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

Alok Yadav, Rajiv Kumar Garg *, Anish Sachdeva

Department of Industrial and Production Engineering, Dr. B. R. Ambedkar National Institute of Technology, Jalandhar 144008, India

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ABSTRACT

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 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

* Corresponding author.
E-mail address: gargrk@nitj.ac.in (R.K. Garg).

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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

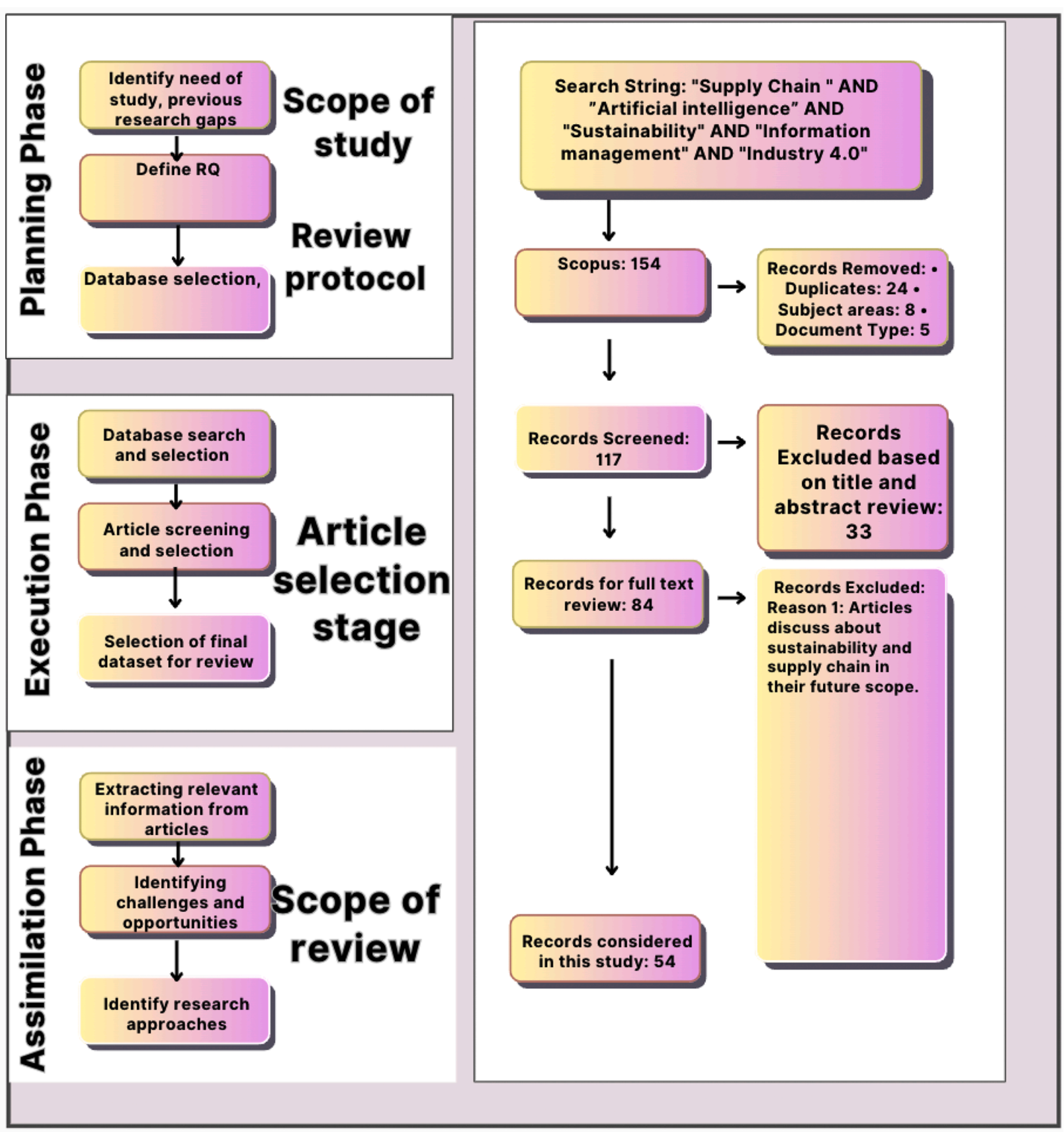

Fig. 1. PRISMA for SLR (Authors' work).

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
Challenges in adopting AI.

Serial No.	Name of Challenge	Description	Refs.
1	Data Quality and Integration	Ensuring data consistency, cleanliness, and accuracy across various SC platforms.	(AL-Khatib & Shuhaiber, 2022; Osei et al., 2023; Yadav et al., 2024b)
2	High Implementation Costs	AI infrastructure and training demand a large initial outlay of funds.	(Akbari et al., 2023; Akram et al., 2024)
3	Technological Complexity	Integration of AI with current systems and procedures might be challenging.	(Patidar et al., 2022; Alamsjah & Yunus, 2022)
4	Lack of Skilled Workforce	scarcity of experts in SCM and AI.	(Hwa & Te Chuan, 2024; Richey et al., 2023)
5	Cybersecurity Risks	Excessive data usage that makes one more susceptible to cyberattacks.	(Gaikwad, 2024; Zamani et al., 2023)
6	Data Privacy Concerns	Handling confidential data with sensitivity while following the law.	(Kavota et al., 2024)
7	Resistance to Change	Organisational resistance to implementing new technologies and inertia.	(Joel et al., 2024)
8	Ethical and Legal Issues	Managing the legal consequences of AI use and addressing ethical issues.	(Dubey et al., 2022)
9	Scalability Issues	Deploying AI technologies over international supply chains presents challenges.	(Kadena & Rajnai, 2024; Singh et al., 2023)
10	Interoperability Problems	Assuring the smooth integration of AI systems with various SC software.	(Chen et al., 2021; Hendriksen, 2023; Nayal et al., 2021)
11	Lack of Standardization	Lack of industry norms for the application of AI in supply chains.	(Akhtar et al., 2023)
12	Reliability and Trust	Fostering stakeholder confidence in decisions and insights produced by AI.	(Esfahbodi et al., 2023; Richey et al., 2023)
13	Environmental Impact	Regulating how AI operations and infrastructure affect the environment.	(Di Vaio et al., 2024)
14	Dynamic Supply Chain Environment	Modifying AI systems in response to quickly shifting supply chain circumstances.	(Muthuswamy & Ali, 2023; Thakur et al., 2023)
15	Vendor and Partner Collaboration	Making sure that data exchange and engagement with outside partners are done effectively.	(Atadoga et al., 2024)
16	Integration with Legacy Systems	Challenges in combining AI with antiquated or legacy SC systems.	(Cannas et al., 2024)
17	Continuous Monitoring and Updating	Continuous supervision, preservation, and modernization of AI systems are necessary.	(Odimarha et al., 2024)

to more effective and sustainable supply chain operations.

SCM may significantly improve information management and promote sustainability by utilizing these AI techniques, which can reduce waste, maximize resource utilization, and boost overall efficiency.

Table 2
AI techniques and their application in SC.

Technique	Applications	Refs.
ML	*Demand Forecasting:* ML algorithms evaluate past sales information, industry patterns, and outside variables to forecast future demand, cutting down on waste and overproduction. *Inventory Optimization:* With the use of ML models, one can minimise overstock and stockout scenarios, maintain ideal inventory levels, and cut down on waste and surplus inventory.	(Aggarwal et al., 2024)
Natural Language Processing	*Supplier Risk Management:* NLP technologies are used to evaluate textual data from social media, news, and other reports in order to find supply chain vulnerabilities including supplier financial instability or geopolitical problems. *Customer Feedback Analysis:* In order to find opportunities for improvement in product design, packaging, and delivery that are in line with sustainability goals, NLP approaches process customer reviews and comments.	(Jamwal et al., 2021; Yadav et al., 2022a)
Robotic Process Automation	*Order Processing Automation:* RPA may reduce errors and increase efficiency by automating repetitive operations like order entry and invoicing. This lowers resource consumption. *Compliance Monitoring:* Every sustainability requirement may be routinely met across the SC by automating the tracking of regulatory compliance.	(Aggarwal et al., 2024; Yadav et al., 2022b)
Computer Vision	*Quality Control:* AI-enabled computer vision systems may detect flaws in items more precisely than human inspectors, which minimises waste by guaranteeing that only superior products are distributed. *Warehouse Management:* Warehouse operations and layouts can be optimised with computer vision, which also helps to save energy and improves space usage.	(Chen et al., 2021; Dubey et al., 2022)
Predictive Analytics:	*Maintenance Prediction:* AI foresees equipment breakdowns before they happen, enabling proactive maintenance that prolongs gear life and uses fewer resources and downtime. *Route Optimization:* By optimising delivery routes, predictive analytics can lower emissions and fuel usage.	(Goodarzian et al., 2023; Patidar et al., 2024)
Blockchain with AI Integration	*Traceability and Transparency:* AI and blockchain technology work together to provide real-time tracking of commodities from point of origin to point of destination, improving transparency and guaranteeing SSC practices. *Fraud Detection:* AI systems are able to identify irregularities and possible fraud in transactions, guaranteeing moral sourcing and lowering the possibility of counterfeiting.	(Abaku et al., 2024; Zhou et al., 2024)
Deep Learning:	*Supply Chain Planning*: In order to enhance SC planning and decision-making procedures and achieve more sustainable resource utilisation, deep learning models evaluate large and	(Odimarha et al., 2024)

(*continued on next page*)

Table 2 (*continued*)

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

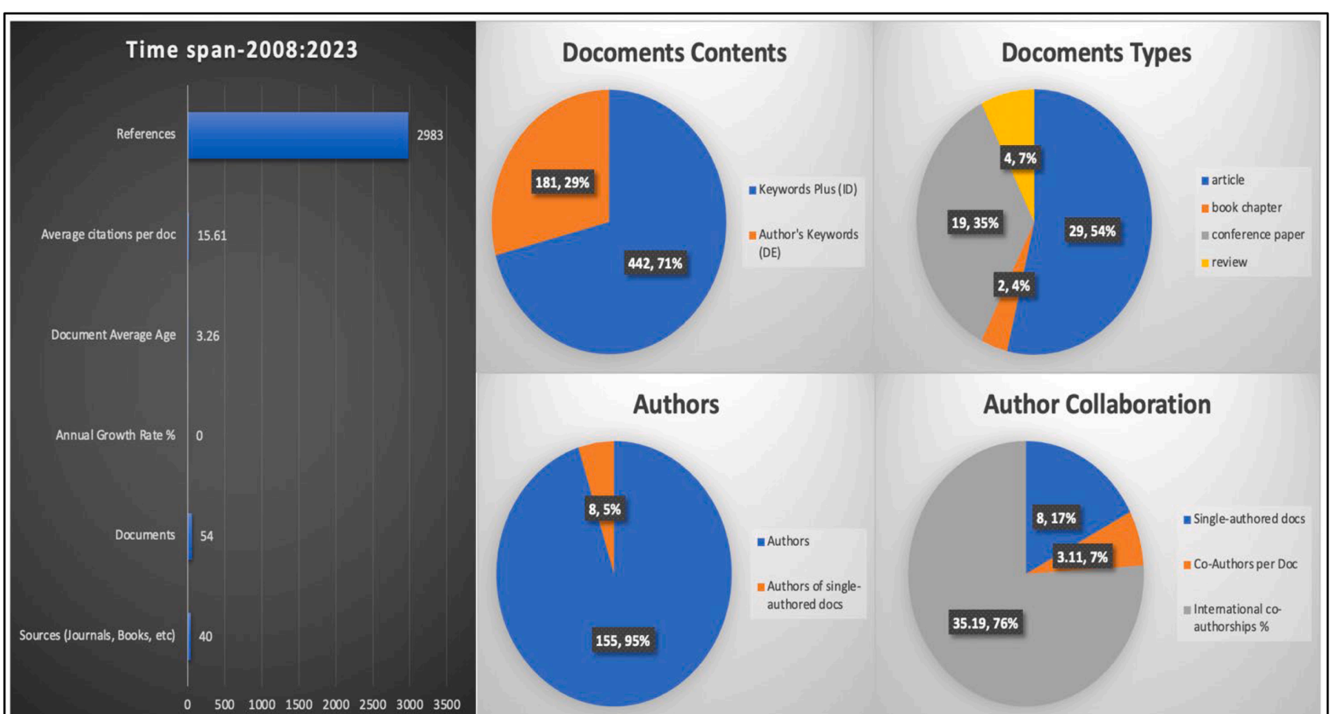

Fig. 2. Main information of data (Authors' work).

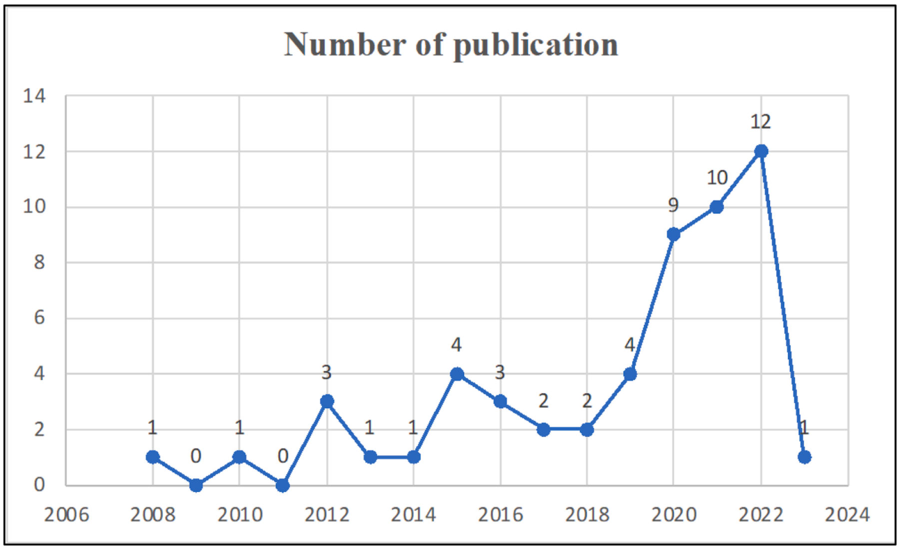

Fig. 3. Yearly publication in SSC and AI (Authors' work).

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 and widening discourse in this field.

Table 3
Citation per 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

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:

$$Y(j) = p\log(jk+1) + Y(0)\, for\, j \geq 0, \tag{1}$$

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

Table 5
Top 10 source-specific citation format.

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

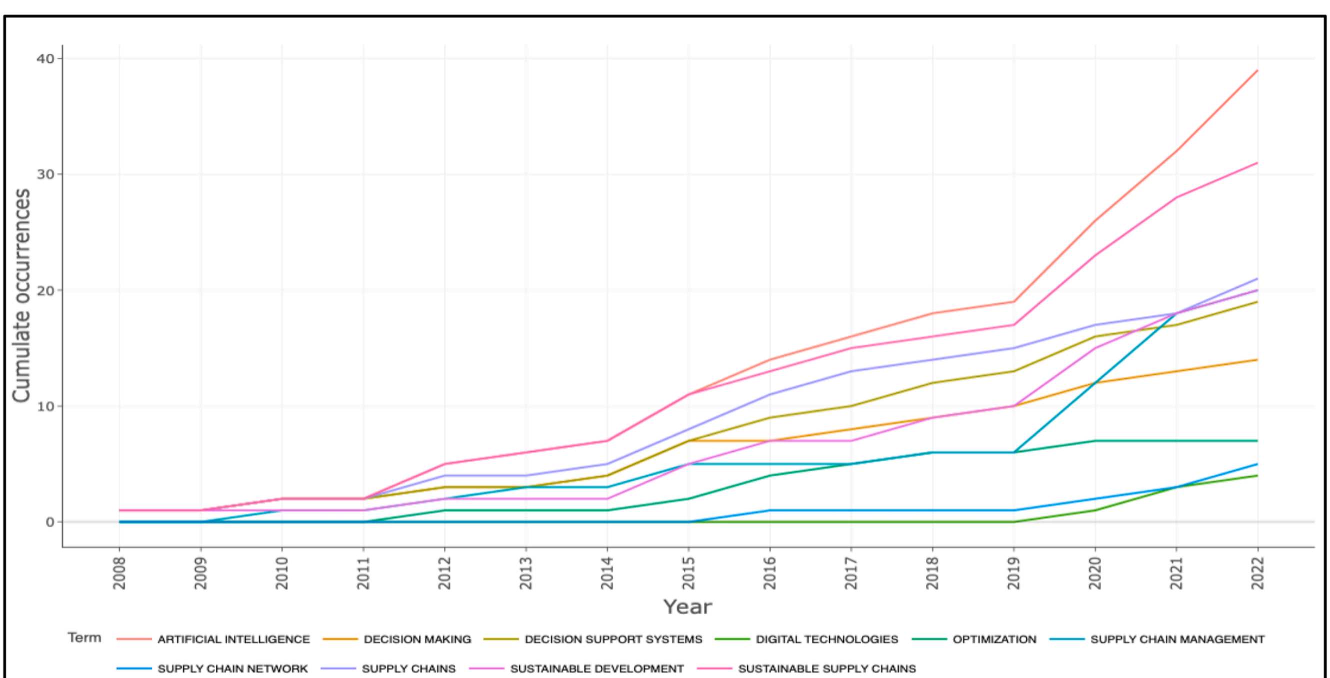

Fig. 4. Word dynamics of author keyword (Authors' work).

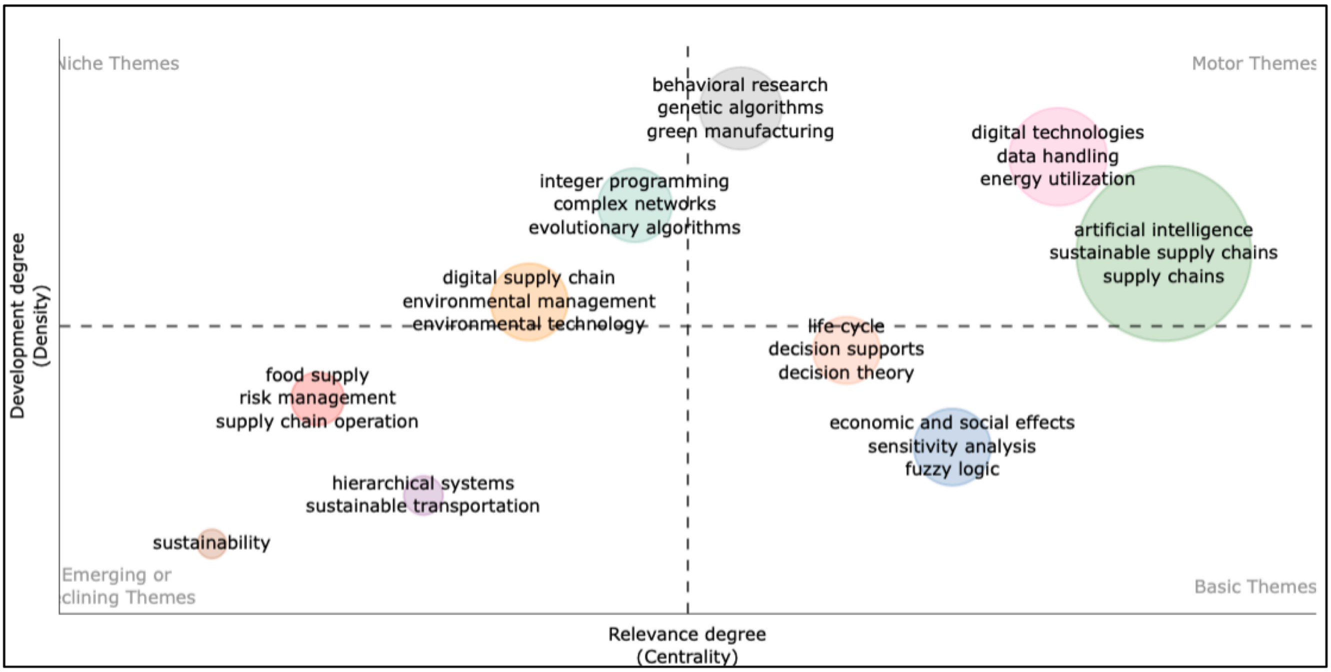

Fig. 5. Thematic map between development degree and centrality (Authors' work).

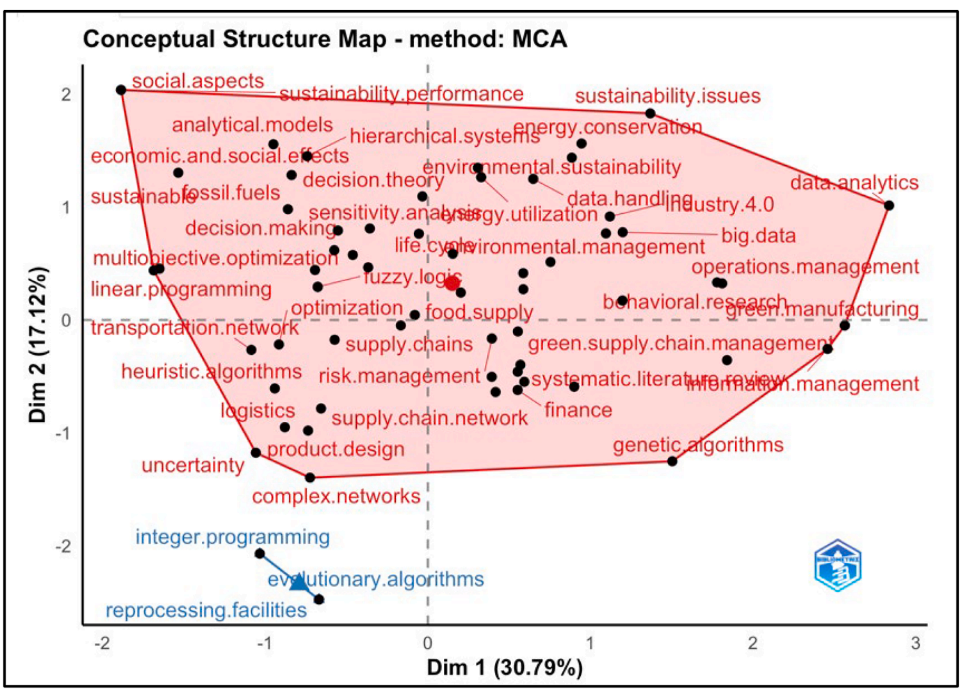

Fig. 6. Factorial analysis of variables (Authors' work).

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.

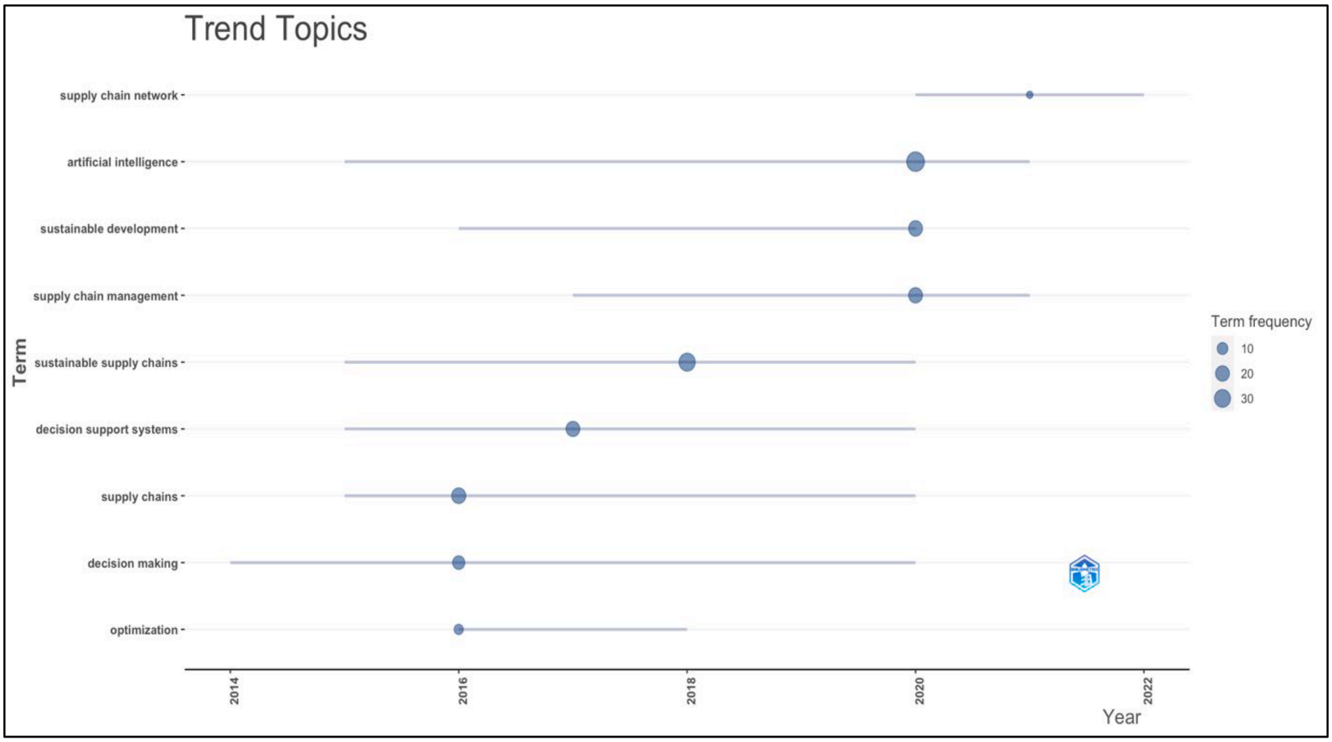

Fig. 7. Trend topics over time (Authors' work).

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, 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.

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

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

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 AI-driven 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. Cutting-edge 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 knowledge-based 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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