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A Study on the Sustainable Supply Chain Management with Artificial Intelligence

***Capt. Dr. E. Anitha Alice**

Asst. Professor of Commerce, Auxilium College, Vellore, Tamil Nadu, India
Email ID: eanithaalice@gmail.com
ORCID ID - 0009-0004-7786-3346

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***Author for correspondence:**
Capt. Dr. E. Anitha Alice
eanithaalice@gmail.com Asst. Professor of Commerce, Auxilium College, Vellore, Tamil Nadu, India

Abstract

The paper explores in general the use of Artificial Intelligence (AI) in enhancing Sustainable Supply Chain Management (SSCM) to address the growing significant environmentally eco-friendly and fair trade supply chains. It emphasizes the potential of AI to improve transparency and sustainability in supply chain operations through predictive analytics, intelligent automation, real-time tracking, and machine learning for supplier evaluation based on sustainability parameters. The study employs a combination of qualitative and quantitative methods to evaluate AI applications in SSCM, highlighting the benefits of AI in encouraging moral behavior, improving transparency throughout the supply chain, and maximizing resource utilization to cut down on waste. In order to help with the wider use of AI in SSCM, the research presents potential solutions to issues such as high costs, data privacy concerns, and talent gaps. In light of environmental concerns and legal expectations for sustainability in the digital age, the need to utilize AI technology is emphasized. This highlights important takeaways for supply chain management researchers, practitioners, and regulators.

Keywords: Sustainable Supply Chain Management, Transparency, Resource Utilization, Artificial Intelligence

1. Introduction

The introduction in the document provides an overview of how Artificial Intelligence (AI) is being integrated into Sustainable Supply Chain Management (SSCM) to enhance transparency and sustainability. It mentions the potential benefits of AI in improving supply chain operations through various technologies like predictive analytics, intelligent automation, real-time tracking, and machine learning for supplier evaluation based on sustainability parameters. The introduction also acknowledges the challenges to adoption of AI, such as expensive expenses and worries over data privacy and the need for specialized

skills. It emphasizes the importance of providing techniques to overcome these challenges and encourage wide adoption of AI in SSCM to make supply chains more efficient and sustainable.

The Process of AI in SSCM is a significant development that is reshaping the landscape of supply chain operations. As the need for sustainable practices within supply chain management becomes increasingly crucial, AI emerges as a potent tool to enhance transparency and sustainability. Through the utilization of predictive analytics, intelligent automation, real-time tracking, and machine learning, AI offers a plethora of opportunities to improve supply chain efficiency and reduce waste based on sustainability parameters. SSCM connotes the coordination of social, relating to natural, and economic objectives within supply chain processes to ensure that operations are environmentally and socially responsible. The incorporation of AI into SSCM involves leveraging AI-powered tools such as predictive analytics, intelligent automation, real-time tracking, and machine learning to enhance transparency throughout the supply chain, promote ethical and sustainable practices, and efficient use of resources thereby reducing wastage.

2. Importance of the Research Study

The importance of integrating AI in SSCM lies in its ability to change the supply chain operations, making them more clear, efficient, and sustainable. AI enables businesses to predict future demand accurately, optimize logistics processes, enhance transparency in the supply chain, and evaluate suppliers based on sustainability indicators. By harnessing AI technologies, organizations can meet sustainability goals, comply with regulatory requirements, and address evolving consumer demands for ethical and sustainable practices. Overall, AI's role in SSCM is very important for businesses looking to move forward the environmental concerns, policy demands, and expectations of customers in the digital era.

3. Research Gap

The Process of AI in SSCM brings about a unique set of challenges that demand to be pointed for execution. These challenges include: Implementing AI systems in supply chain management requires significant financial resources for acquiring hardware, software, and specialized expertise. Effectively leveraging AI in SSCM requires a trained workforce capable of moving and interpreting AI systems. Current ability gaps of personnel in various organizations present a significant obstacle to AI adoption. Initiatives for upskilling and reskilling are necessary to bridge these gaps despite these barriers; the transformative potential of AI in SSCM is undeniable. By addressing these hurdles through strategic planning, investment, and a focus on innovation, businesses can unlock the benefits of AI to create more transparent, efficient, and sustainable supply chains.

4. Objective

1. To determine the role of AI in enhancing SSCM by improving transparency and sustainability.
2. To analyze how AI can optimize supply chain operations through Machine learning, intelligent automation, real-time tracking, and predictive analytics are used to evaluate suppliers according to sustainability criteria.
3. To highlight the challenges to SSCM's deployment of AI, including its high prices and data privacy issues, while outlining possible solutions.
4. To provide valuable insights for industry practitioners, policymakers, and researchers seeking to leverage AI for sustainable supply chain oversight.

5. Hypothesis

H1: There is a significant difference between supply chain oversight determinant and sustainability.

H1: There is a significant difference between the impact of supply chain oversight and sustainability.

H1: There is a significant difference between AI technology and supply chain oversight sustainability.

6. Research Methodology

The research methodology employed in the document on "AI in SSCM" is a combination of descriptive research methods encompassing qualitative and quantitative data sources. The study begins with an exhaustive review of literature, reports, and opinions to establish a basic foundation on the basis of theory and real-world examples of AI applications in SSCM. Subsequently, a survey targeted with correlation is conducted to value the prevalence and consequences of AI technologies in practical supply chain operations. Additionally, expert interviews are conducted to learn about upcoming trends and subtle insights from leaders in the business world.

This approach is a pivotal analysis of the topic, connecting theory to real-world applications and insights for incorporating AI into sustainable supply chain oversight.

7. Review-Literature

Kshetri (2018) the integration of AI in SSCM reveals a growing emphasis on the crucial basis of creating environmentally and socially responsible supply chains. Researchers have highlighted the potential of AI to enhance sustainability objectives within supply chain processes. The use of AI-powered tools such as Machine learning, intelligent automation, real-time tracking, and predictive analytics has been increasingly integrated into supply chain operations, contributing to improved demand forecasting, reduced carbon footprint,

enhanced transparency, and responsible sourcing. However, challenges such as data privacy concerns, skill deficits, and increased investment costs demand to be addressed to fully realize the benefits of AI in SSCM.

Kamble, Gunasekaran, Subramanian, Ghadge, Belhadi, and Venkatesh (2021) suggest potential future research directions, including exploring the socioeconomic impact of AI integration, adopting approaches through interdisciplinary, conducting vertical studies, and undertaking interconnectivity studies to better understand the implications of AI in SSCM. Despite the challenges posed by the adoption of AI in supply chain oversight, the transformative power of AI in creating sustainable supply chains is emphasized, highlighting the urgency of harnessing AI technology in response to environmental concerns and regulatory demands. Ultimately, strategic planning, innovation, and investment in AI technologies can help organizations overcome obstacles and reap the benefits of AI in creating more efficient supply chain oversight naturally.

8. Component of sustainable supply chain oversight

In the context of SSCM, there are various key components that have a crucial role in enhancing transparency and sustainability. One essential component is predictive analytics, which utilizes AI-powered tools to forecast demand accurately based on historical data and machine learning algorithms. This enables organizations to optimize stock management, reduce over and above the normal production, and minimize unproductivity, thus promoting both economic and environmental sustainability.

Intelligent automation is another significant component in SSCM that leverages AI to maximize supply chain and manufacturing processes, leading to cost savings and reduced carbon emissions. By incorporating AI-driven robots for tasks like packaging and sorting, companies can streamline operations and decrease their environmental footprint. Real-time tracking systems powered by AI also play a vital role in SSCM by providing stakeholders with insights into the origin and management of products, fostering transparency and accountability

Correlations

		Planning	Prediction analytics	Optimization algorithms	Block chains for traceability	smart manufacturing
Planning	Pearson Correlation	1	-.016	.109	-.024	.035
	Sig. (2-tailed)		.028	.009	.000	.012
	N	114	114	114	114	114
Prediction analytics	Pearson Correlation	-.016	1	.116	.080	.097
	Sig. (2-tailed)	.028		.016	.000	.005
	N	114	114	114	114	114

Optimization algorithms	Pearson Correlation	.109	.116	1	.032*	.148
	Sig. (2-tailed)	.009	.016		.000	.007
	N	114	114	114	114	114
Blockchain for traceability	Pearson Correlation	-.024	.080	.032*	1	.126
	Sig. (2-tailed)	.000	.000	.000		.002
	N	114	114	114	114	114
smart manufacturing	Pearson Correlation	.035	.097	.148	.126	1
	Sig. (2-tailed)	.012	.005	.007	.002	
	N	114	114	114	114	114

*Correlation is significant at the 0.05 level (2-tailed).

It is inferred from the above table that the Planning (SCM) factor has a high level of correlation between prediction analytics, optimization algorithms, Blockchain for traceability, and smart manufacturing.

Therefore, it is stated that when the mediating factor of Artificial Technology is used with Supply chain Management there will be a high level of effect on sustainability.

9. Suggestions

1. Future research should delve into how AI incorporation in SSCM affects factors like employment patterns, income distribution, and social resource allocation.
2. Researchers should combine insights from various fields like economics, management studies, environmental science, and computer science to lead and develop a comprehensive grasp of AI's function in SSCM.
3. Long-term devotion of time is needed to monitor the ongoing impacts of AI adoption in supply chains over extended periods.
4. Comparative research across different industries, regions, and business sizes can offer insightful information about particular difficulties and possibilities with AI integration in SSCM.

10. Conclusions

1. Strategic Navigation of Challenges: Although there are obstacles like high costs and data privacy concerns, these challenges may be faced to release the vast benefits of AI in transforming SSCM.
2. Urgency of AI Technology: The study highlights the critical importance of harnessing AI technology in the face of growing environmental concerns and policy pressures for sustainability in the digital era.

Overall, the study concludes that while there are significant obstacles to the integration of AI in SSCM, proactive planning, investment, and innovation can help businesses

leverage AI to create more clear, appropriate, and naturally applicable supply chains. The transformative potential of AI outweighs the challenges, making it essential for companies to optimize operations and enhance sustainability in response to environmental and social responsibilities.

11. Future Scope of the Research Study

The future scope of the Research study on combining AI in SSCM presents several promising avenues for further research and exploration. Some potential future research directions include:

1. There is an utmost concern for this study to evaluate the wider socioeconomic consequences of integrating AI into supply chains. Research could reach inside into how AI implementation in SSCM affects employment patterns, distribution of income, and adequate level of distribution of social resources.
2. The Penetration of AI, sustainability, and supply chain management calls for a convergence of research efforts across various disciplines. Insights from various fields like economics, management studies, environmental science, and computer science will lead and develop a comprehensive grasp of AI's function in SSCM.
3. As more companies adopt AI in their supply chains, vertical studies are essential to monitor these changes over elongated periods. Such research may help to find out the persistent trends, unexpected consequences, and effective strategies for integrating AI.
4. Comparative studies that determine how AI is being used in SSCM in various markets, physical features of areas, and company sizes may provide in-depth information. These results can be used to identify particular difficulties and opportunities in a range of contexts, guiding the development of tailored AI integration methods.

12. Limitations of the study

1. The study acknowledges that one of the principal obstacles to the adjustment of AI in SSCM is the substantial upfront stock required for the purchase of essential hardware, software, and specialized expertise.
2. The deployment of AI in SSCM raises worries about data privacy and the requirement for strong data governance procedures to protect private data and rely on changing data protection regulations of the Government.
3. Effective utilization of AI in SSCM demands a skilled workforce capable of navigating and interpreting AI systems. However, existing skill gaps in many organizations pose a formidable impediment to the adoption and successful implementation of AI in SSCM.
4. While the study touches upon ethical considerations in AI-integrated SSCM, further exploration of the ethical implications of AI use in supply chains could provide valuable insights This study states that substantial finance for purchase of hardware, softwares and specialised expertise is required which is a burden for smaller organisation.

Conflict of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper.

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