

Survey Paper on: Leveraging Artificial Intelligence (AI) and Blockchain to Enhance Supply Chain Management for a Ganapati Idol Selling Platform

Patil Sahil Dinanath¹, Yadav Ashish Suryaprakash², Bahurupi Vrushali Pratik³,
Patil Yash Nilesh⁴, Dabake Soham ManojKumar⁵

^{1, 2, 3, 4, 5} Department of Information Technology, Pillai College of Engineering, New Panvel

Abstract:- This study introduces a new digital platform that is focused on enhancing customer engagement in the retailing of the Ganesh idol. It integrates artificial intelligence, machine learning, and blockchain into a single online platform. The website would provide an engaging shopping experience for customers. For instance, buyers can interact with AR-based 3D models that can help preview, customize, and evaluate idol designs in detail prior to purchase. The aim is to go beyond mere conventional e-commerce models and create a more personalized and interactive marketplace driven by modern digital technologies.

To implement this, we use computer vision, deep learning models, and generative models like Semantic Segmentation. These methods provide clear visualizations and tailored customizations. In contrast, traditional methods may be restricted when processing images or using predictive models such as LSTM, ARIMA, and GRU. These techniques have difficulty with dynamic user edits/changes or detailed artistic features. Semantic Segmentation combined with AR tools can facilitate real-time customization and realistic design previews, while blockchain-based smart contracts preserve the integrity of every transaction in a secure, open, and tamper-proof environment, furthering trust and accountability at every point in the supply chain.

Moreover, the study shows that by integrating deep learning methods with AR-enabled 3D visualization, customers can participate in design-related activities. They can personalize features based on their preferences. Utilizing blockchain for safe and traceable exchanges, the system establishes a sound, adaptable, and transparent structure. This renovates not only the supply chain but also upgrades the overall e-commerce.

Keywords: Artificial Intelligence, Machine Learning, Supply Chain Management.

1. Introduction

The rapid growth in the digital economy is making the traditional supply chain practices increasingly difficult. Certain issues such as inefficiencies, lack of transparency, and security are common problems. The present study has proposed a new platform for the retail industry of the Ganapati idol, which is integrated with Artificial Intelligence and blockchain.

AI predicts the demand for products, inventories, and provides personalized experiences to customers through immersive 3D idol customization using AR. Simultaneously, blockchain builds trust and accountability through the secure recording of transactions in a transparent, tamper-proof way using smart contracts. In sum, technology integration is expected to enhance operations, stakeholder trust, and material sustainability verification.

In all, the proposed solution enhances supply chain efficiency while providing real-time insights to artisans and suppliers, interactive customization options to customers, and verified eco-friendly choices.

1.1 Objectives:

The aim of this project is to reimagine supply chain management within the retail sector of the Ganapati idol. We seek to create a single platform driven by AI and blockchain technology.

The platform will:

- Improve efficiency through AI-driven demand forecasting and smart resource allocation.
- Provide security and transparency through smart contracts enabled by blockchain and permanent, tamper-proof logs of all transactions.
- Increase customer engagement by offering real-time AR-based 3D customizations of idols along with AI-enabled personalized recommendations.
- Assist in eco-sustainability by verifying that raw materials are genuinely environmentally safe.

Allow complete traceability by tracking every stage in the supply chain, right from material procurement to final delivery.

1.2 Scope:

The project encompasses the entire design, development, and deployment of a supply chain management system for the retailing of the Ganapati idol.

The system's objectives are to address the following key challenges:

- Poor inventory monitoring and control
- Lack of transparency in transactions and material flows
- Few chances for customer-driven customization
- The urgent need for sustainable and eco-friendly practices

Blockchain-based smart contracts would automate agreements among artisans, suppliers, and customers. This will ensure reliability, accountability, and security within every stage of the supply chain. Simultaneously, the platform promotes environmental sustainability by confirming through blockchain verification the authenticity of eco-friendly raw materials.

Conceived to bring in more efficiency and reduce the risk of fraud, it also hopes to reshape some of the conventional supply chain practices of the idol-making industry. The project blends transparency and sustainability with customer-focused innovation, striving to create a modern digital marketplace that supports artisans, builds trust with customers, and influences the cultural and environmental aspects of the Ganapati idol celebrations positively.

2. Literature Survey

A literature survey clearly outlines existing research in a particular area in a structured way. This research covers the present-day research in the integration of AI and blockchain into the field of supply chain management. The review aims at underlining the main approaches, analyzing their positive and negative sides, and explaining the need for the proposed hybrid framework. For clarity, the survey is divided into three major sections: the role of AI in supply chain operations, blockchain for ensuring transparency and traceability, and the combined effect of those two technologies.

1. Integration of Artificial Intelligence and Blockchain Technology (2023)

This 2023 study proposes a framework for modernizing traditional supply chains by incorporating AI and blockchain technology. It emphasizes the contribution of AI in the form of CNN, GAN, and AR, as these improve demand forecasting and inventory optimization, allowing customers to request a product with interactive 3D customization. Additionally, blockchain provides a secure and transparent layer with unchangeable records, hence

guaranteeing traceability and data integrity thanks to smart contracts that automate processes with little labour. This greatly adds value when applied to confirming the use of sustainable raw materials. While this study does not provide practical implementations or case studies, it forms a very solid theoretical basis for decentralized, smart, and green supply chain systems.

2. AI in Supply Chain Management (2021)

Talks about how AI technologies like machine learning, natural language processing, and computer vision transform operations across various stages-demand forecast, procurement, logistics, and customer service, among others. This research points out how AI can help improve overall efficiency by making real-time decisions, reducing costs of operations, and improving the accuracy of planning with data-driven algorithms that spot patterns and optimize resources in distributed networks. Also included are practical applications, such as predictive analytics for inventory management, AI-driven chatbots for customer engagement, and the use of autonomous vehicles, drones, and land logistics. Yet, this investigation acknowledges that there are also challenges regarding quality of data, system integration, workforce expertise, and ethical concerns that demand explainability from AI. The authors conclude by stating that AI is not just supportive; AI is a core driver of an intelligent, flexible, resilient supply chain that orchestrates toward digitally enabled logistics ecosystems.

3. Artificial Intelligence Applications for Information, 2024

This paper reviews the broad vista of Artificial Intelligence applications in the management and processing of information with a focus on how AI enhances efficiency, speed, and accuracy in handling large volumes of data. Core AI techniques are discussed with examples, like NLP, machine learning, and semantic analysis, in information retrieval, classification, recommendation generation, and summarization. The research further notes that AI systems will be able to adapt to user behaviour, deliver more personalized content, and extract valuable insights from unstructured datasets. At the same time, it realizes challenges relating to data privacy, transparency in algorithmic functions, and ethical considerations; hence, AI will remain at the centre of the future intelligent information system.

4. Blockchain Technology in Supply Chain Management 2020

This study investigates how blockchain restructures supply chain management through guaranteed transparency, traceability, and security at all stages of operation. Blockchain, being a decentralized and tamper-proof ledger, ensures that all transactions-from the procurement of raw materials to the delivery of finished products-are permanently recorded and verifiable, hence reducing significant risks of fraud, counterfeiting, and human error. In this respect, the research also underlines that smart contracts reinforce such a framework by further automating transactions, thus building up trust among stakeholders and smoothing both logistics and inventories. The practical cases noted in several industries, from food and pharmaceuticals to manufacturing, suggest the wide relevance of this technology. Despite this fact, this research also recognizes some drawbacks that remain unsolved: issues of scalability, integration with legacy systems, and regulatory compliance. In any case, blockchain emerges as a foundational technology toward the creation of more efficient, secure, and transparent supply chains while assuring much better accountability.

5. The Study on Artificial Intelligence Supply Chain Management and Logistics Business Success, Conducted in 2023

Has highlighted the necessity of integrating artificial intelligence with supply chain management and logistics to achieve competitive advantage. It is envisaged that modern enterprises depend heavily on intelligent systems for coordination in operation, logistics optimization, and prompt adaptation to altered market conditions. Predictive analytics, IoT, and automated decision-making form part of AI-powered tools, through which enhanced visibility, responsiveness, and efficiency are achieved along the value chain. Indeed, the research also underlines the need to share data at an appropriate level along with seamless system integration among suppliers, manufacturers, and distributors, not only yielding cost reduction but also increasing customer satisfaction. Conclusively, it has been stated that the future of supply chains would definitely get reshaped by unified deployment of intelligent technologies that will enable real-time coordination and end-to-end visibility.

6. Artificial Intelligence Use in Indian Agriculture (2020)

This study investigates the potential and practical applications of AI in Indian agriculture, with specific reference to how this technology can help resolve deep-rooted challenges such as low productivity.

This includes inefficient resource utilization and dependence on conventional farming practices. The use of AI-powered tools in conjunction with remote sensing, weather forecasting, crop monitoring, and irrigation automation provides the farmer with important information for decision-making, thereby reducing costs and increasing yields. Particular emphasis has been given to the adoption of machine learning models and mobile-based advisory platforms developed for small and marginal farmers. Though there are considerable benefits accruing from its adoption, the study identifies a few key barriers, such as limited awareness, inadequate digital infrastructure, and the need for stronger policy support. The study thus concludes that with appropriate integration strategies, AI holds immense potential to modernize Indian agriculture and contribute toward sustainable rural development.

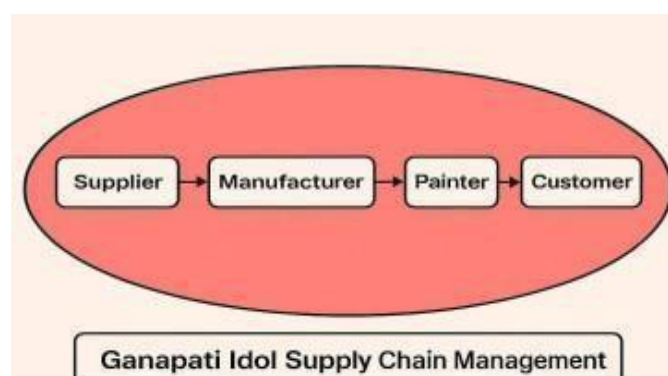
7. Digital Supply Chain Management Using Artificial Intelligence (AI), Machine Learning (ML), and Blockchain (2022)

The paper presents an overall analysis of how AI, ML, and blockchain reshape digital supply chain management to become more intelligent, transparent, and adaptive. It reviews the use of AI and ML algorithms on predictive analytics, demand forecast, risk assessment, and process automation. Blockchain enhances these capabilities with data integrity, end-to-end traceability, and secure transactions using decentralized ledgers and smart contracts. These technologies, when integrated, bring greater visibility to the supply chain, reduce delays, and increase coordination among suppliers. The paper uses case studies from manufacturing and retail industries to show measurable gains not only in efficiency but also in customer satisfaction. The study concludes that AI, ML, and blockchain must be used together to create resilient, future-ready supply chains that can respond efficiently to rapidly changing market conditions.

3. Proposed Methodology

3.1 Existing System Introduction:

The existing Ganapati Idol Supply Chain Management system follows the traditional linear structure, and there are four major stakeholders involved in the supply chain-suppliers, manufacturers, painters, and customers. Suppliers supply raw materials such as clay, paints, and decoration items. However, because of a lack of digital tools, That prevents effective inventory tracking and quality assurance. The idols are manufactured by the manufacturers themselves. Manually, by molding and sculpting, without AI-powered monitoring and optimization of the process. Painters add finishing touches using traditional colouring and ornamentation techniques; no digital preview or opportunities for customer customization are offered. Finally, customers buy idols only from physical stores or exhibitions without personalization, order tracking, or information about the origin of the product. The result of such a manual, disjointed process consists of a number of disadvantages-the absence of full transparency, delays in inefficient tracking, less customer interaction, and no security measures such as blockchain that authenticate the product to avoid counterfeiting. prevents effective inventory tracking and assurance of quality. The idols then go into production by manufacturers,



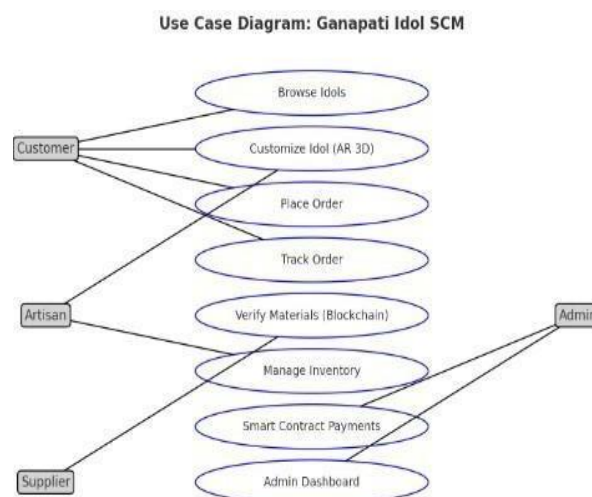
Implementation:

The approach involved in the implementation plan for this survey paper is to first design and develop the core architecture by integrating AI with blockchain technology in a phased manner. First, data collection and preprocessing will be carried out to train Machine learning models will be developed to forecast demand and suggest personalized products, while blockchain-based smart contracts will ensure secure, transparent, and tamper-proof tracking of transactions and materials. A web-based interface with interactive features shall be developed. This shall also include augmented reality-enabled 3D visualization for the real-time customization of Ganapati models. The system shall thereafter be subjected to integration testing, ensuring that AI modules, blockchain ledgers, and the front-end application can communicate well. After verification, it shall be deployed in a pilot phase among selected artisans, suppliers, and customers for feedback and refinement. The further work shall involve continuous monitoring and iterative enhancement towards scalability, high user satisfaction, and long-term sustainability objectives.

3.2 Propose System Introduction:

The system architecture proposed in this paper is a comprehensive multilayer framework that ensures a supply chain management solution which will be secure, intelligent, and transparent for the Ganapati idol retail sector. This is designed in six interdependent tiers. The Frontend Layer provides an intuitive interface built with modern frameworks such as ReactJS or Angular, thereby enabling the stakeholders-suppliers, manufacturers, and customers-to interact smoothly. The API Layer acts as a secure intermediary by authenticating the requests and transferring data efficiently between the frontend and the backend. The Business Logic Layer enforces the business rules and integrates both blockchain and database systems for the function of production tracking, order management, and control over workflow. At the very heart of trust and accountability, the Blockchain and Smart Contracts Layer ensures immutable records of each transaction and automates-perhaps through decentralized verification-certain processes such as payments and inventory updates. The Database Layer manages a variety of both static and dynamic datasets-from user information to inventory records, to AI-generated output used in analytics and forecasting. Finally, the Dashboard Visualization Layer offers real-time, role-based insight into key indicators, such as stock levels, shipment status, and production activities that have taken place, thus facilitating effective decision-making with the help of supply chain management.

Use Case Diagram:

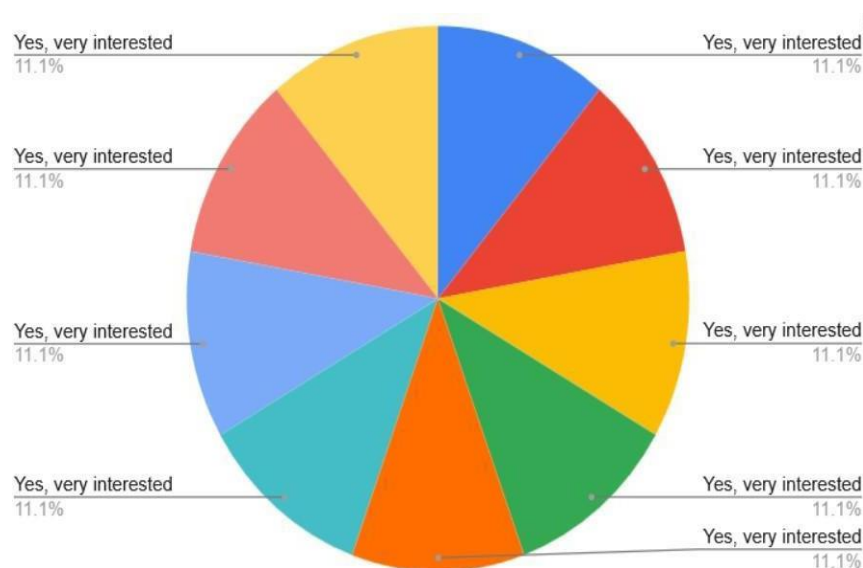


This use case diagram depicts the interaction of various stakeholders of the supply chain management platform for the Ganapati idol with the main features of the system. The customers can view the idols, customize them in 3D using AR, place the order, and track the delivery status. Through the system, the artisans can manage their inventory of idols and customize them according to the customer's requirements. The suppliers will verify the quality and authenticity of the eco-friendly raw materials through blockchain-based validation.

In contrast, the admin controls the entire system through the dashboard, ensuring smooth and secure transactions via blockchain-enabled smart contracts. The ellipses are representations of use cases, or tasks/functionalities, while the lines that connect them show the relationships the actors have with those tasks. Or better to say, this diagram defines both who the users of the system are and what type of actions they will be enabled to perform by making the platform transparent, secure, and customer-friendly.

3.3 Survey Analysis:

A survey conducted to gauge the acceptance of digital platforms amongst artisans on the question: “Would you be interested in selling your idols online?” revealed an unequivocal interest, with 100% strongly showing a willingness to do so. The overwhelming response indicates that the artisans are ‘ready for adoption’ of digital solutioning, besides underscoring the pragmatic relevance of the proposed system, especially since the platform addresses industry needs; it therefore validates the project's objectives of modernization, efficiency, and sustainability.



Implementation Plan:

The proposed system's implementation plan is a structured and modular approach. This helps ensure that all components and technologies are well integrated. The development starts with the frontend interface, designing an intuitive role-based GUI using modern frameworks like ReactJS for stakeholders such as suppliers, manufacturers, and customers. Then, develop an API layer for secure and effective communication between the frontend and backend levels to ensure efficient data routing and robust validation. The backend business logic will then be implemented to handle workflows like order management, inventory updates, and production tracking, maintaining the system rules and operational logic in parallel.

Concurrently, there will be a deployment of the blockchain layer on platforms such as Ethereum or Hyperledger to enable the use of smart contracts for transaction automation and immutable, transparent recording of supply chain activities. A relational or NoSQL database layer will be integrated for user information storage, product details, and outputs from AI models supporting demand forecasting and personalization. Machine learning models will also be trained and integrated with back-end services for delivering dynamic analytics and intelligent decision support.

Finally, a dashboard visualization layer will be implemented to provide real-time, role-specific insights into key metrics such as inventory status, shipment progress, and sales performance. The entire system will undergo unit and integration testing, followed by pilot deployment with selected stakeholders. Feedback gathered during this phase will inform iterative refinements necessary to maintain the system scalable, reliable, and capable of delivering a high level of user satisfaction.

3.4 Techniques:

Our hybrid technique integrates:

- Artificial Intelligence (AI) Algorithms: Semantic Segmentation – Colour customization
- U-Net architecture with ResNet-34 encoder
- Smart alerts and preferences mapping
- Blockchain Smart Contracts: Order ledger Supply chain checkpoints
- 3D Visualization: Blender API for real-time 3D updates and user-selected styling recognition.

4. Summary:

This project demonstrates how integrating Artificial Intelligence and blockchain can transform the conventional Ganapati idol supply chain into a more transparent, efficient, and customer-centric ecosystem. Using blockchain's immutable ledger, the system reduces paperwork, human error, and third-party overhead, thereby lowering operational costs and accelerating dispute resolution. Smart contracts further automate payments and track provenance, making sure that, for example, raw materials like biodegradable clay and plant-based pigments are verifiably certified on-chain to further build trust between artisans, suppliers, and customers. AI-driven analytics amplify operational efficiency via demand forecasting and personalized recommendations. Time-series models like LSTM accurately forecast seasonal Ganapati demand, enabling better planning and reducing inventory costs through dynamic segmentation. Similarly, AI-driven logistics optimization improves distribution efficiency. Such a reduction of operational waste and inefficiency was demonstrated in platforms like Uber Freight, where machine learning reduced empty miles. On the customer side, the AR-enabled 3D customization tool enhances engagement and conversion, with retailers seeing increased sales and attaining higher average order values as shoppers can interact with products virtually before buying. Lastly, implementing hybrid Layer-2 blockchain solutions increases transaction throughput while reducing gas fees; integrating Large Language Models enables advanced query handling and conversational interfaces. Recent studies indicate that integration of LLMs and IoT, and blockchain data can enhance decision-making and operational insights, which would be a valuable way to extend system capabilities.

In conclusion, the proposed, The AI-blockchain-enabled Ganapati idol platform strikes a balance between efficiency and trust, hence presenting a sustainable, transparent, immersive e-commerce model. Beyond religious artistry, it creates a scalable blueprint for modernizing the artisanal markets and fostering eco-conscious digital marketplaces.

5. Future Scope:

In the future, the platform can be expanded by developing a dedicated mobile applications cater to both artisans and customers, with multi-language support to ensure wider access. AI-powered marketing tools can even help artisans showcase their idols to a wider customer base by recommending intelligent suggestions and personalized promotions. Integrations can be further made for trusted logistics partners and secure payment gateways that help in smooth order fulfilment and delivery operations. It will require continuous improvements in order to maintain scalability, user adoption, and sustainability over the long term. These will modernize not only the traditional Ganapati idol supply chain but also create an inclusive, efficient, and eco-friendly digital marketplace.

References

- [1] O. Kuznetsov, P. Sernani, L. Romeo, E. Frontoni, and A. Mancini, "On the Integration of Artificial Intelligence and Blockchain Technology: A Perspective About Security," in *IEEE Access*, vol. 12, pp. 3881-3897, 2024, doi: 10.1109/ACCESS.2023.3349019.
- [2] P. Dudezyk, J. K. Dunston, and G. V. Crosby, "Blockchain Technology for Global Supply Chain Management: A Survey of Applications, Challenges, Opportunities and Implications," in *IEEE Access*, vol. 12, pp.70065-70088, 2024, doi: 10.1109/ACCESS.2024.3399759.

-
- [3] G. Culot, M. Podrecca, and G. Nassimbeni, "Artificial intelligence in supply chain management: A systematic literature review of empirical studies and research directions," *International Journal of Production Economics*, vol. 250, pp. 108–123, 2024, doi: 10.1016/j.ijpe.2024.108123.
 - [4] R. Toorajipour, V. Sohrabpour, A. Nazarpour, P. Oghazi, and M. Fischl, "Artificial intelligence in supply chain management: A systematic literature review," *J. Bus. Res.*, vol. 122, pp. 502–517, 2021, doi: 10.1016/j.jbusres.2020.09.009.
 - [5] A. Yadav, R. K. Garg, and A. Sachdeva, "Artificial intelligence applications for information management in sustainable supply chain management: A systematic review and future research agenda," *Int. J. Inf. Manag. Data Insights*, vol. 4, no. 2, p. 100292, 2024, doi: 10.1016/j.jjime.2024.100292.
 - [6] L. Witt, A. T. Fortes, K. Toyoda, W. Samek, and D. Li, "Blockchain and Artificial Intelligence: Synergies and Conflicts," *arXiv preprint arXiv:2405.13462*, 2024. [Online]. Available: <https://arxiv.org/abs/2405.13462>
 - [7] J. D. Harris and B. Waggoner, "Decentralized and Collaborative AI on Blockchain," in *Proc. 2019 IEEE International Conference on Blockchain (Blockchain)*, Jul. 2019, pp. 368–375, doi: 10.1109/Blockchain.2019.00057.
 - [8] D. Bhumichai, C. Smiliotopoulos, R. Benton, G. Kambourakis, and D. Damopoulos, "The Convergence of Artificial Intelligence and Blockchain: The State of Play and the Road Ahead," *Information*, vol. 15, no. 5, art. 268, 2024, doi: 10.3390/info15050268.
 - [9] A. Gupta, G. Awatade, S. Padole, and Y. Choudhari, "Digital Supply Chain Management Using AI, ML and Blockchain," 2022, doi: 10.1007/978-981-19-0240-6_1.
 - [10] A.-A. A. Sharabati and E. R. Jreisat, "Blockchain Technology Implementation in Supply Chain Management: A Literature Review," *Sustainability*, vol. 16, no. 7, art. 2823, 2024, doi: 10.3390/su16072823.
 - [11] V. Charles, A. Emrouznejad, and T. Gherman, "A critical analysis of the integration of blockchain and artificial intelligence for supply chain," *Annals of Operations Research*, vol. 327, no. 1, pp. 7–47, Aug. 2023, doi: 10.1007/s10479-023-05169-w.
 - [12] K. Wannenwetsch, I. Ostermann, R. Priel, F. Gerschner, and A. Theissler, "Blockchain for Supply Chain Management: A Literature Review and Open Challenges," *Procedia Computer Science*, vol. 225, pp. 1312–1321, 2023, doi: 10.1016/j.procs.2023.10.119.
 - [13] E. Hirata, M. Lambrou, and D. Watanabe, "Blockchain technology in supply chain management: insights from machine learning algorithms," *Maritime Business Review*, vol. 6, no. 2, pp. 114–128, May 21, 2021, doi: 10.1108/MABR-07-2020-0043.
 - [14] P. K. Singh, "Digital Transformation in Supply Chain Management: Artificial Intelligence (AI) and Machine Learning (ML) as Catalysts for Value Creation," *International Journal of Supply Chain Management*, vol. 12, no. 6, pp. 57–63, 2023, doi: 10.59160/ijscm.v12i6.6216.
 - [15] N. Tsolakis, R. Schumacher, M. Dora, and M. Kumar, "Artificial intelligence and blockchain implementation in supply chains: a pathway to sustainability and data monetisation?" *Annals of Operations Research*, vol. 327, no. 1, pp. 157–210, Aug. 2023, doi: 10.1007/s10479-022-04785-2.
 - [16] M. Islam, M. Monjur, and T. Akon, "Supply Chain Management and Logistics: How Important Interconnection Is for Business Success," *Open Journal of Business and Management*, vol. 11, pp. 2505–2524, 2023, doi: 10.4236/ojbm.2023.115139.