation of load sharing and the<br>reduction of environmental effect,<br>agent-based models enable<br>collaborative logistics across various<br>SC participants. | (Joel et al., 2024;<br>Naim et al., 2023)         |
| Optimization<br>Algorithms: | Production Scheduling: AI<br>optimisation techniques enhance<br>production schedules, cutting down<br>on wasteful use of resources and idle<br>time.<br>Sustainable Sourcing: By weighing<br>costs and environmental effect, these<br>algorithms are able to determine the<br>raw material sources that are the<br>most sustainable.  | (Chauhan et al.,<br>2020; Kavota et al.,<br>2024) |
| AI-Driven IoT               | Real-Time Monitoring: SC processes<br>can be monitored in real time by AI-<br>integrated IoT devices, allowing for<br>quick adjustments to cut down on<br>waste and inefficiencies.<br><i>Smart Warehousing:</i> AI and IoT<br>sensors work together to monitor<br>conditions, maximise energy use, and<br>effectively manage inventory in<br>warehouses.   | (Aggarwal et al.,<br>2024)                        |

### 3. Descriptive analysis

#### 3.1. Analysis using bibliometrics

To advance the application of AI in SSCM, we aim to give a thorough overview of the current state of research, identify gaps, and propose a future research agenda through this systematic review and bibliometric analysis. Numerous software programs, each with specific advantages and disadvantages, have been used to undertake bibliometric analyses. We used the R mapping software for this work, which has several packages appropriate for bibliometric analysis. The Scopus database provided the data for the study. The following framework delineates the many steps of the mapping process, commencing with the descriptive analysis.

## 3.1.1. Primary information

The findings of a bibliometric review of articles obtained from the Scopus database are compiled in this study. First, Bib Tex-formatted data were extracted from the Scopus database and used with specific commands in R Studio for in-depth research. There were multiple stages to the bibliometric evaluation, beginning with extracting data from Scopus, a scientific database renowned for its vast compilation of academic publications. The extracted data included papers from 2008 to 2023 that dealt with SSCM and artificial intelligence. This period was chosen to include the most current and pertinent developments in the subject. The investigation shed light on how research topics change over time, the significance of different publications, and the collaboration networks among researchers. An overview of the publication trends is given in Fig. 2 of the study, which also shows the rise in SSCM and AI research activities during the previous 15 years. This visualization highlights the growing corpus of research and scholarly interest in utilizing AI to improve SCM sustainability.

## 3.1.2. Publication over time

Based on our bibliometric analysis, we observed an increase in SSC and AI papers. Few papers were made in the field until 2012 when it was barely active. This pattern can be seen in Fig. 3, which also features the



Fig. 2. Main information of data (Authors' work).



Fig. 3. Yearly publication in SSC and AI (Authors' work).

first noteworthy publication on AI's application to SSCM from 2008. More research on theoretical frameworks and preliminary case studies was needed between 2008 and 2012. When the value of sustainability in SC and the promise of AI were increasingly acknowledged, the number of articles rose over the years, from 2013 to 2018. With the arrival of AI technologies and the increasing emphasis on sustainable business practices, publications saw a notable uptick after 2019. A significant increase was observed after 2019, with 54 research publications produced in the last 15 years. This trend underscores AI's critical role in enhancing SSCM and its increasing academic and practical interest. This trend emphasizes how important AI is to improving SSCM and how much interest academia and industry have in it.

## 3.2. Annual average of citations

Our study examines the references made to 54 articles that analyse the effects of artificial AI on SSCM between 2008 and 2023. Incredibly productive are the publications from 2010 to 2018, with average citation counts per piece of 153.00 and 94.00, respectively, more than the rest, which is explained in Table 3. This suggests that research from these years produced foundational theories, methodology, and case studies that greatly influenced subsequent studies, indicating a considerable influence on the academic community. These critical contributions highlight the dynamic growth of research over the past 15 years at the nexus of AI and SSCM. They also demonstrate the growing maturity

## Table 3

| Citation p | jei year. |                  |               |              |
|------------|-----------|------------------|---------------|--------------|
| Year       | N         | MeanTCperArticle | MeanTCperYear | CitableYears |
| 2008       | 1         | 0.00             | 0.00          | 14           |
| 2009       | 0         | 0.00             | 0.00          | 0            |
| 2010       | 1         | 153.00           | 12.75         | 12           |
| 2011       | 0         | 0.00             | 0.00          | 0            |
| 2012       | 3         | 1.67             | 0.17          | 10           |
| 2013       | 1         | 5.00             | 0.56          | 9            |
| 2014       | 1         | 11.00            | 1.38          | 8            |
| 2015       | 4         | 14.25            | 2.04          | 7            |
| 2016       | 3         | 36.00            | 6.00          | 6            |
| 2017       | 2         | 23.50            | 4.70          | 5            |
| 2018       | 2         | 94.00            | 23.50         | 4            |
| 2019       | 4         | 26.50            | 8.83          | 3            |
| 2020       | 9         | 13.78            | 6.89          | 2            |
| 2021       | 10        | 2.60             | 2.60          | 1            |
| 2022       | 12        | 1.08             |               | 0            |
| 2023       | 1         | 0.00             | 0.00          | $^{-1}$      |
|            |           |                  |               |              |

and widening discourse in this field.

#### 3.2.1. Source clustering through Bradford's law

Using the Bradford law, source clustering can be accomplished by determining the relationship between the most productive journals (j) and the cumulative yield Y(j). It is possible to calculate the journal's literature yield, which has to be obtained by the following formulae:

$$Y(j) = plog(jk+1) + Y(0) for j \ge 0,$$
 (1)

Here p, u and Y (0) are constant.

Data from the top journals are shown in Table 4, using Bradford's law to group the sources. The most abundant source was the "International Journal of Production Research", which had a frequency of 4 and a cumulative frequency of 4. Similarly, "Sustainability(Switzerland)" ranks second with a cumulative frequency of 8. Table 4 lists the top journals in popularity, frequency, and cumulative frequency.

#### 3.2.2. Source local impact

The dataset yielded twenty sources for 54 articles across eight categories. Table 5 shows that the "International Journal of Production Research" and "Sustainability (Switzerland)" is the most cited journal.

#### Table 4

| Top 10 Source clustering by Bradford's | . Law |
|--|-------|
|--|-------|

| Source  | Rank | Freq | Cum<br>Freq | Zone      |
|---|------|------|-------------|-----------|
| International journal of production research        | 1    | 4    | 4           | Zone<br>1 |
| Sustainability (Switzerland)                        | 2    | 4    | 8           | Zone<br>1 |
| Journal of cleaner production                       | 3    | 3    | 11          | Zone<br>1 |
| Expert systems with applications                    | 4    | 2    | 13          | Zone<br>1 |
| Journal of self-governance and management economics | 6    | 2    | 17          | Zone<br>1 |
| Processes   | 9    | 2    | 23          | Zone<br>2 |
| Annals of operations research                       | 15   | 1    | 29          | Zone<br>2 |
| Business strategy and the environment               | 16   | 1    | 30          | Zone<br>2 |
| Computers and industrial engineering                | 17   | 1    | 31          | Zone<br>2 |
| Economics, management, and financial markets        | 18   | 1    | 32          | Zone<br>2 |

## Table 5

Top 10 source-specific citation format.

| Element   | h_index | g_index | m_index | TC  | NP | PY_start |
|---|---------|---------|---------|-----|----|----------|
| International journal<br>of production<br>research            | 3       | 4       | 0.231   | 174 | 4  | 2010     |
| Journal of cleaner<br>production                              | 3       | 3       | 0.375   | 164 | 3  | 2015     |
| Expert systems with<br>applications                           | 2       | 2       | 0.286   | 72  | 2  | 2016     |
| Journal of self-<br>governance and<br>management<br>economics | 2       | 2       | 0.5     | 19  | 2  | 2019     |
| Processes   | 2       | 2       | 0.667   | 13  | 2  | 2020     |
| Sustainability<br>(Switzerland)                               | 2       | 3       | 0.667   | 28  | 3  | 2020     |
| Computers and<br>industrial<br>engineering                    | 1       | 1       | 0.333   | 17  | 1  | 2020     |
| Economics,<br>management, and<br>financial markets            | 1       | 1       | 0.25    | 12  | 1  | 2019     |
| Energy systems  | 1       | 1       | 0.333   | 3   | 1  | 2020     |
| European journal of<br>operational research                   | 1       | 1       | 0.2     | 30  | 1  | 2018     |

In addition, many prestigious journals are listed in the Scopus and Web of Science databases and have a high impact factor and impact score. This indicates that many prestigious engineering journals are interested in this study area.

## 3.2.3. Word dynamics

The word dynamics of the author's keyword are shown in Fig. 4, which helps to identify the use growth rate of keywords between 2008 and 2023. from the figure, it is clear that Artificial Intelligence and Decision Making are the most dynamic keywords.

#### 3.2.4. Thematic map

Through a thematic analysis of publications utilizing the keywords provided by the authors, we identified the most popular subjects in sustainable supply chain research. A scale assessed the relative importance of every keyword's contribution. A clustering algorithm was also used to discover different themes on the term dataset. These approachgenerated relevant scientific clusters from connected keywords are displayed separately using a thematic map. An indicator of a theme's predominance on the map is its density. Sustainable supply chains and artificial intelligence were discovered to be two recurring themes through the thematic mapping of data related to these supply chains. The relationship between each theme's degree of development or density and its degree of importance or centrality is depicted in Fig. 5, which is the thematic map.

## 3.2.5. Factorial analysis

Using this method, a large dataset is divided into more minor variables focusing on a chosen few aspect. The most prevalent factors were found in the 54 papers that were analyzed for this analysis. These variables covered the many themes of supply chain management, AI, sustainable development, optimization, food supply, decision theory, Industry 4.0, and other pertinent issues. A correlation between these parameters and the standard common variable was found in this study. The findings of factorial analysis of these variables are shown in Fig. 6, which also offers insights into their relevance in the context of the investigation.

## 3.2.6. Trend topics

Fig. 7 shows the top study topics in artificial intelligence and sustainable supply chains from 2008 to 2023, based on the keywords used by authors. Studies on decision-making and optimization were expected in 2008, but in 2016, attention turned to artificial intelligence and decision-making in sustainable supply chains. Sustainability in the supply chain was a major topic of many articles during this time. With the advent of AI and sustainable supply chain management starting in 2020, sustainable development has received more attention. The figure illustrates how study subjects have changed throughout time. In the three years of data we analysed, artificial intelligence ranked first with a frequency of 39, followed by SCM with a frequency of 20.



Fig. 4. Word dynamics of author keyword (Authors' work).



Fig. 5. Thematic map between development degree and centrality (Authors' work).



Fig. 6. Factorial analysis of variables (Authors' work).

## 3.3. Discussion on trending topics in the supply chain

### 3.3.1. Supply chain network designing

The process of designing a supply chain network entails figuring out how many, where, and what kind of manufacturing facilities are needed and assigning suppliers and markets to each facility. Building the supply chain network is a crucial and challenging choice in today's competitive business climate. Many strategic decisions in design, such as where to locate facilities, can become quite expensive to change. Supply chain design, for instance, necessitates tactical judgments about inventory control and strategic considerations about the location of facilities. The conventional method used by the majority of supply chain design models now in use treats location and inventory decisions independently. However, ignoring how short-term inventory and long-term location decisions interact might result in less-than-ideal outcomes.

## 3.3.2. Supply chain sustainability

Incorporating sustainability issues into business operations is currently one of the most active research areas in SCM. SC orientation could lead to an improvement in SC sustainability.



Fig. 7. Trend topics over time (Authors' work).

## 3.3.3. Decision support systems

Organizations have prioritized SCM and investment more due to the tightening global market competitiveness, shortened product life cycles, and elevated consumer demands. In today's highly competitive and dynamic world, disagreements in SCM decision-making are unavoidable. As such, it is now more important than ever to be able to handle problems amicably. With the ability to provide customized solutions for effectively analysing and navigating intricate supply chains, decision support systems have become increasingly important in these situations. Various tactical and strategic SCM procedures, such as capacity planning, production planning, sales forecasting, inventory management, demand planning, and logistics, are made more accessible by these systems. Though decision support system-enabled SC with an IT focus has several benefits, their adoption is still relatively small.

## 3.3.4. Supply chain optimisation

Businesses require a SC that can quickly adjust to changing conditions in today's dynamic and chaotic marketplaces. Coordination and integration of all activities, from sourcing raw materials to distributing completed goods, emphasizing sustainability, can help businesses retain and enhance their market position. Competing objectives must be fulfilled for resource, social, economic, and environmental sustainability.

# 3.4. Challenges of information management in sustainable supply chain management through artificial intelligence

The processes known as "information management," which include determining what information is needed, gathering, classifying, storing, processing, packaging, distributing, and using it, are the foundation of organizational learning. Table 6 lists the Information Management Challenges for Future SC. Every SC is centred around its information system, which is now essential to day-to-day operations. Information systems facilitate accessible communication and coordination between suppliers and end users in the supply chain. Information management frequently faces several issues, such as managing growing volumes of data, providing information accessibility, reducing information silos,

### Table 6

Challenges for future SC in the field of information management.

| Challenges                                  | Refs.                                |
|---|--------------------------------------|
| Obtaining reliable supply chain information | (Cao et al., 2021; Nayal et al.,     |
| Challenges with advanced analytics and      | 2021)                                |
| amalgamation                                | (Lim et al., 2021; Meyer et al.,     |
| Implications for supply chain information   | 2021; Varsha et al., 2024)           |
| quality management                          | (Liu & Lin, 2021; Nguyen et al.,     |
| Information-based technologies and their    | 2021)                                |
| role in supply chain management             | (Frederico, 2021; Kazancoglu         |
| Designing a sustainable supply chain        | et al., 2022)                        |
| framework                                   | (Jamwal et al., 2021; Strube et al., |
|   | 2021)                                |

connecting with legacy systems, digitizing records, automating operations, and enhancing data quality. Concerns about data sharing between supply chains and data confidentiality must be addressed to implement effective information management methods.

Industrial sectors are being reshaped by the development of AI techniques, which is also likely to have far-reaching consequences for global production and environmental impacts. The effects of AI on long-term prosperity are mixed. It has been discovered that AI is aiding enterprises in achieving sustainability in SCM. Optimization, recovery strategies, and condition monitoring for SC systems may all benefit from AI techniques. Research obstacles for AI-enabled methods in SC sustainability are shown in Table 7.

### 3.5. Benefits of integration of AI with SC

Integrating AI into SC operations for information management significantly enhances sustainability through various vital benefits. AI optimizes supply chain processes by automating routine tasks and improving operational efficiency, reducing resource wastage and energy consumption. Its predictive analytics capabilities enhance demand forecasting and inventory management, minimizing overproduction and excess inventory. Real-time decision-making support from AI systems

## Table 7

Challenges in AI-enabled sustainable supply chain methods.

| Challenges                                 | Refs.                                |
|--|--------------------------------------|
| Analysis of the Effects of AI Methods on   | (Adelekan & Sharmina, 2024;          |
| Sustainable Supply Chain.                  | Akram et al., 2024; Callinan et al., |
| From an environmental point of view, what  | 2022)                                |
| effect do AI-based methods in Industry 4.0 | (Yadav et al., 2022a; Zizic et al.,  |
| have?                                      | 2022)                                |
| Problems with conditional supervision and  |                                      |
| forecasting                                |                                      |
| Problems with Quality forecasting          |                                      |
| Developing intelligent decisions with AI   |                                      |

allows supply chains to adapt swiftly to changes and disruptions, maintaining continuity with minimal environmental impact. AI also improves resource management by identifying inefficiencies, optimizing raw materials and energy use, and promoting sustainable consumption patterns. Enhanced supply chain transparency, achieved through AIdriven data tracking and analysis, helps identify and address sustainability issues such as carbon footprint and ethical sourcing.

Additionally, AI optimizes transportation routes and logistics, reducing fuel consumption and emissions and thus lowering the overall carbon footprint. It also aids in sustainable procurement by evaluating suppliers based on sustainability criteria, ensuring environmentally friendly practices throughout the supply chain. AI's insights into production and supply chain processes help reduce waste, supporting a circular economy approach. Furthermore, AI ensures compliance with environmental regulations and standards, mitigating legal risks and promoting sustainable operations. These efficiencies and waste reductions translate into significant cost savings, which can be reinvested in sustainability initiatives. Overall, AI integration boosts supply chain efficiency and profitability and fosters environmental sustainability and ethical practices, making it a vital tool for modern supply chain management.

# 4. Proposed framework for AI in information management in sustainable supply chain

This study will present a framework for an SSC based on AI. The framework considers the following three primary components: the various stages of the supply chain, the opportunities offered by AI methods, and the benefits derived from AI in all three dimensions of sustainability. The findings of this study's review indicate that AI-driven technologies play an essential role in developing a sustainable supply chain. This is the case because the evidence demonstrates that these technologies improve the overall efficiency of SCM. We have created an artificial intelligence-based application for sustainable supply chain work in the future by using the findings from previous research. In Fig. 8, we can see the proposed framework for AI in information management in a sustainable supply chain.

## 4.1. Sustainable supply chain phases

This phase of the proposed AI-sustainable supply chain framework includes the various stages of an SSC. A tremendous amount of data is generated during the different stages of the supply chain. AI techniques can handle these kinds of data. The findings of this study show that the use of AI can improve the performance of supply chains.

### 4.2. Artificial intelligence algorithms

The second most important part of the framework is the AI algorithm, which incorporates various AI techniques. Our research found that AI techniques can handle large and complex datasets. There are advantages and disadvantages to each AI technique. Our study suggests a feedback loop that can extract information from machine-generated data to use AI effectively. This data may be in a complicated format, but it can be accessed using artificial intelligence (AI). This phase must balance the sustainability dimensions to achieve optimal supply chain performance.

## 4.3. The effectiveness of a sustainable supply chain system

The results of this study show that a more effective SC system can be created using supply chain data extracted from various stages using AI algorithms. Adopting AI strategies enhances the SCM system's ability to perform economically, socially, and environmentally. The cluster analysis section contains a detailed analysis of the various studies in the various sub-research fields. We can now add the performance of the supply chain system as the third major part of our proposed framework. The proposed framework addresses a sustainable supply chain's economic, social, and environmental aspects.

#### 5. Research implication

An examination of the relevant literature reveals widespread consensus amongst sustainable supply chain professionals and authors that there needs to be more in-depth, systematic research into the application of AI in this field. This motivated us to perform a bibliometric study and literature assessment on sustainability. Implications for academics, professionals, and policymakers are provided below to aid future studies.



Fig. 8. AI-based framework for SSC (Authors' work).

## 5.1. Conceptual advancements

This article explains that using AI in a sustainable supply chain has many advantages. Furthermore, this article provides an overview of the most important contributions in this field and a list of SCM-related topics that have been studied. The existing literature on artificial intelligence (AI) applications in sustainable supply chains should be evaluated for their strengths and weaknesses. This article's uniqueness is in its ability to identify themes and clusters. Based on the research areas, we have identified groups in this study. In the preceding discussion, these clusters were mentioned. As a result of our research, we now have a thorough understanding of how AI can be used in a sustainable supply chain.

#### 5.2. Supervisory contributions

This review article provides helpful information that will help practitioners and policymakers because it clarifies the importance of AI applications in the supply chain for achieving sustainability. Cuttingedge technologies like cyber-physical systems, the Internet of Things, additive manufacturing, and intelligent manufacturing limit the number of manual occupations available to qualified individuals as Industry 4.0 and environmental concerns gain traction. This study has discussed several supply chain research opportunities that may be conducted using AI methods. These changes will assist companies in creating more Industry 4.0 jobs. Managers and practitioners must also evaluate the subjects discussed in this study. The research will make it easier for practitioners to comprehend how supply chain practices can be sustainable through AI techniques. The current study raises the question of whether applying AI techniques to businesses benefits all sectors or nations equally. Quick surveys must be conducted to determine whether this technological advancement in the industry improves business conditions or destroys supply chain activities. Managers or policymakers may decide to address this issue in the future.

#### 5.3. The consequences for researchers

Based on bibliometrics and a comprehensive review of the literature, we have identified the following key research areas for investigators to investigate further:

- I. The current study examines how artificial intelligence (AI) has altered SCM supply chain practices. The primary focus of this research is to investigate various AI applications in supply chain management.
- II. According to our research, using AI techniques has changed the supply chain scenario in industries. Industry 4.0 practices also benefit from these techniques, according to our study. AI's impact on the SC in Industry 4.0 would be more attractive to investigate in future studies.
- III. Additionally, empirical studies focusing on the key factors influencing and impeding the adoption of AI techniques in sustainable supply chains are required. Various methods can also determine how these drivers and barriers are related. If drivers and barriers are identified, AI applications will be quicker to implement in SCM.

## 6. Conclusion

This study aims to discuss the role of AI technologies in information management in achieving SC sustainability. The present study used an SLR strategy to uncover current research advances in AI, SC, and sustainability integration for information management. An SLR was conducted on the Scopus digital scientific database as part of the study. Following the screening, 54 articles were chosen for evaluation. The importance of various major enabling technologies in AI was thoroughly examined. The findings suggest that AI technology can help to improve SC sustainability. There are different new areas of research in AI and SC sustainability.

According to our findings, the "International Journal of Production Research" and "Sustainability (Switzerland)" publish the most papers on AI applications for an SSC. The study's findings suggest that Organizations need to employ technologically advanced tools involved in knowledge-based SC to maintain the quality of products and fulfil market demands. Also, the study's findings highlight a notable increase in AI research in supply chain SCM, focusing on ML and data mining applications. Predictive analytics, inventory control, logistics optimization, and sustainability are essential research areas. There is a noticeable trend towards integrating AI with IoT and blockchain to improve information management. AI has the potential to enhance sustainability in supply chain management (SCM), as evidenced by its practical applications in resource optimization, sustainable logistics, and predictive maintenance. Also, challenges like system integration and data quality must be resolved. This study revealed several research questions and barriers to adopting AI, which can be investigated further. To create a better framework, it is advised that future research and studies consider these challenges when developing their knowledgebased SC model. This study has some limitations. It merely examined research articles on SC, AI, and sustainability. As a result, future research can include empirical studies that focus on the issues associated with sustainability in specific industries and geographical areas.

#### CRediT authorship contribution statement

Alok Yadav: Writing – original draft, Methodology. Rajiv Kumar Garg: Supervision. Anish Sachdeva: Supervision.

## Declaration of competing interest

The authors declare that there is no potential conflict of interest.

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