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Synergistic Blockchain and IoT Systems for Automated Returns and Remanufacturing

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ABSTRACT

Reverse logistics is necessary in cases where a completed product requires being reintroduced into the supply chain to the source, most commonly, the consumer, back to the manufacturer. This process may include other stages that require reverse logistics, especially when the returns are because of defects, unsold products, and reusing the packaging. Even though the consumer is the last point in the logistical chain, businesses should expect these returns to reduce the operational disruptions. This paper discusses the incorporation of Blockchain and Internet of Things (IoT) technology as a solution to streamlining the reverse supply chain (RSC). We will explore how these technologies can minimize waste and enhance environmental sustainability, and then explore how these technologies are applied in supply chain management. The decentralized and immutable nature of blockchain guarantees transparency and safety, whereas the IoT connects the physical and the digital worlds, facilitating efficient and automated processes. The results indicate that a hybrid of Blockchain and IoT forms a powerful digital RSC system, which provides a higher level of data security, transparency, and consumer confidence.

Keywords: *Blockchain Technology; Technology Integration; Digital Supply Chain; Waste Management; Consumer Trust.*

INTRODUCTION

The issue of supply chain disruptions is a long-standing problem that has changed in line with technological changes. The personal computers that were invented in the 1980s transformed supply chain management by enhancing the accuracy and efficiency of operations. Agility, flexibility, and responsiveness in the supply chain have become the key to success as business organisations are experiencing rapid changes in their markets (Bag et al., 2020),(Alam, 2026). Nowadays, Blockchain, a

distributed registry that records unchangeable digital records, is an important tool in improving supply chain processes. The technology can be used to share data safely in decentralized networks to provide greater visibility and lower fraud risk. Compared to the classical centralized systems, Blockchain supports peer-to-peer transactions, where every node in the network checks transactions, and data is secure and intact (Ahmed et al., 2026),(Raza et al., 2024).

Moreover, IoT also offers the most important connection between the online and the real world, where devices can independently gather and share information, which also increases the effectiveness of operations. The paper focuses on the use of Blockchain and IoT to streamline reverse logistics and remanufacturing to develop an efficient system with minimal waste and high performance (Ghiasvand & Tosarkani, 2026),(Sahabuddin, Tan, et al., 2023).

Personal computers are now used by businesses to perform tasks more frequently and easier like word processing and bookkeeping, and customizable spreadsheets and map-based user interfaces make logistics and supply chain planning easier. Agility, flexibility, and responsiveness are essential in businesses to succeed in the current cutthroat industry. Khan et al., (2026) successful companies constantly innovate throughout their supply chain and corporate operations, setting themselves apart by being nimble and relevant. As the pace of change quickens, improving the efficiency and visibility of an organization's supply chain becomes crucial. Blockchain is a type of distributed ledger system that stores digital data exchanges or transactions using immutable records. According to Siddiqui et al., (2023) the system sends a request for a transaction to interconnected peer-to-peer networks of computers called nodes. Each of these nodes solves an equation to assess and confirm transactional consistency across the network. After validation, the transaction is joined with other transactions to create a block of ledger data.

Blockchain technology allows businesses to track all transactions while sharing papers, individual data, and cryptocurrency. According to Sahabuddin et al., (2023) the ledger is challenging to hack because it is entirely distributed over the network, and all nodes must update it simultaneously. The network will flag a corrupted transaction if it notices that one record does not match the others. According to Meihui et al., (2023) think of this technology as Google Docs, where multiple users can simultaneously view and edit the same document, as opposed to Word documents that can only be locked and owned by one person. Change Tracking is always enabled, and the system is simultaneously accessible from every node in the network (Zhou et al., 2021). Consumers use almost all products as a result of visibility, accurately gathering and identifying data from each supply chain link, as well as for transparency, disseminating this data (Hailiang et al., 2023).

LITERATURE REVIEW

Reverse Supply Chain Technology Impacts And Consequences

Reverse supply chain (RSC) are integral to the recycling and remanufacturing sectors, facilitating the return, repair, and reuse of products. However, RSC often incurs additional costs due to handling, transportation, and the complexity of managing returns. The blockchain technology can help to overcome some of these issues by providing an open and immutable system to monitor the products throughout their lifecycle (Kumar et al., 2023). The technology enables companies to have a decentralized account of their transactions, and as such, they do not need intermediaries, and operational inefficiencies are minimized (Alam et al., 2026). In addition, IoT also boosts RSC since it gives real-time monitoring of returned products, and therefore, products are effectively recycled or reutilized. Nevertheless, implementing Blockchain and IoT has certain issues because of the platform heterogeneity and the absence of unified regulations (Dutta et al., 2020). These barriers should be overcome in future studies to make the adoption smooth. This is defined as returning the unsold items or goods packaging reused (Hou et al., 2022). Although it's not an easy thing to do as it involves the cost of extra operations and has many challenges and hindrances, just consider the actual price of the products making is lesser than the shipping cost, and if we do that again and again, we must bear the

consequences of shipping, and that's not profitable (Samy et al., 2021). Other than that its important to keep in mind the cost of repair and maintenance as the unnecessary infrastructure for tracking and ensuring the status of items due date (Feng et al., 2019),(Khokhar et al., 2022).

Now the word blockchain encompasses the process of storing and transferring the database, as it stores information in blocks for companies to work better and perform operations well. It has a variety of data stored in its collection and is also organised accordingly (Behnke & Janssen, 2020). Its a worth spending money on as it's the need for any company who wanted to work effectively and manage operations efficiently (Fatima et al., 2026). The customers do not need any middle party because the Blockchain technology gathers, stores, and saves the data, and its transactions among its users.

The impacts of the Blockchain is that we can entrust our data, it transparency is one of their plus point as it has the greatest tendency to make the flow of information transparent and the crucial tool for the decentralized tactics could be the design framework of blockchain combining with IoT for that instance all the devices are embedded and connected therefore for storage, their efficienct performances. Currently, there are several blockchain platforms available, and each platform has its own specificities and requirements, making it difficult for companies to adopt the technology (Khokhar, Hou, et al., 2020). Another challenge is the lack of regulatory frameworks to govern the use of blockchain technology in the supply chain (Philipp et al., 2019). The lack of regulation makes it difficult for companies to use the technology confidently and could potentially lead to legal issues in the future. Finally, there is a need for more education and training on blockchain technology to enable companies to understand the whole process (Sharma et al., 2025).

METHODOLOGY

The theoretical model used to examine the Blockchain and IoT integration in open and closed-loop reverse supply chain is presented in this study. Our choice of the definition of reverse logistics is the one proposed by Alam et al., (2025), who define it as the treatment of product recovery to be reused, recycled, or disposed of. Integration of Blockchain with reverse logistics enables the storage of data in a secure, transparent, and decentralized manner, and the use of IoT can track and manage end-of-life (EOL) products in real-time. We discuss the roles and relations between different participants in the reverse logistics process and the necessity to establish effective communication and collaboration with the help of Blockchain and IoT technologies. Our analysis is based on case studies and existing literature, with a focus on how these technologies can improve supply chain transparency, traceability, and security.

A theoretical framework for digital RSC in open and closed space loop Reverse logistics for economic, social, and environmental reasons is gaining more and more attention in industrial organizations. Several definitions of reverse logistics have been proposed in the literature. How- The terms once used, which can be identified in the literature, are the opposite logistics, returns management, green distribution, and green logistics. These terms are mainly used for reference same concept. To our knowledge, the most widely used definition is this was suggested by Khokhar, Iqbal, et al., (2020), who defined reverse logistics as product recovery management, components, and materials used or removed by manufacturing companies. It is also a process design, work in progress, finished products, and related information, from the place of consumption to the point of departure, with the purpose of use or creating value and improving waste management. Additionally, Chang et al., (2019) Duan et al., (2025) defined reverse logistics as reverse forward. Therefore, the inverse logistics can be termed as reverse logistics and product returns possession. Finally, we can note that the definitions of the inverse value logistics can vary according to the type of product and the type of operation or even incentives that force companies to implement the opposite logic- the basic system of Khokhar et al., (2025). Reverse logistics activities also include the collection, disassembly, recycling, reuse, replication, and final investment of EOL returns or old items. Only four operations, including recycling, reuse, reproduction, and disposal, were discovered and described by Khaskhelly et al., (2023) and are included in Table 1. However, disassembly is also a significant sector in reverse logistics. Additionally, it is a systemic sub-

assembly and component manufacturing technique. It recovers pure material fractions with the intention of separating hazardous materials, reusable components, and subassemblies. The activities are shown in the table below.

Table 1: Function's Defination Of Reverse Logistics.

ACTIVITIES	DEFINITIONS
Remaking	Materials undergo revision or undergo a discharge process. Useful parts can go back to production again; it can be different, not the same as before, but come in as a new product.
Recycling	The material goes to cooperatives for sorting, separation, and processing. Waste is transformed into new raw materials at a lower cost.
Reprocess	The material has been used and reprocessed multiple ways and times before it is needed to repair Adaptation or separation does not change the primary material structure.
Disassembling	a methodical approach to sharing a product's EOL pieces and subset. Its objectives are to recover pure material components, separate dangerous chemicals, particularly recyclable components, and subset.
Emitting / dumping	Even though the restoration of the value of material is difficult and impossible, value and material, such as the energy refilling, incarnation, are recycled further after emitting them.

Manage participants in a digital RSC

Understanding the significance and influence of digital tools in the context of hazardous waste management within the Reverse Supply Chain (RSC) is essential. It allows us to explore the roles and impact of various actors involved in the digital RSC. Both the external and internal factors are involved in the wastage of hazadrous waste management process. Table 1 presents the roles and levels of influence of external actors, for instance, the lack of direct connection, which can become a hindrance in cooperation and also information sharing, although it's important to note that these external actors don't have a direct relationship with the hazardous waste processing company. emphasizing the need for effective communication systems that promote transparency, trust, and security. Scholars have emphasized the significance of these factors. Therefore, employing Blockchain and IoT technologies can serve as efficient solutions for managing both internal and external participants in the RSC, facilitating collaboration and ensuring effective waste management processes.

Integrating Blockchain and IoT in Open and Closed Loop supply chain

Reverse logistics involves the application of digital devices to locate returned products, retrieve them, and ensure their quality and traceability. Within an open-loop system, products are drawn out of materials and/or retrieved from them, but they can be directed in another direction instead of being directed back to the original producers. These items are then recycled or reused in other sectors that are involved in recycling or the reuse of materials. Digital technologies such as Blockchain and IoT can be used to enhance the functionality of the reverse supply chain (RSC) systems. These solutions simplify the collection and analysis of data on end-of-life (EOL) items, which gives them a higher level of traceability. Also, there is a positive impact of Blockchain use on the corporate information-sharing processes, which promote cooperation and build trust among the supply chain members. Scholars have

outlined a number of advantages of integrating Blockchain in reverse logistics, including greater trust, less environmental impact, improved privacy and security, improved traceability, effective governance, auditability, and higher productivity.

An example would be the openness of Blockchain, which may raise confidence, as shown in Figure 1. Also, the combination of IoT and Blockchain allows for better management of the entire product life cycle, which minimizes the impact on the environment. A comprehensive reimbursement of EOL products can be guaranteed as we approach a state of near real-time information exchange. Trust is also a key factor in effective cooperation, and the blockchain technology allows the transmission of information in a safe manner, including accurate references and dates, among credible operators. The ability of blockchain to build smart contracts is a major advantage that generates trust among all supply chain participants.

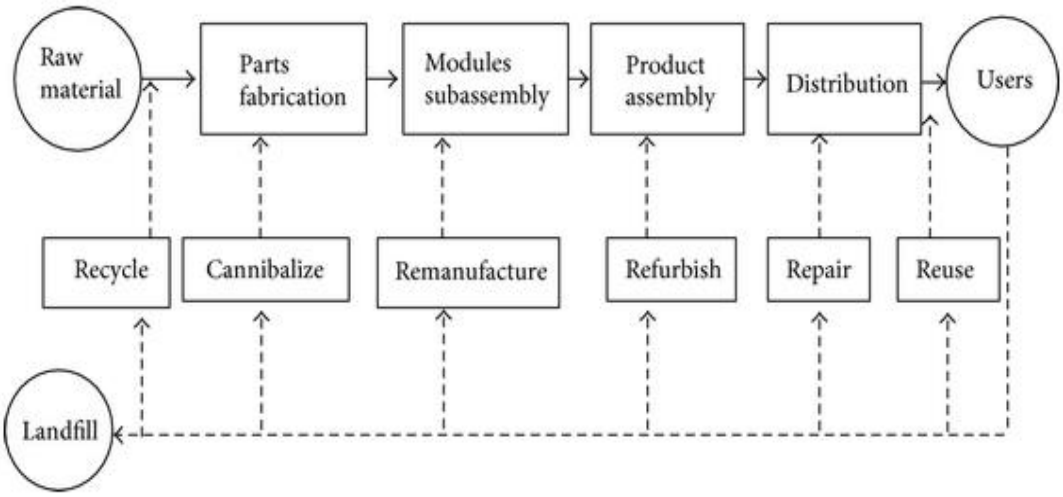

Figure 1. Process of reverse supply chain.

The use of digital tools in reverse logistics is meant to find, retrieve, and determine the quality and traceability of returned products. In an open-loop system, goods are mined or reclaimed out of materials and can be channeled into various other destinations by circumventing the original manufacturers and redirected to other industries where the goods can be recycled or reused (Hossain et al., 2023). The combination of digital tools, including Blockchain and the Internet of Things (IoT), has been considered to improve the functioning of reverse supply chain (RSC) systems. The tools allow gathering and processing the end-of-life (EOL) product data, enhancing the traceability and providing some other benefits like product information transparency, immutability, and generating smart contracts (Zeb Khaskhelly et al., 2022).

The blockchain-based technology, specifically, can affect the policies related to information sharing, the improvement of cooperation processes, and the building of trust between the members of the supply chain positively. Using Blockchain, trusted and valid information will be provided with the ability to transfer it across operators without intermediaries. Smart contracts on the basis of the Blockchain could be used to automate different tasks and occurrences, enabling the management of control, monitoring, and documentation of the RSC (Bekrar et al., 2021).

The adoption of Blockchain and smart contracts can be useful in the management of the interactions among internal and external actors in the RSC. This is visualized in Figure 2, and it is based on the model suggested by Bekrar et al. (2021). However, it is also worth mentioning that not every external actor is covered by these smart contracts, i.e., manufacturers of connected objects and waste management publishers.

Figure 3 is a digital open-loop RSC, which uses IoT and smart contracts based on Blockchain. IoT sensors such as QR codes, RFID, and NFC facilitate the RSC activities: collection, transportation, receipt, inspection, unloading, sorting, and recycling or disposal of EOL products. The modern world is full of digital technologies. We are connecting as individuals and as organizations in ways that were not previously possible thanks to the Internet of Things (IoT). The opportunities and risks of this newfound connectivity are, however, present. This paper explores the ways in which companies can potentially achieve untapped potential, gain consumer trust, and minimize the risks of data security breaches through a combination of IoT and blockchain software. The repositories of behavioral and transactional user data located throughout the globe contain the information that can help businesses, ranging from retailing and logistics to healthcare, to enhance their products and services and make them more customized. However, this information is also open to abuse by dishonest people.

Globally dispersed repositories of behavioral and transactional user data hold insights that can assist businesses from retail to logistics to healthcare in improving their goods and services and making them more individualized. However, this information is also open to abuse by dishonest people. So how can businesses protect data security? The solution may lie in combining blockchain and IoT technologies. In addition, how can consumers trust the algorithmic recommendations being pushed their way, especially when it comes to things like healthcare, given the growing adoption of AI across a variety of industries?

The primary goal is to connect the physical and digital worlds. The intriguing aspect is that it links people and devices together. IoT establishes a connection between humans and machines, with advantages for humans. Imagine, for instance, that your refrigerator could order a replacement light when the old one broke. This type of scenario is made possible by IoT technology. Let's now talk about the value of IoT in relation to blockchain-based solutions. Two significant advantages of blockchain technology are the reduction in verification and networking costs. The decentralized validation consensus approach used by blockchain networks allows for cost-effective transaction verification, which is related to the cost of verification.

Figure 2. Impact of Blockchain on supply chain partnership and performance.

Enhancing transparency, traceability, and efficiency are just a few advantages of incorporating blockchain technology into the reverse supply chain (RSC). Organisations may get beyond problems with trust, information asymmetry, and coordination complexity by utilising the decentralised and unchangeable features of blockchain technology. The application of blockchain in the reverse supply chain is explained in full here:

Blockchain enables the construction of an immutable record of each product's trip along the reverse supply chain, which is necessary for product authentication and provenance verification. Blockchain

makes sure that each product is transparent and legitimate by giving it a special identification and keeping track of pertinent details like its origin, state, and ownership changes. This reduces the possibility of fake or fraudulent goods entering the supply chain by enabling stakeholders to confirm the provenance and authenticity of returned products.

Better Traceability and Tracking: The distributed ledger technology of blockchain allows for real-time tracking of returned goods at every link in the reverse supply chain. Businesses may collect and store information on the whereabouts, condition, and handling of products by combining IoT devices like sensors and RFID tags with blockchain. After being safely recorded on the blockchain, this information offers a thorough and auditable history of each product's transit, aiding effective tracking and reducing losses.

A shared and synchronised record of product information that is accessible to all stakeholders, thanks to blockchain, promotes transparency. Authorised users may access the blockchain to examine pertinent data, including product characteristics,_warranty information, maintenance history, and disposal instructions. Authorised users include manufacturers, merchants, logistics providers, and customers. This openness makes them sure about the whole process which going on while doing operations. Digital technologies are pervasive in the modern world. We are connecting as individuals and as organizations in ways that were not previously possible thanks to the Internet of Things (IoT). However, there are opportunities and risks associated with this newfound connectivity. In this article, we examine how businesses may be able to realize unrealized potential, increase consumer trust, and reduce data security risks by combining IoT and blockchain software. Globally dispersed repositories of behavioral and transactional user data hold insights that can assist businesses from retail to logistics to healthcare in improving their goods and services and making them more individualized. However, this information is also open to abuse by dishonest people. blockchain technology's end-to-end visibility and transparency in the supply chain. Blockchain technology eliminates inefficiencies and brings about many integrations, resulting in significant enhancements and increased profits. Blockchain is a type of distributed ledger system that stores digital data exchanges or transactions using immutable records. [6]The system sends a request for a transaction to interconnected peer-to-peer networks of computers called nodes. Each of these nodes solves an equation to assess and confirm transactional consistency across the network. After validation, the transaction is joined with other transactions to create a block of ledger data. Blockchain technology allows businesses to track all transactions while sharing papers, individual data, and cryptocurrency.[7]The ledger is challenging to hack because it is entirely distributed over the network, and all nodes must update it simultaneously. The network will flag a corrupted transaction if it notices that one record does not match the others. [8]Think of this technology as Google Docs, where multiple users can simultaneously view and edit the same document, as opposed to Word documents that can only be locked and owned by one person. Change Tracking is always enabled, and the system is simultaneously accessible from every node in the network. Consumers use almost all products as a result.

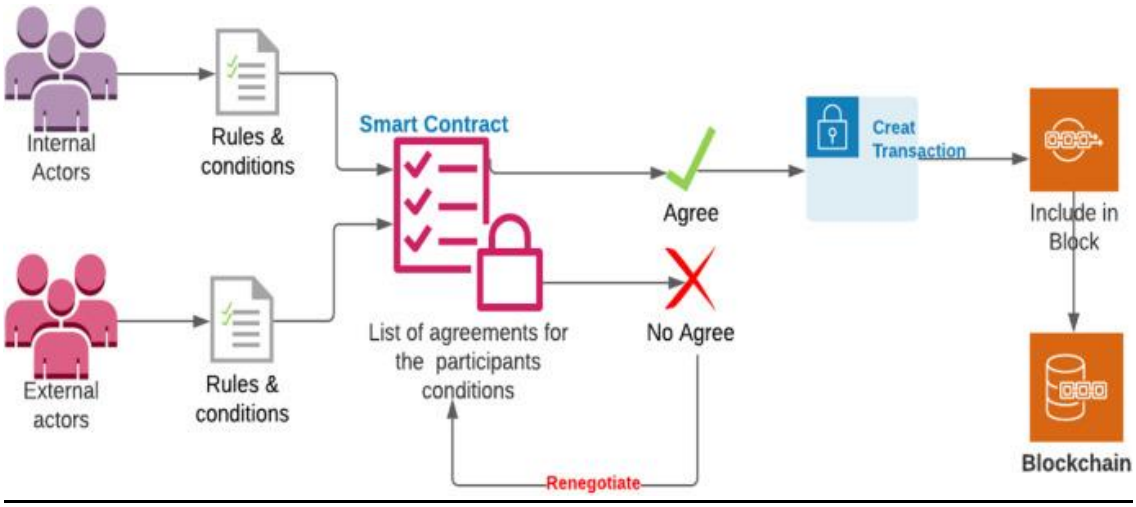

Figure 3 .the working of supplychain process through blockchain and IOT.

The network of entities involved in the movement of goods and materials is known as the supply chain. Physical and informational flows connect these organizations... The transformation, movement, and storage of products and materials are all examples of physical flows. To handle the everyday movement of materials and commodities, parties must coordinate information flows. Another essential component of information flows is planning. The logistics, production, and transportation of raw materials, completed items, and products from one site to another are organised by supply chain management (SCM). Costs may be cut, manufacturing cycles can be accelerated, and risk can be reduced with an effective SCM approach. Supply chain visibility has two sides, according to renowned authority Alexis Bateman, head of MIT Sustainable Supply Chain at the MIT Centre for Transportation and Logistics. Visibility: Accurately gathering and identifying data from each supply chain link. Transparency: Disseminating this data. Companies should consider their industry, rules and regulations, integrated values, and all the processes involved in the supply chain management have some extent of hindrance in applying and determining the right level of supply chain transparency. Inefficiency in the system is another common problem. Suppliers and providers struggle to determine who needs what, when, and how. Poor upstream inventory management, inaccurate store attribution, erratic demand, and slow shelf rotation are examples of inefficiencies. Product recalls are also costly and time-consuming since businesses must return suppliers' goods and their own products to resolve the issue. Blockchain's role: One significant challenge is determining the economics and application of blockchain and IoT. For example, using Blockchain smart contracts to regulate IoT data and device performance may face significant legal opposition. It is clear that security is critical, where IoT security is already an issue. It's worth noting that blockchain is also seen as a way to protect the Internet of Things and overall security. However, it is a distinct issue with multiple variables to consider, such as the actual security of the physical IoT and Blockchain devices. IoT devices monitor machine maintenance and safety. Blockchain provides an immutable database of operational data and maintenance information for everything from engines to elevators. Third-party repair partners can easily maintain an immutable record by monitoring the blockchain ledger for preventive maintenance, returning to the blockchain to register their work. Government agencies have access to operational records for compliance purposes.

Globally dispersed repositories of behavioral and transactional user data hold insights that can assist businesses from retail to logistics to healthcare in improving their goods and services and making them more individualized. However, this information is also open to abuse by dishonest people. So how can businesses protect data security? The solution may lie in combining blockchain and IoT technologies. In addition, how can consumers trust the algorithmic recommendations being pushed their way, especially when it comes to things like healthcare, given the growing adoption of AI across a variety of industries?

DISCUSSIONS AND ANALYSIS

Integration of Blockchain and IoT in Reverse Supply Chain

The use of blockchain in reverse logistics brings many advantages, including increased traceability, fraud mitigation, and transparency. RFID tags and QR codes are IoT that are utilized to gather information about the condition, position, and status of returned products and are safely stored on the Blockchain. It provides an unalterable and auditable account of product movements and transactions, which gives all participants in the supply chain access to the correct and current information. The consequences of combining Blockchain and IoT also allow the automation of processes using smart contracts, which activate actions following specific conditions, making them more effective and requiring fewer people to make decisions. In an open-loop RSC, the recovered goods are repurposed or recycled and could be diverted to other industries to do so. With the integration of Blockchain and IoT, it is better to track and monitor these goods, provide them with higher traceability, and minimize losses.

The combination of IoT and Blockchain in the supply chain in the reverse mode opens the possibilities to increase data security, increase the level of transparency, and improve the functioning. The decentralized registry of blockchain makes the entire process of the product going through the reverse logistics process fully traceable and transparent, minimizing the chances of fraud and ensuring adherence to the regulatory standards. IoT will enable real-time data on the status, location, and condition of the products, and can be utilized to streamline the processes of logistics and recycling. Combined, these technologies present a robust platform for handling the intricacies of reverse logistics, especially in businesses where there are high returns volumes and product lifecycle control. Nonetheless, issues of standardization, regulatory policies, and privacy of data need to be resolved before large-scale adoption.

Reverse supply chain management can be defined as the management of the flow of goods, materials, and data between the consumer and the producer or any other appropriate paths. It has been hard to streamline this process in the past due to issues such as the lack of openness, information asymmetry, and limited traceability. To improve the efficacy and efficiency of reverse supply chain activities, blockchain technology and the Internet of Things (IoT) integration provide new possibilities. Against the background of the reverse supply chain, this essay aims to discuss the outcomes of combining blockchain with IoT. Blockchain is a distributed registry that ensures the reliability and security of transactions, is decentralized, transparent, and irreversible. It runs on a network of peers, whereby all interactions are documented in a specific block and then connected to previous blocks to create an unalterable chain. The main features of blockchain, such as transparency, impossibility of alteration, consensus mechanisms, and smart contracts, could significantly help reverse supply chain management.

The term "Internet of Things" refers to an internet of networked gadgets that have been fitted with software, sensors, and communication capabilities so they may gather and share data. Real-time data on items, their states, and their whereabouts are vitally important and obtained by IoT devices. Operations in the reverse supply chain can be enhanced by utilising this data. Globally dispersed repositories of behavioral and transactional user data hold insights that can assist businesses from retail to logistics to healthcare in improving their goods and services and making them more individualized. However, this information is also open to abuse by dishonest people. So how can businesses protect data security? The solution may lie in combining blockchain and IoT technologies. In addition, how can consumers trust the algorithmic recommendations being pushed their way, especially when it comes to things like healthcare, given the growing adoption of AI across a variety of industries? The primary goal is to connect the physical and digital worlds. The intriguing aspect is that it links people and devices together. IoT establishes a connection between humans and machines, with advantages for humans. Imagine, for instance, that your refrigerator could order a replacement light when the old one broke. This type of scenario is made possible by IoT technology. Let's now talk about the value of IoT in relation to blockchain-based solutions. Two significant advantages of blockchain technology are the reduction in verification and networking costs. The decentralized validation consensus approach used

by blockchain networks allows for cost-effective transaction verification, which is related to the cost of verification.

These are some examples of how IoT can be applied to a blockchain solution. In each of these situations, the system's ability to remain trustworthy depends on the ability to collect temperature data and push it into a blockchain without human intervention. The notarization and assurance of the authenticity of a college diploma require external processes for documentation validation, similarly. To keep the data in a blockchain accurate, these are some examples of processes that must take place before being added to the blockchain. IoT technologies, especially in situations involving IoT sensors and the intake of data that are applicable to many industries, play a critical role in this process of digital fusion. That calls for a human middleman. A big benefit is having a reliable count that reveals who has access, who is transacting, and a record of all those transactions. Security is a key feature of blockchain since it can validate data and ensure that it originates from a reliable source. Given the prevalence of IoT bias, this advantage is very helpful. Businesses that employ a blockchain and Internet of Things (IoT) combo are continually calculating security measures like device authentication, but this is only the tip of the iceberg. Colourful security layers must be used to fully ensure security

Accelerated Data Change

According to Aftrex Market Research, one of the primary advantages of combining IoT and blockchain is rapid data change. According to reports, the current implementation of blockchain has limitations in this area because it limits the number of deals per second. To handle the quantum of data, the number of IoT biases, and the speed at which two parties distribute, a further enterprise- grade approach, similar to an authorization-grounded blockchain, is needed. A blockchain that can handle the speed of IoT data exchange and minimize the time it takes to validate deals by using trusted bumps is needed to handle the performance conditions of IoT.

Improved Security

The fusion of technology has the potential to improve secure dispatches and reinforce sequestration agreements. It's not just prejudice; it's also device-to-device, mortal-to-human, and mortal-to-device. A big benefit is having a reliable count that reveals who has access, who is transacting, and a record of all those transactions. Security is a key feature of blockchain since it can validate data and ensure that it originates from a reliable source. Given the prevalence of IoT bias, this advantage is very helpful. Businesses that employ a blockchain and Internet of Things (IoT) combo are continually calculating security measures like device authentication, but this is only the tip of the iceberg. Colourful security layers must be used to fully ensure security.

Lower Costs

One of the most lauded advantages for businesses is the capability to reduce functional costs. Blockchain enables peer-to-peer data submission without centralized control, cutting costs for businesses. It will be very expensive to span a centralized structure that is largely reliable. While addressing the scale of IoT, decentralization enables a more cost-effective way to exclude single points of failure.

Streamlines Accounting

Account is one of the first departments within a company to profit from the increased translucency handed by blockchain and IoT. realities must understand which associations are participating in transferring plutocrat/ data across a time- stamped direct chain. It’s a solid and reliable chain of deals that can’t be altered.

CONCLUSIONS

Applying blockchain and IoT technologies to the reverse supply chain offers a promising solution to the inefficiencies and challenges inherent in traditional returns and remanufacturing processes. By leveraging the transparency and immutability of blockchain and the real-time tracking capabilities of IoT, businesses can build more efficient, secure, and transparent reverse logistics systems. This convergence not only improves operational efficiency but also enhances consumer trust by ensuring product authenticity and reducing fraud risks. However, further research is needed to overcome the technical and regulatory hurdles to full implementation. As businesses continue to explore the potential of blockchain and IoT, the advantages of these technologies in the reverse supply chain will become increasingly apparent, driving innovation and sustainable development in the industry.

The convergence of blockchain technology and the Internet of Things (IoT) has become a key element of decentralized strategies. This convergence combines hash-based proof-of-work, strong cryptography, and peer-to-peer networks, aiming to address the limitations and vulnerabilities in current IoT deployments. The rapid development of blockchain technology offers solutions to challenges such as improved connectivity, security, transparency, and stability. Scholars have conducted extensive research on the convergence of blockchain and IoT, reviewing relevant literature and exploring the issues and requirements related to building robust and interoperable communication frameworks. This paper explores the current development trends of blockchain technology and delves into the convergence of blockchain and IoT. The paper discusses the advantages and disadvantages of this combined approach. With IoT, data can be transmitted over the internet to a private blockchain network, ensuring the creation of an immutable record of transaction participants. For example, IBM Blockchain enables enterprises to securely share and access IoT data without relying on centralized control and operation. Each transaction is recorded, added to a data block, and appended to the immutable data chain.

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