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Research Article

IntelliChain - Supply Chain Management Solution

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ABSTRACT

IntelliChain emerges as a game-changing supply chain management system that effortlessly integrates the powers of Blockchain, Internet of Things (IoT), and Artificial Intelligence (AI). IntelliChain places a high priority on real-time tracking, transparency, and predictive analytics in an attempt to completely transform traditional supply chain procedures. By integrating Blockchain technology, a transparent and safe framework is established, guaranteeing data that cannot be manipulated and improving supply chain visibility. The system, enhanced by IoT devices, gathers real-time data from various operations, promoting a networked ecosystem spanning from transportation to warehouses. By providing predictive analytics and enabling anticipatory decision-making based on past data and present inputs, the integration of AI technology enhances the platform. Thus, by offering a cutting-edge and intelligent solution, IntelliChain hopes to give enterprises unmatched supply chain management insights and resilience.

Keywords: Transportation Management System(TMS), Warehouse Management System(WMS), Sales Management System(SMS), Business to Business(B2B), Business to Consumer(B2C).

I. INTRODUCTION

Intellichain positions itself as a cutting-edge solution ready to revolutionise traditional operations and usher in a new era of efficacy, transparency, and anticipatability in the constantly changing field of supply chain management. Intellichain is a dynamic web-based platform that offers end-to-end supply chain solutions. It is not just a project, but rather a full suite of services that includes Order Management, Transportation Management, Warehouse Management, Sales Management, Customer Management, Manufacturer Management, and Retailer Management. The smooth integration of cutting-edge technologies, specifically Blockchain, Internet of Things (IoT), and Artificial Intelligence (AI), is at the core of Intellichain's transformative potential. Intending to break through traditional paradigms, this combination provides a revolutionary platform that guarantees real-time tracking, transparency, and predictive analytics. The days of fragmented and opaque supply chain processes are long gone, as Intellichain deftly and perceptively clarifies the complex dynamics of modern trade.

Intellichain aims to provide organisations with actionable information through the synergy of Blockchain, IoT, and AI. This allows them to optimise their operations and strengthen their competitive advantage in the market. Intellichain is at the vanguard of the global digital transformation, leveraging technology to streamline conventional methods and bring them more user-friendly. With bold goals of improving accountability, transparency, and efficiency throughout supply chain ecosystems, Intellichain becomes a game-changer in the trade industry.

Within supply chain development, Intellichain not only enhances processes but also fortifies systems to withstand unheard-of disruptions. By utilising the immutability of Blockchain, the connection made possible by IoT

devices, and the analytical power of AI, organisations that work with Intellichain are able to anticipate, adapt, and prosper in dynamic scenarios. Recognising the significant impact that supply chain interruptions can have in today's changing business scene, Intellichain acts as a strategic ally by offering proactive solutions to lower risks, increase continuity, and ensure smooth operations even in the face of unforeseen barriers.

This paper explores the disruptive potential of Intellichain, an all-inclusive supply chain management solution that seamlessly combines artificial intelligence (AI), blockchain, and the Internet of Things (IoT). Intellichain is a cutting-edge platform committed to transforming end-to-end supply chain operations. It provides a wide range of services, such as Order Management, Transportation Management, Warehouse Management, Sales Management, Customer Management, Manufacturer Management, and Retailer Management. Through the utilization of these state-of-the-art technologies, Intellichain hopes to offer a perceptive and intelligent method of managing the complexities of modern trade.

The platform tackles the issues of fragmented and opaque supply chain processes by redefining conventional paradigms and providing real-time tracking, transparency, and predictive analytics. This study examines how Intellichain's creative technology integration gives businesses actionable information to boost their competitive edge, optimise processes, and effectively and strategically traverse the complexity of today's market environment.

II. LITERATURE REVIEW

S. E. Chang and Y. Chen, "When Blockchain Meets Supply Chain: A Systematic Literature Review on Current Development and Potential Applications," This study surveys the literature, covering 106 publications, to investigate how supply chain management is affected by blockchain technology. It highlights blockchain's ability to address trust and performance challenges in normal supply chains, identifying important issues and future prospects. The report provides a roadmap for future research and development in this subject by offering insights into prospects for automation and improved performance. [1]

T.-M Choi, "A System of Systems Approach for Global Supply Chain Management in the Big Data Era," The purpose of this research is to examine new methods for managing the complex complexities of global supply chain management (GSCM). It discusses how to enhance GSCM operations through the application of large-scale data collection and the system of systems (SoS) methodology. The global supply chain is used as an example to examine SoS principles and talk about popular big data technologies. It recommends integrating big data technology into the SoS approach to boost the effectiveness of GSCM and give practitioners fresh insights into optimal supply chain management. eld. [2]

C. W. Craighead, D. J. Ketchen, K. S. Dunn and G.
T. M. Hult, "Addressing Common Method Variance: Guidelines for Survey Research on Information Technology, Operations, and Supply Chain Management," CMV, arising from using the same survey method to measure variables, can distort relationships between them. An analysis of recent survey research across prominent journals reveals inadequate addressing of CMV, with weak remedies often employed. These findings underscore the importance of addressing CMV effectively in information technology and operations management research. Recommendations are provided to enhance future research designs and mitigate the detrimental effects of CMV. [3]

K. Toyoda, P. T. Mathiopoulos, I. Sasase and T. Ohtsuki, "A Novel Blockchain-Based Product Ownership Management System (POMS) for Anti-Counterfeits in the Post Supply Chain," all through order to prevent piracy throughout the post-supply chain, this article offers a revolutionary Product Ownership Management System (POMS) that uses blockchain technology. By leveraging blockchain technology to authenticate product ownership through the integration of RFID tags, customers can reject imitation goods even when they have genuine RFID information. When the system is deployed on Ethereum, its cost-performance analysis demonstrates that it is reasonably priced, managing product ownership with up to six transfers for less than $1. [4]

J. Wang et al., "Toward a Resilient Holistic Supply Chain Network System: Concept, Review and Future Direction," This paper explores the concept of a Holistic Supply Chain Network (H-SCN) and its relevance in addressing crises such as financial downturns. Through a systematic review, it classifies different Supply Chain Networks (SCNs) and emphasizes the need to enhance the resilience of H-SCNs. Additionally, the paper provides a

comprehensive definition of resilient systems and proposes future research directions for resilient H-SCN systems. [5]

C. K. Wu and colleagues, "Supply Chain of Things: A Connected Solution to Enhance Supply Chain Productivity," In order to improve supply chain productivity and quality, this article suggests integrating supply chain with IoT using the SCoT paradigm. It lists the Smart Supply Chain Ecosystem's (SSCE) four core applications and associated use cases. For intelligent operations and quality enhancement, a brand-new worldwide SCoT platform utilizing the IEEE P2668 standard, IDex, is presented. Subsequent research will focus on techniques for implementation. SCoT is expected to affect end-to-end traceability, intelligent decision-making, smart transportation, automated quality control, and effective integration. [6]

M. Quayson, C. Bai and V. Osei, "Digital Inclusion for Resilient Post-COVID-19 Supply Chains: Smallholder Farmer Perspectives," The COVID-19 epidemic has caused supply chain disruptions in farming, which have made matters worse for smallholder farmers in poor nations. This study advocates for the critical digital change needed to build resilient and sustainable supply networks, especially for impoverished farmers. Our mission is to safeguard smallholder farmers' means of subsistence by preventing major disruptions through the use of digital technology and encouraging digital inclusion. The feasibility and constraints of post-COVID-19 digital inclusion in underdeveloped countries are also discussed. [7]

P. Cui, J. Dixon, U. Guin and D. Dimase, "A Blockchain-Based Framework for Supply Chain Provenance," The globalization of the electronics supply chain has made it increasingly challenging to maintain security and integrity, particularly when working with fake components. This research proposes a blockchain-based method to trace electronic components throughout the supply chain. The design offers a non-destructive way to track and trace devices by implementing a permissioned blockchain using Hyperledger. A viability analysis of the technique demonstrates how well it enhances supply chain traceability. [8]

R. S. Gaonkar and N. Viswanadham, "Analytical Framework for the Management of Risk in Supply Chains," The framework for categorising This study presents supply chain risk-management concerns, emphasizing the tactical, operational, and strategic levels. It proposes two approaches to address supply chain fluctuations, disruptions, and disasters: building chains with built-in risk tolerance and reducing damage after the fact. The creation of two protective models for deviation and disruption management results from the mapping of event propagation caused by supplier nonperformance. These models of mathematical programming present practical methods to achieve reliable supply chain design. [9]

III. PROPOSED METHODOLOGY

The proposed methodology of IntelliChain's approach is the integration of cutting-edge technology to create a reliable and effective supply chain management system. Blockchain technology, smart contracts, the Internet of Things (IoT), and artificial intelligence (AI) are important elements that are all needed to guarantee supply chain transparency, security, and optimization.

Smart contracts are deeply integrated into the system to automate contractual operations and enforce secure agreements within the supply chain. These self-executing contracts, which are guided by preset norms, simplify procedures and lessen the need for middlemen, which increases productivity and lowers operational complexity.

One essential component of our process is the integration of Internet of Things (IoT) devices. These strategically placed gadgets on shipments gather dynamic data in real time, offering priceless insights about location, temperature, and humidity, among other important characteristics. By providing the system with accurate and current data, this real-time data gathering enables stakeholders to take rapid action in response to new difficulties and make well-informed decisions.

Predictive analytics is how Artificial intellect (AI) elevates the system's intellect, taking centre stage in our process. Artificial intelligence (AI) algorithms analyse data collected from Internet of Things (IoT) devices to forecast potential disruptions and optimise various supply chain areas. This guarantees a proactive and flexible approach to supply chain operations and includes, but is not limited to, demand forecasting, route optimisation, and inventory management.

An essential component of our strategy is the deployment of numerous end-to-end supply chain management services, including Order Management, Transportation Management, Warehouse Management, Sales Management, Customer Management, Manufacturer Management, and Retailer Management. The smooth integration of these services offers stakeholders a complete solution to optimize the supply chain procedure.

We are creating a web interface with user-friendly accessibility so that stakeholders can effectively monitor and manage their roles in the supply chain. This interface gives users a uniform and user-friendly platform by acting as a gateway to the several services that IntelliChain offers.

Our methodology is based on the principles of adaptability and continuous improvement. We intend to adapt the system based on real-time data, user experiences, and developing industry standards by including feedback loops and agile development approaches. IntelliChain is well-positioned to improve supply chain operations' resilience, efficiency, and transparency not just as a solution but also as a dynamic and responsive ecosystem.

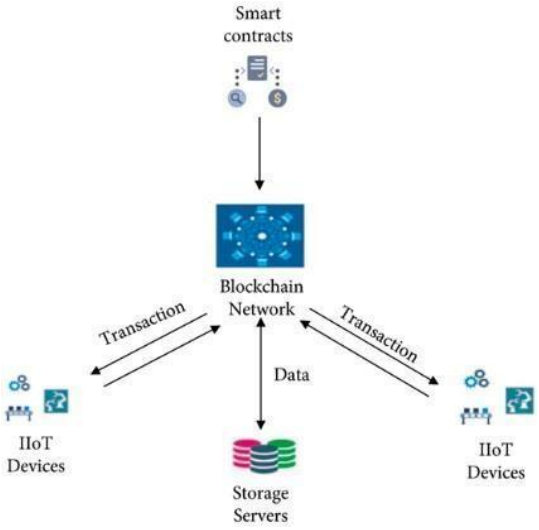

Fig 3.1 Existing Framework

The existing framework shown in Fig 3.1 uses blockchain technology for secured data transactions whereas, for lifetime changes, situational changes and changes due to external factors can potentially impact the supply chain. The goal of this research is to extend the existing framework by including AI predictive analysis to adapt to real-time events.

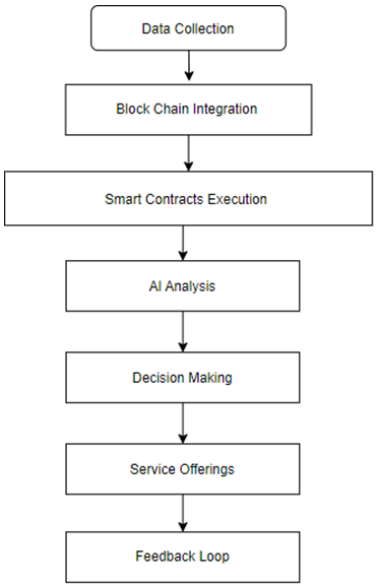

Fig 3.2 Flow of AI model in the proposed system

The existing system has been adopted with AI predictive analysis as shown in Fig 3.2 above to accommodate the livetime changes and suggest or notify the person in-charge.

Blockchain:

The decentralized ledger technology known as blockchain powers a number of cryptocurrencies, most famously Bitcoin. It is essentially a chain of records, or blocks, connected by timestamps and cryptographic hashes to form an unchangeable and safe structure. Because of its decentralised structure, blockchain technology runs as a peer-to-peer network, with each user owning a copy of the full blockchain, increasing transparency and eliminating a centralised point of control. Security is an essential element of any system, and consensus techniques such as proof-of-work and proof-of-stake ensure it by making it exceedingly difficult for unauthorised changes to take place.

One of the major aspects of blockchain technology is its immutability, or the ability to be almost irreversible once data is added to the chain. This function promotes system trust and guarantees the accuracy of transaction records. Due to blockchain's transparency, all users of the network have access to the same data and can see the complete history of transactions. Furthermore, with the introduction of smart contracts, which are self-executing agreements with established conditions that allow contract obligations to be automatically enforced and carried out without the need for middlemen, blockchain now has programmable capabilities. Beyond its connection to cryptocurrencies, blockchain's secure and decentralized features make it a viable option for boosting confidence, cutting fraud, and expediting procedures in a variety of industries. This represents a revolutionary change in data management and transaction techniques.

IoT:

The Internet of Things (IoT) marks the beginning in a new era of connectivity and data-driven decision-making, and it is fundamentally changing supply chain management. In short, the Internet of Things is a network of networked items that include sensors and communication capabilities. IoT enables the ability to collect and track data in real-time throughout supply chains, which is fundamentally transforming how organisations run and optimise their logistical operations.

Real-time monitoring is one main way that IoT is being used in supply chains. Businesses may track the exact location and status of items during the entire transportation trip by attaching sensors and RFID tags to shipments. Because of this real-time information, proactive decision-making is made possible, enabling organizations to maximize the flow of commodities and react quickly to possible disturbances. IoT also helps with condition monitoring, which is important for businesses that handle delicate or perishable goods. Continuous insights are provided by sensors that track environmental variables including temperature and humidity. This enables prompt response to preserve product quality and regulatory compliance. IoT's versatility extends to predictive maintenance, asset tracking, warehouse automation, and smart packaging, providing a comprehensive solution to improve overall performance, cut costs, and increase operational efficiency.

AI Predictive Analysis:

Predictive analytics is the term for applying machine learning and artificial intelligence (AI) methods to historical data analysis in order to forecast future results or events. Organisations can forecast future occurrences and make informed decisions by identifying patterns, trends, and links in data using algorithms and statistical models. The most commonly used algorithms in AI predictive analysis :

1. Time Series Analysis - Time series analysis is a subset of predictive analytics that deals with data points that are collected or recorded over time. To forecast future values, it entails analyzing and modeling time-ordered data streams. The temporal ordering of observations, in which every data point is linked to a distinct timestamp

2. Regression -In AI predictive analysis, regression is a statistical technique for determining the relationship between one or more independent variables and a dependent variable. Understanding and measuring the relationship between variables is the aim of regression analysis, which also aims to generate predictions based on this knowledge. It is a supervised learning technique that is frequently used in forecasting.

3. Decision tree analysis - A supervised machine learning technique called decision tree analysis can be applied to both regression and classification problems. With each internal node signifying a decision made in response to a given feature's value, each branch signifying a decision's possible outcomes, and each leaf node reflecting the final option, it presents decisions or predictions as a tree-like structure.

4. Naive Bayes Classifier - The Naive Bayes Classifier is a statistical algorithm for machine learning that is used to solve classification problems in AI predictive analysis. Its foundation is the Bayes theorem, which determines a hypothesis's probability in light of the evidence that has been observed. For text classification and spam filtering in particular, Naive Bayes is a strong and effective classifier despite its simplicity and the "naive" assumption of independence between features.

IV. IMPLEMENTATION

1. Order Management System (OMS)

An all-encompassing Supply Chain Management (SCM) system's Order Management System (OMS) is a key element that facilitates the smooth processing and delivery of customer orders. Its main focus is on managing orders throughout their whole lifecycle, making sure that everything is accurate, transparent, and delivered on time. Order information such as product characteristics, quantity, and desired delivery options are captured by the Order Management System (OMS) when clients place orders via various channels, such as the IntelliChain website or mobile app. This information forms a strong basis for efficient order processing.

Real-time inventory management, which is closely integrated with the Inventory Management System, is a crucial component of the OMS's capabilities. By providing constant updates on product availability, this integration helps businesses prevent stockouts and excess inventory. Thus, by verifying payments, confirming product availability, and choosing the most effective fulfillment plan, the OMS helps to optimize order processing. In order to promote an adaptable and responsive supply chain, this may entail routing orders to warehouses, manufacturers, or distributors in accordance with predetermined guidelines. The OMS also allows for order cancellations and adjustments, understanding that client needs are ever-changing. When clients need to change shipping details or quantity after placing an order, the order management system (OMS) effectively manages these changes while keeping cancellations under control and puts the needs of the customer first. Customers and internal stakeholders can track the status of their orders in real time with the OMS's comprehensive order status tracking, which is available for the duration of the order fulfillment process. This commitment to transparency fosters integrity, effectively manages client expectations, and ultimately raises satisfaction and confidence.

Example Scenario: Imagine a situation where a consumer orders a well-liked product via the IntelliChain platform. Order processing, real-time inventory checks, and order details collection are all done by the OMS. The order is directed for immediate fulfillment by the OMS if the product is in stock at a local warehouse. The OMS allows for address correction in the case that the consumer makes a mistake. The purchase status gets modified by the OMS, which also ensures that the fulfillment center in question receives the revised information, following the error correction by customer service. The OMS keeps the consumer informed at every stage of the order fulfillment process, from picking and packaging to shipment. If any unanticipated problems occur, such as a shipping delay, the OMS sets off alarms for both the customer and internal stakeholders, allowing for proactive communication and resolution.

2. Transportation Management System (TMS)

The foundation of the whole Supply Chain Management (SCM) system is the Transportation Management System (TMS), which acts as a key to maximize the organization, supervision, and planning of transportation-related tasks. Its main goal is to increase the overall efficacy, lower expenses, andThe efficient movement of goods from their

point of origin to their final destinations within the supply chain network is meticulously planned by the TMS in order to achieve this. One of the most important functions of the TMS is route optimization, which ensures that the best possible transportation routes are identified by assessing factors such as delivery windows, traffic, and distance. This tactical method reduces transportation expenses and speeds up delivery, which helps with operational and financial responsibility.

Furthermore, the TMS plays a crucial part in the carrier selection process by making it easier to carefully assess carriers according to important factors like capacity, dependability, and cost-effectiveness. This guarantees that the selected carriers are exactly in line with the particular transportation requirements of the company, resulting in a mutually beneficial and productive partnership. The TMS's ability to provide real-time shipment tracking via cutting- edge technology complements these features. Instantaneous visibility into the progress of cargo across the whole transportation process is beneficial to stakeholders. This openness is essential for making proactive decisions and resolving problems quickly, which strengthens the supply chain's overall resilience.

Example Scenario: Imagine a situation where IntelliChain has to ship a shipment of popular items from a production plant to local distribution hubs. Prior to being used, the TMS optimizes the transportation routes according to variables including delivery windows, traffic patterns, and distance. For the particular transportation requirements, it chooses carriers that provide the optimum mix of affordability and dependability. Real-time tracking information is supplied by the TMS as the goods proceed through the supply chain. This makes it possible for all parties involved to keep an eye on the status of every shipment and quickly address any unforeseen problems. The TMS notifies the appropriate stakeholders in the event of delays or modifications to delivery schedules, promoting efficient communication and cooperation. When the TMS reaches the regional distribution centers, it records delivery confirmations and instantly updates the system. This information is crucial for inventory management since it helps the business to efficiently fulfill customer requests and maintain accurate stock levels. The Transportation Management System from IntelliChain is essentially a tactical tool that enhances visibility, streamlines transportation logistics, and ensures the timely and effective delivery of goods along the whole supply chain.

3. Warehouse Management System (WMS)

The Warehouse Management System (WMS) is a key component of supply chain management's (SCM) complicated structure. It's an application that makes warehouse operations more efficient and precise. Its primary objective is to increase the efficiency of order fulfillment, inventory control, and the entire logistics system at warehouse facilities. The WMS greatly aids in the seamless operation of the supply chain by achieving this. The primary function of the WMS is inventory optimization. This entails tracking inventory locations and levels in real-time while strategically positioning stock to make the best use of available space through the use of sophisticated algorithms. In addition to reducing storage costs, this strategy optimizes warehouse operations and makes prudent use of available resources to satisfy the demands of a changing supply chain environment. The WMS is also accountable for the careful coordination of order picking and fulfillment. The WMS ensures that customer orders are fulfilled accurately, promptly, and error-free by optimizing picking routes and tactics. This competence is critical to delivering fast and accurate deliveries that meet or exceed customer expectations, which ultimately results in satisfying and long-lasting customer experiences.

The WMS is in charge of effectively overseeing the acceptance of incoming products in the receiving and putaway domains. It ensures timely availability of items for order fulfillment in the future by verifying shipments against purchase orders and directing the strategic positioning of things inside the warehouse. The automation of different warehouse activities, such as inventory counts, replenishment, and order processing, is another way that the WMS sets itself apart. Automation lowers human mistake rates and improves overall operational effectiveness, freeing up warehouse workers to concentrate on more complex and strategic work that advances supply chain process optimisation.

Example Scenario: Imagine a situation when a manufacturer sends a sizable consignment of goods to IntelliChain. By overseeing the receiving stage and comparing the received goods with the relevant purchase order, the WMS plays a critical part in this process. After that, it controls the putaway procedure, directing warehouse workers to arrange the products in the best possible places according to variables like item velocity and storage capacity. The WMS optimizes order pickup routes in response to customer orders to guarantee prompt and precise

item retrieval. For instance, the WMS might combine picking if the same SKU is included in several orders in order to reduce time spent traveling throughout the warehouse. The WMS provides precise visibility into stock availability by updating inventory levels in real-time as orders are chosen and packed.

4. Sales Management System (SMS)

The Sales Management System (SMS) is a crucial tool in the vast subject of Supply Chain Management (SCM) as it facilitates the optimization of sales processes and customer communications. Fundamentally, the SMS functions as a tactical instrument intended to optimize sales processes, cultivate client connections, and greatly enhance the overall effectiveness of the supply chain. Skillfully managing order processing and tracking is one of its core features. The system maintains accuracy in order input, offers real-time visibility into order status, and promotes a smooth fulfillment process by efficiently recording and processing customer orders. In the larger supply chain environment, this skill is crucial for rapidly addressing customer expectations and guaranteeing a happy and effective sales experience.

Apart from its exceptional ability to process orders, the SMS also features extensive Customer Relationship Management (CRM) features. This feature stores and organizes important client data, such as purchase history and preferences, to help organizations carefully manage and cultivate customer relationships. By utilizing this abundance of information, companies may customize their approaches, provide individualized services, and eventually raise client satisfaction levels. A holistic approach to sales management is established by the SMS's CRM integration, which combines customer-centric strategies with order processing efficiency to create a seamless and productive sales environment that is part of the larger supply chain architecture.

Example Scenario: Think about IntelliChain launching a new range of products. By taking and processing customer orders for the new products, the SMS plays a crucial part. Orders are fulfilled quickly to satisfy customers, and it tracks the fulfillment process in real-time. Important customer data is stored via the SMS's CRM features, which enables IntelliChain to customize advertisements and promotions for clients who have expressed interest in the new product line. The SMS's ability to forecast sales is put to use when it examines previous sales information and industry trends about the new product line. With the help of this data-driven strategy, IntelliChain is better able to predict demand, modify inventory levels appropriately, and streamline the supply chain in preparation for the launch of new items. Furthermore, the SMS offers instruments for evaluating the new product line's performance, empowering IntelliChain to make well-informed choices for continuous enhancements and modifications to its sales tactics.

5. Customer Management System (CMS)

With an emphasis on maximizing interactions between companies and customers, the Customer Management System (CMS) is essential to the intricate world of Supply Chain Management (SCM). The CMS, which is positioned as a tactical instrument, centralizes extensive data like contact details, purchase history, and preferences while streamlining customer-related operations. This centralized strategy greatly improves supply chain efficiency by enabling companies to provide customized services and obtain comprehensive insights into consumer behavior.

The CMS's functionality is improved through integration with order management systems, which preserve comprehensive transaction records and order histories. Companies use this past data to efficiently target promotions and predict client wants. Additionally, the CMS makes communication easy and allows companies to interact with clients by sending them tailored messages and offers. The technology facilitates the implementation of tailored marketing techniques by firms, thereby improving customer experience and cultivating loyalty through client segmentation. Consider the following hypothetical situation: IntelliChain uses the CMS to provide a customized experience, making use of comprehensive customer profiles and preferences for effective involvement in the larger context of supply chain management.

Example Scenario: Think about how IntelliChain can improve its customer interactions by using the CMS. A consumer has a well-documented profile in the CMS after making multiple transactions via the IntelliChain platform. In addition to standard contact information, the system saves user preferences, like desired delivery window and desired product categories. The CMS easily interacts with the order management system to update the transaction history whenever this customer places a new order. This enables IntelliChain to send automated

notifications with customized order confirmations and delivery information. IntelliChain uses the CMS data to determine the customer's preferences and delivers personalized marketing for products that are relevant to them, increasing the possibility that they will make more purchases.

6. Manufacturer Management System (MMS)

The Manufacturer Management System (MMS), which falls under the wide category of Supply Chain Management (SCM), efficiently plans and directs manufacturing operations. The MMS is positioned strategically and focuses on maximizing collaboration between manufacturers and other supply chain actors, which enhances the effectiveness of the supply chain as a whole and production efficiency. Its main function is to plan and schedule production, which synchronizes manufacturing processes with demand estimates and supply chain requirements. This optimisation minimizes production delays and aids in the efficient use of resources. Smooth supplier coordination guarantees the timely and effective flow of components and raw materials. By working together, this cooperative strategy lowers the possibility of supply chain interruptions and facilitates just- in-time manufacturing techniques for increased operational agility.

Mechanisms for quality assurance and control that monitor the whole manufacturing process are essential components of the MMS. This is crucial to maintaining and improving product quality since it involves keeping an eye on product specifications and making sure that strict quality standards are followed. Furthermore, the system performs very well in effective inventory management, avoiding stockouts or overstocks by placing completed goods in a strategic location along the supply chain. Because of its many features, the MMS is a vital tool for manufacturers looking to improve productivity, encourage teamwork, and uphold quality standards in the larger context of supply chain management.

Example Scenario: Think about IntelliChain using the MMS to streamline its production procedures. The MMS works with suppliers to guarantee a sufficient and timely supply of raw materials when a spike in demand is anticipated. After then, the system coordinates scheduling and production planning, streamlining manufacturing processes to satisfy the spike in demand. Throughout the production cycle, quality control procedures are carried out, and the MMS keeps a close eye on product specifications and standards compliance. Overstock is avoided by effective inventory management, and completed goods are arranged to be distributed smoothly along the whole supply chain.

7. Retailer Management System (RMS)

The Retailer Management System (RMS) is a key component of the Supply Chain Management (SCM) system, which is designed to fulfill the unique requirements of retailers. Strategically positioned, the RMS maximizes cooperation between retailers and other supply chain participants, boosting the network's overall effectiveness. Giving retailers real-time inventory visibility and expediting order processing are two of the RMS's primary functions. This improves the overall customer experience by facilitating correct order fulfillment, intelligent decision-making, and dynamic stock level monitoring. The system's smooth interaction with suppliers guarantees a consistent supply of goods, reduces lead times, and improves supply chain agility—all of which are especially beneficial for merchants managing shifting customer needs.

Moreover, the RMS provides retailers with efficient price and promotion management. Retailers can optimize sales and sustain a competitive edge by implementing targeted promotions, discounts, and pricing adjustments based on consumer behavior and market trends analysis. Real-time sales data is captured by the integration with Point of Sale (POS) systems, which enhances the possibilities of the RMS even further. Retailers can utilize this data-driven strategy to make informed decisions regarding product assortment, inventory management, and strategic planning by gaining important insights into customer preferences and purchase habits. In essence, the Retailer Management System turns into a tactical advantage that strengthens teamwork, expedites retail procedures, and raises the supply chain network's general efficacy.

Example Scenario: To improve retail operations, think about having IntelliChain implement the RMS. With the system's real-time inventory visibility, retailers can keep an eye on stock levels and react quickly to fluctuations in demand. Accurate order fulfillment is ensured by efficient order processing, which enhances the client experience. The RMS ensures a steady supply of products by facilitating efficient

communication among suppliers. The system also helps with pricing and promotion methods, allowing merchants to dynamically adjust to changing consumer preferences and market trends. Integrating with point-of-sale (POS) systems allows businesses to acquire important sales data and make informed decisions that optimize inventory and boost overall store performance.

8. Distributor Management System (DMS)

An essential part of the vast field of supply chain management (SCM) is the Distributor Management System (DMS), which focuses on enhancing the communication and collaboration between distributors and manufacturers. The DMS is a strategically positioned device that is meticulously engineered to optimize the distribution process, enable efficient communication, and dramatically improve the overall effectiveness of the supply chain network. Its many features support an adaptable and efficient distribution network, which is essential for satisfying the changing needs of distributors.

The DMS's ability to handle order processing and fulfillment for distributors with efficiency is one of its main features. The technology guarantees accuracy in order input, offers real-time visibility into order status, and speeds up the delivery process by efficiently capturing and processing distributor orders. This capacity lays the foundation for an adaptable and effective distribution network in addition to satisfying the varying needs of distributors. Furthermore, distributors are empowered with ongoing access to stock levels through real-time inventory management integrated into the DMS, which allows them to make well-informed decisions on inventory replenishment and order fulfillment. By averting situations of stockouts or overstock and enhancing the general responsiveness of distribution operations, this function helps to optimize inventory management. Moreover, the DMS plays a crucial part in distributor route optimisation by strategically taking into account variables like delivery dates, traffic, and distance. The technology expedites the delivery process and reduces transportation expenses by guaranteeing that products are transported via the most efficient routes. This tactical move dramatically improves the distribution network's overall efficiency and positions the DMS as a crucial link in the complex supply chain management network.

Example Scenario: Suppose that IntelliChain wants to improve distribution procedures and implements the DMS. Distributors use the system to place orders, and it gathers and processes all the necessary information. Distributors may make educated judgments by having visibility into stock levels thanks to real-time inventory management. Distributors can expedite delivery and save money on transportation by using the DMS to optimize their routes. When distributors and manufacturers work together well, they may easily arrange delivery times and get timely information on product availability.

9. CATMAN - Category Management System

A strategic method used in supply chain management called the Category Management System (CatMan) aims to handle product categories as efficiently as possible along the whole supply chain. Fundamentally, CatMan is primarily concerned with the tactical management of specific product categories, which includes everything from purchasing and inventory management to advertising and sales. The principal objective is to optimize the performance of every category, guaranteeing congruence with client inclinations, market patterns, and total profitability.

Assortment planning is an important procedure in the CatMan system. It entails the deliberate curation and selection of goods within a category, taking into account variables like brand, size, and cost. The goal of this strategic planning is to combine items in the best possible way to satisfy consumer preferences and effectively meet market demands. CatMan relies heavily on effective inventory management, which uses replenishment cycle optimisation, reorder point management, and demand forecasting to ensure proper stock levels for every category.

Another essential component of CatMan is supplier collaboration, which emphasizes building trusting connections with suppliers to promote a smooth supply chain. Contract negotiations, supplier relationship management, and working together on product improvements are all part of this. CatMan also uses Data Analytics and Insights to obtain important data on market trends, category performance, and consumer behavior. Decision-making procedures pertaining to pricing plans, promotional activities, and product placements are informed by this data-driven approach. By using a Customer-Centric Approach, CatMan ensures that customers have a personalized

and fulfilling experience by customizing product offers and marketing strategies based on customer insights, feedback, and purchase trends.

Example Scenario: An electronics-focused retail chain serves as an excellent illustration of CatMan in action. Here, CatMan combines strategic inventory management to optimize stock levels based on demand estimates with painstaking assortment planning for items like computers, smartphones, and accessories. Close relationships with electronic manufacturers are necessary for supplier collaboration to conduct negotiations and launch new products. While a customer-centric approach customizes marketing campaigns to match customer preferences, data analytics directs pricing tactics and promotional efforts, ultimately improving the electronics category's entire purchasing experience. Fundamentally, CatMan is a dynamic and adaptable supply chain management strategy that tracks consumer trends and market conditions constantly in an effort to maximize the performance of each product category.

V. RESULT

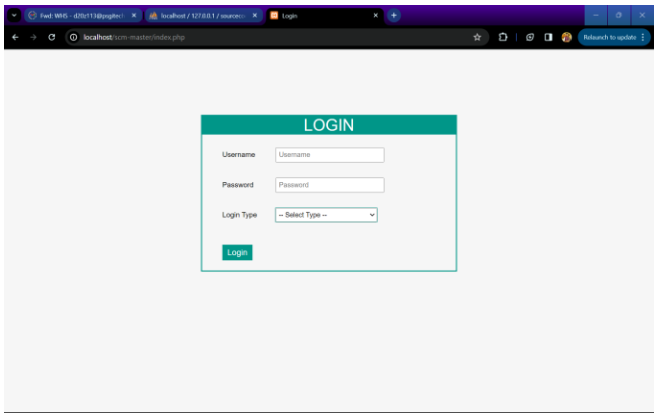

Fig 5.1 Login Page

The username field, password field, and login type selector are the three primary components of the user-friendly interface-designed login page. Users can enter their email address or username in the visible username form at the top of the page. Users can safely put their password in the password area, which is located beneath the username field. To help users understand the format that must be used for their input, both fields have placeholder text. Users can select their preferred login type using the login type selector located next to the password box. This feature gives users more control over how they access the system by supporting several authentication methods and preferences.A large "Login" button that invites people to enter their credentials and access the system is visible beneath these elements. Users may log in quickly and easily thanks to the login page's clear, structured layout, modern color scheme, and user-friendly design.

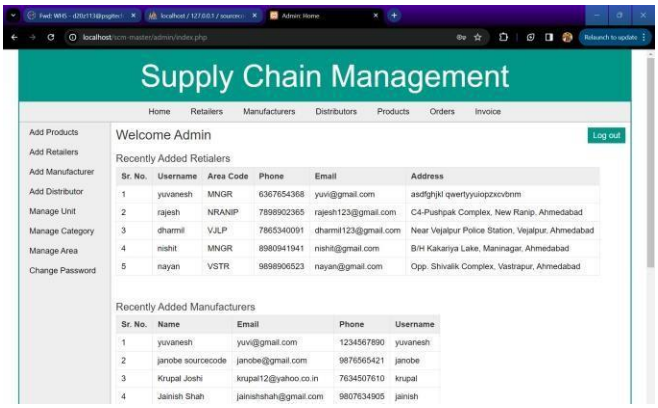

Fig 5.2 Admin Page

The admin page makes it simple to manage items and stakeholders by offering a thorough overview of manufacturers and merchants that have recently been added. There are sections dedicated to adding and managing

distributors, producers, retailers, and items. For effective organization, users can additionally control geographical areas, categories, and units. For security reasons, administrators can also update their passwords on this page. A user-friendly interface with simple tools for adding and changing data is what makes it appealing to the eye. All things considered, the admin page improves efficiency and control by streamlining the management of stakeholders and products.

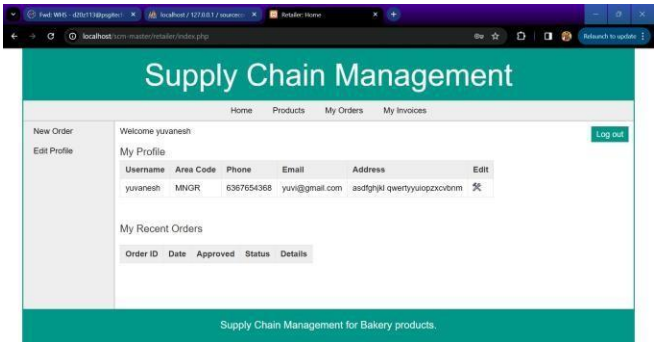

Fig 5.3 Retailer Login Window

Key capabilities are easily accessible through a streamlined interface in the retailer login window. It has options to amend the retailer's profile and place a new order. The retailer's account details and settings are briefly summarized in the "My Profile" section. The window also shows a list of recent orders, making it simple for businesses to keep track of their order history. The information is displayed succinctly, and there is straightforward navigation throughout the intuitively built interface. Retailers' user experience is improved since they can easily access the features they require. The retailer login window is made to be effective and simple to use overall, giving retailers a smooth experience.

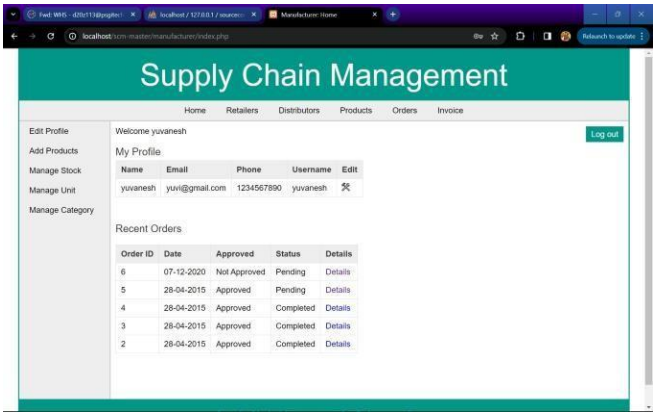

Fig 5.4 Manufacturer Login Window

The login window provided by the manufacturer has an easy-to-use interface with easily accessible functions. It offers functions for managing product information, adding new products to the catalog, and editing the manufacturer's profile. The software also allows manufacturers to monitor sales performance and control product pricing. Additionally, the window offers capabilities for managing categories and units, ensuring that products are accurately classified. The manufacturer's account information and settings are shown in brief under the "My Profile" section. Additionally, manufacturers are able to track order history and sales by viewing their latest orders. The manufacturer login window's overall goal is to improve user productivity and expedite product administration.

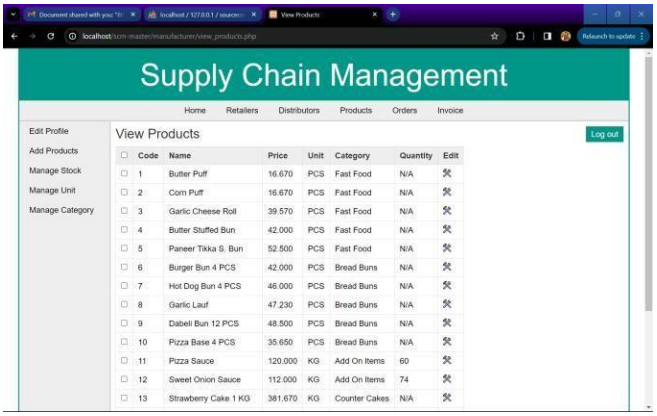

Fig 5.5 Warehouse Management System

A wide range of tools are available on the warehouse management page to help with effective inventory management. It offers functions for managing stock levels, adding new products to the inventory, and editing the warehouse profile. Warehouse managers have easy access to real-time stock level monitoring, inventory quantity updates, and stock movement tracking. Additionally, the page offers facilities for managing units and categories, guaranteeing precise product structure and classification. Warehouse managers can also access and modify their account details and preferences in the "My Profile" area. The warehouse management page's overall goal is to increase productivity and optimize inventory management procedures.

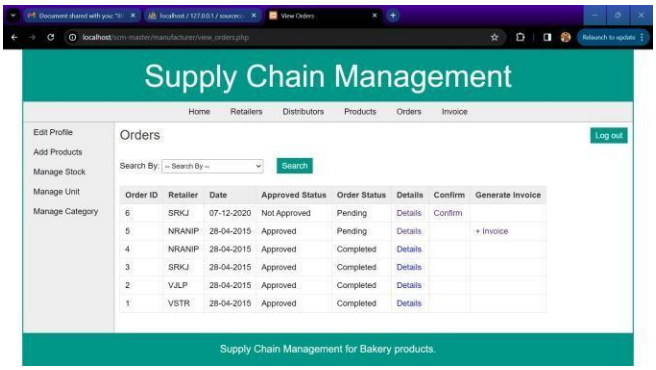

Fig 5.6 Order Management System

An effective central location for tracking and handling orders is the order management page. Important details including the order number, store name, order date, approved status, and current order status are displayed. Administrators may quickly check and modify each order's status, guaranteeing prompt processing and delivery. Additionally, the website has comprehensive order data that enables administrators to examine and modify order details as needed. To further expedite the order fulfillment process, administrators can confirm orders and create bills straight from the order management page. The order management page's overall goal is to increase order visibility and expedite order processing to increase productivity.

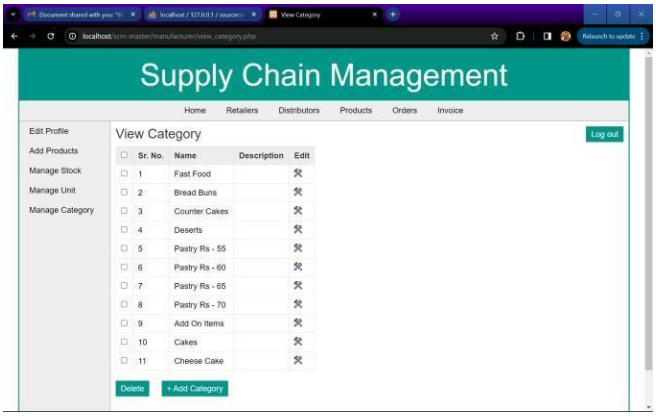

Fig 5.7 Category Management System

For efficient maintenance of product categories, the category management page provides a thorough interface. It presents information in a straightforward and orderly manner by displaying categories along with a name, description, and serial number. The catalog can be readily updated and kept current by administrators by adding new categories or editing existing ones. The page also has a delete button that lets administrators get rid of unnecessary or out-of-date categories. The arrangement is intended to be easily navigable, featuring simple controls for effective category management. The category management page improves the overall structure and usefulness of the product catalog by streamlining the process of creating and maintaining product categories.

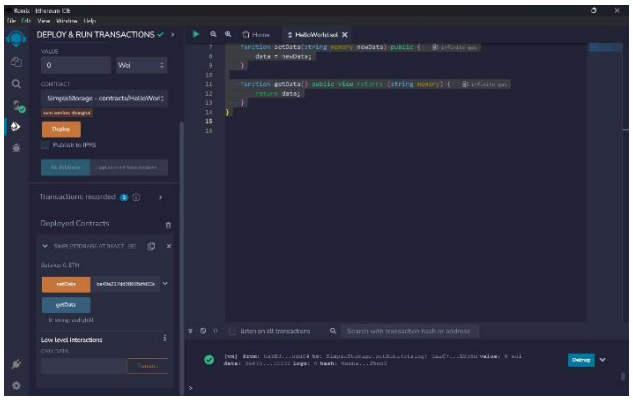

Fig 5.8 Pushing Data into Blockchain

All the order details of a customer received by the retailer or the manufacturer are hashed using md5 and Secure Hash Algorithm (SHA) and the hashed value is created as an instance and pushed into the deployed smart contract in the mainnet. The details that are hashed include the customer details, orderid, productid of the purchased products, product category, product name, and billing details. The set data function written in solidity is deployed using Remix IDE in the above case is called through the Infura API key and the data is pushed.

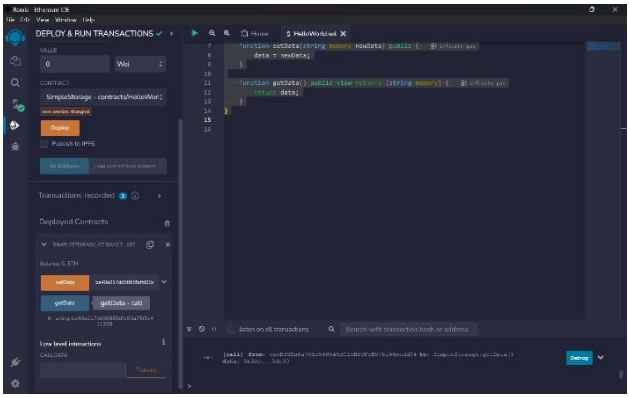

Fig 5.9 Fetching Data from Blockchain

Inorder to provide order details, the pushed data are fetched according to the needs. The getdata function is deployed for this purpose.

VI. CONCLUSION

The IntelliChain project's future course is determined by its dedication to both industry leadership and technological advancement. The objective is to maintain IntelliChain's leadership in the digital supply chain management space by incorporating state-of-the-art advancements in Blockchain, IoT, and AI technologies into its technological infrastructure. With an emphasis on cooperation and interoperability, IntelliChain seeks to interact with many parties, such as trade associations and educational establishments, to create a positive environment. To optimize IntelliChain's potential, supply chain professionals will be empowered through digital literacy and skill development efforts, and strategic relationships will be established to utilize collective experience.

Furthermore, IntelliChain emphasizes ongoing development by utilizing strong monitoring, assessment, and feedback systems. IntelliChain's impact will be measured by establishing performance measurements and KPIs, and optimizations will be guided by user feedback. The main goals will be accountability, transparency, and ethical behaviour in line with more general sustainability objectives. With its commitment to innovation, collaboration, and ethical conduct, IntelliChain is well-positioned to be a positive influence in the dynamic supply chain management sector.

VII. REFERENCES

[1] S. E. Chang and Y. Chen, "When Blockchain Meets Supply Chain: A Systematic Literature Review on Current Development and Potential Applications," in IEEE Access, vol. 8, pp. 62478-62494, 2020, doi: 10.1109/ACCESS.2020.2983601

[2] T. -M. Choi, "A System of Systems Approach for GlobalSupply Chain Management in the Big Data Era," in IEEE Engineering Management Review, vol. 46, no. 1, pp. 91-97, 1 First Quarter, march 2018, doi: 10.1109/EMR.2018.2810069.

[3] C. W. Craighead, D. J. Ketchen, K. S. Dunn and G. T. M. Hult, "Addressing Common Method Variance: Guidelines for Survey Research on Information Technology, Operations, and Supply Chain Management," in IEEE Transactions on Engineering Management, vol. 58, no. 3, pp. 578-588, Aug. 2011, doi: 10.1109/TEM.2011.2136437

[4] K. Toyoda, P. T. Mathiopoulos, I. Sasase and T. Ohtsuki, "A Novel Blockchain-Based Product Ownership Management System (POMS) for Anti-Counterfeits in the Post Supply Chain," in IEEE Access, vol. 5, pp. 17465-17477, 2017, doi: 10.1109/ACCESS.2017.2720760

[5] J. Wang et al., "Toward a Resilient Holistic Supply Chain Network System: Concept, Review and Future Direction," in IEEE Systems Journal, vol. 10, no. 2, pp. 410-421, June 2016, doi: 10.1109/JSYST.2014.2363161
[6] C. K. Wu et al., "Supply Chain of Things: A Connected Solution to Enhance Supply Chain Productivity," in IEEE Communications Magazine, vol. 57, no. 8, pp. 78-83, August 2019, doi: 10.1109/MCOM.2019.1900120.
[7] M. Quayson, C. Bai and V. Osei, "Digital Inclusion for Resilient Post-COVID-19 Supply Chains: Smallholder Farmer Perspectives," in IEEE Engineering Management Review, vol. 48, no. 3, pp. 104-110, 1 third quarter, Sept. 2020, doi: 10.1109/EMR.2020.3006259
[8] P. Cui, J. Dixon, U. Guin and D. Dimase, "A Blockchain Based Framework for Supply Chain Provenance," in IEEE Access, vol. 7, pp. 157113-157125, 2019, doi: 10.1109/ACCESS.2019.2949951
[9] M. Kamalahmadi and M. Mellat-Parast, "Developing a resilient supply chain through supplier flexibility and reliability assessment", International Journal of Production Research, vol. 54, no. 1, pp. 302-321, 2016
[10] S. Y. Ponomarov and M. C. Holcomb, "Understanding the concept of supply chain resilience", Int. J. Logist. Manag, vol. 20, no. 1, pp. 124-143, 2009.
[11] M. S. Shahbaz, R.M. Rasi, R. Z. Zulfakar, M.H. Bin Ahmad, M. F. Abbas and M. F. Mubarak, "A Novel Metric of Measuring Performance for Supply Chain Risk Management: Drawbacks and Qualities of Good Performance", Journal of Fundamental and Applied Sciences, vol. 10, pp. 967-988, 2018.
[12] A. Hmioui, B. Bentalha and L. Alla, "Service supply chain: A prospective analysis of sustainable management for global performance," 2020 IEEE 13th International Colloquium of Logistics and Supply Chain Management (LOGISTIQUA), Fez, Morocco, 2020,pp. 1-7, doi: 10.1109/LOGISTIQUA49782.2020.9353940
[13] R. S. Gaonkar and N. Viswanadham, "Analytical Framework for the Management of Risk in Supply Chains," in IEEE Transactions on Automation Science and Engineering, vol. 4, no. 2, pp. 265-273, April 2007, doi: 10.1109/TASE.2006.880540
[14] M. Du, Q. Chen, J. Xiao, H. Yang and X. Ma, "Supply Chain Finance Innovation Using Blockchain," in IEEE Transactions on Engineering Management, vol. 67, no. 4, pp. 1045-1058, Nov. 2020, doi: 10.1109/TEM.2020.2971858
[15] S. Wang, D. Li, Y. Zhang and J. Chen, "Smart Contract-Based Product Traceability System in the Supply Chain Scenario," in IEEE Access, vol. 7, pp. 115122- 115133,2019,doi:10.1109/ACCESS.2019.2935873
[16] B. Müßigmann, H. von der Gracht and E. Hartmann, "Blockchain Technology in Logistics and Supply Chain Management—A Bibliometric Literature Review From 2016 to January 2020," in IEEE Transactions on Engineering Management, vol. 67, no. 4, pp. 988-1007, Nov. 2020, doi: 10.1109/TEM.2020.2980733
[17] M. Chamekh, M. Hamdi and S. E. Asmi, "A new architecture for supply-chain management," 2017 14th IEEE Annual Consumer Communications & Networking Conference (CCNC), Las Vegas, NV, USA, 2017, pp. 77-82,doi: 10.1109/CCNC.2017.7983085
[18] R. Hajar and N. Saida, "Supply chain management, between resilience and sustainability: A literature review," 2022 14th International Colloquium of Logistics and Supply Chain Management (LOGISTIQUA), EL JADIDA, Morocco, 2022, pp. 1-6, doi: 10.1109/LOGISTIQUA55056.2022.9938028
[19] H. Stadtler and C. Kilger, Supply Chain Management and Advanced Planning - Concepts Models Software and Case Studies, Berlin:Springer, 2005
[20] M. Eskandarpour, P., J. Dejax, O. Miemczyk and Péton, "Sustainable supply chain network design: an optimization-oriented review", Omega, vol. 54, pp. 11-32, 2015.
[21] Y. Khaoua, Y. Mouzouna, J. Arif, F. Jawab and M. Azari, "The Contribution of Blockchain Technology in the Supply Chain Management: The Shipping Industry as an Example," 2022 14th International Colloquium of Logistics and Supply Chain Management (LOGISTIQUA), EL JADIDA, Morocco, 2022, pp. 1-6, doi: 10.1109/LOGISTIQUA55056.2022.9938046
[22] B. Ageron, O. Bentahar and A. Gunasekaran, Digital supply chain: challenges and future directions Supply Chain Forum: An International Journal, vol. 21, no. 3, pp. 133-138, 2020.
[23] P. Dutta, T. M. Choi, S. Somani and R. Butala, "Blockchain technology in supply chain operations: Applications challenges and research opportunities", Transportation research part e: Logistics and transportation review, vol. 142, pp. 102067, 2020.
[24] M. Kouhizadeh, S. Saberi and J Sarkis, "Blockchain technology and the sustainable supply chain: Theoretically exploring adoption barriers", International Journal of Production Economics, vol. 231, pp. 107831, 2021.
[25] R. Van Hoek, "Exploring blockchain implementation in the supply chain: Learning from pioneers and RFID

research", International Journal of Operations Production Management, 2019
[26] G. Narayanan, I. Cvitić, D. Peraković and S. P. Raja, "Role of Blockchain Technology in Supplychain Management," in IEEE Access, vol. 12, pp. 19021-19034, 2024, doi: 10.1109/ACCESS.2024.3361310.
[27] S. Saberi, M. Kouhizadeh, J. Sarkis and L. Shen, "Blockchain technology and its relationships to sustainable supply chain management", Int. J. Prod. Res., vol. 57, no. 7, pp. 2117-2135, Apr. 2019.
[28] R. Verma and N. Dhanda, "Application of supply chain management in blockchain and IoT—A generic use case", Proc. 13th Int. Conf. Cloud Comput. Data Sci. Eng. (Confluence), pp. 405-410, Jan. 2023.
[29] M. Naz, F. A. Al-Zahrani, R. Khalid, N. Javaid, A. M. Qamar, M. K. Afzal, et al., "A secure data sharing platform using blockchain and interplanetary file system", Sustainability, vol. 11, no. 24, pp. 7054, Dec. 2019.
[30] M. M. Queiroz, R. Telles and S. H. Bonilla, "Blockchain and supply chain management integration: A systematic review of the literature", Supply Chain Manag. Int. J., vol. 25, no. 2, pp. 241-254, Aug. 2019.