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Ecommerce Escrow Platform

[1] B. Vaishnavi, [2] K. Yoshitha, [3] Dr. Gousiya Begum, [4] Ms. P. Poornima

[1 2 3 4] Department of CSE, MGIT (A), Gandipet, Hyderabad, 500075, Telangana, India.
Email:bvaishnavi_cse210570@mgit.ac.in;kyoshitha_cse210588@mgit.ac.in,;gousiyabegum_cse@mgit.ac.in;
ppoornima_cse@mgit.ac.in

ABSTRACT :

The Ecommerce Escrow Platform aims with the goal of modernizing traditional online delivery models by combining Blockchain Technology, Smart Contracts, and Public Key Infrastructure (PKI) in a way that enhances trust, security, and user agency. Rather than the organization establishing delivery deadlines, users and producers can now reach agreements through secure, bid-based, smart contract mechanisms and then make mutual decisions. Designated parties on either side stake an equal amount of cash (or other digital tokens) for transparency and accountability. Users can specify their delivery preferences on how they prefer product delivered method (e.g. by delivery truck, airplane, pick-up), when they need the products, where they need the products delivered to (especially, where perishable products need to be harvested and when transactions need to accomodate product use-by dates or time constraints), and impact logistics processes. In fact we have designed a PKI encryption layer to secure all transactions ensuring that the shortcomings of conventional delivery models have been remedied ensuring a platform that is more trustworthy, accountable, and pleasurable to its users.

Keywords: Smart Contracts, Public Key Infrastructure (PKI), Bidding System, Security, Product, User delivery date specification.

Introduction

The Blockchain technology within the Ecommerce Escrow Platform enhances trust, security, and control of users through facilitating decentralized and transparent transactions. Producers and users can engage in secure bid contracts on the basis of their independent identities without the need for a central authority since smart contracts and Public Key Infrastructure (PKI) are employed. Such frameworks guarantee responsibility and data integrity in the online delivery systems.

The application of blockchain technology to Civil Global Supply Chain Management (SCM) systems create disruptive innovations and improvements in the areas of transparency, security, and efficiency. One such innovative application is Dudczyk, Dunston, and Crosby's who built a steganography framework that uses Generative Adversarial Networks (GANs) for high-capacity data embedding. This technique enables accurate data restoration, enhancing the efficiency of modern steganographic processes used in supplychains [1]. In another work, Alkan, Yilmaz, and Kocabaş provided a bibliometric study of 1,874 articles examining blockchain's impact on security enhancement, digital transformation, and SCM acceleration through smart contracts [2]. To solve issues of data privacy and security, Islamic et. al introduced a hybrid model of LSTM and GRU, secure multi-party computation (MPC), and differential privacy preservation within blockchain-based SCM systems [3].Concerns revolving around the environment and sustainability are also coming into focus with the supply chain enhancements seen in blockchain technology. Verlinden et al. evaluated a value chain's carbon and resource footprint within a prostate cancer drug's value chain, noting the importance of exact supplier information for relevant impact calculations. Their results indicate that production in Europe is more environmentally sustainable while Chinese production evidently heightens carbon emissions [4]. Additionally, the combination of the Physical Internet and IoT enables the improvement of sustainability and communication efficacy in supply chains. Xue et al. proposed a hyperconnected order-to-delivery framework with large-scale scheduling problem I-NSGAIII, an innovative optimization algorithm, thereby proving the system's sustainable advantage [5].
Blockchains decentralized capabilities have proven critical in addressing global issues like the COVID-19 pandemic. Idayakumar et al. created a blockchain-based model for vaccine distribution that improves privacy, transparency, and regulatory compliance by smart contracts, bolstering trust and traceability within the vaccine supply chain [6]. Singh, Thakkar, and Warraich again emphasize that blockchain facilitates increased flexibility, security, and trust among the stakeholders which facilitates increased collaboration and flexibility in volatile market environments. Particularly in the biomedical engineering supply chains, Amin, Zuhairi, and Saadat emphasized the advantages of using Hyperledger Fabric Blockchain for securing the supply chain of essential medical resources such as PPE and testing kits, enhancing data transparency and eradicating tampering as well. Today, the e-commerce delivery services rely mostly on a single centralized organization that handles logistics.
This causes lack of control, multiple security problems, restriction of users, delayed delivery, and sensitive data leaked. All the aforementioned drawbacks can be taken care of through the use of blockchain technology because it eradicates central control over commands and gives transparency to actions. By utilizing smart contracts and PKI Based encryption, the system proposed offers trustee-free means of transaction and more control to the users by allowing

them to define their delivery criteria that improves user satisfaction.

Problem Statement

Within the existing online delivery system paradigm, consumer and producer trust and transparency are typically constrained by delivery management inefficiencies, non-accountability, and lax security protocols. Such systems do not have mechanisms for coping with delayed deliveries and compensating equitably, and this results in user dissatisfaction. Furthermore, conventional systems do not incorporate sophisticated security methods, and hence transactions become subject to potential intrusions. Cart Online Delivery System makes use of Blockchain Technology via Smart Contracts and Public Key Infrastructure (PKI) to mitigate such issues. Smart contracts allow customers and producers to agree on the delivery times for products, setting up an accountability system. PKI infrastructure offers greater security through the utilization of encryption and decryption for each transaction, securing sensitive user and producer data. This framework provides a distinct bidding system to decide on product prices, building confidence among users and organizations. It also mandates a compensation framework where delays after defined business days (e.g., two days) attract partial returns to the user, thereby guaranteeing just resolution. The solution put forth targets the transformation of delivery systems online through guaranteeing trust, transparency, and security, while delivering users with a just and dependable service platform.

Existing System

The online delivery systems presently available enable customers to surf, pick products of their choice, and place them in a virtual cart for buying. Once the buying process is finalized, the system calculates an approximate delivery date considering the user's location and logistical limitations. This delivery date estimation is offered by the company, which coordinates the product's dispatch to the consumer. Though this process is widely employed, it lacks mechanisms to deal with possible delays in delivery openly or hold the organization responsible for any divergence from the committed timeline. Moreover, such systems are dependent on conventional techniques for estimations of delivery and do not include latest technologies to support trust, security, or customer satisfaction.

Proposed System

For a solution to overcome the drawbacks of the existing system, a solution is proposed whereby users are vested with power to determine the time of delivery at the time of ordering. This is facilitated by the use of Smart Contracts utilizing Blockchain Technology. Under this method, both the producers and the users mutually come to terms of delivery on a common platform by bidding an equal amount of money or digital coins to form a trusted contract. The system suggested here allows users to specify an estimated date of delivery when they purchase, regardless of the number of days involved for non-perishable items such as accessories and clothing. For perishable items such as food, users can specify both the desired time of delivery and the specific locality where the product is to be delivered. With control given to the users for delivery parameters, the system enhances accountability and trust, where manufacturers are compelled to adhere to the set delivery timetable or face financial sanctions as indicated in the smart contract.

How It Reduces Vulnerabilities Over Current Solutions:

•**User-Controlled Delivery Scheduling**: Users can specify their desired delivery date and place when buying. This is more flexible than fixed organizational estimates.

•**Smart Contracts of Mutual Agreement**: Smart Contracts provide opportunities for agreement among users and producers on the delivery terms. Stake both tokens, having commitments from each.

•**Lexical Security by Blockchain and PKI**: Exchanges are coded by using Blockchain and PKI. They ensure user security by preventing alterations and tampering.

•**Decentralized Trust and Transparency**: Decentralization of contracts obliterates unilateral control through an organization. They establish trust by means of visible agreements among the users.

Literature Review

[1] Dudczyk, J. Dunston, and G. Crosby, "Blockchain Technology for Global Supply Chain Management: A Survey of Applications, Challenges, Opportunities & Implications":

In this paper, a blockchain steganography framework that utilizes Generative Adversarial Networks (GANs) to accomplish high-capacity data embedding is proposed. The reversibility of the GAN allows the original data to be recovered perfectly, adding strength and efficiency to the steganographic process.

[2]G. Alkan, B. Yilmaz, and C. Kocabaş, "The Use of Blockchain Technology in Logistics and Supply Chain Management (SCM): A Systematic

Review":

The research is conducted to understand the effect of blockchain technology on SCM and logistics based on the advantages of transparency, reliability, and efficiency. Bibliometric analysis is employed in this research to assess 1,874 publications in the context and how it enhances security while accelerating digital change. Notable findings are how smart contracts assist in saving cost and accelerating process. The investigation discloses the largest number of publications was achieved by 2023, that China had the largest number of publications and citations, and the best institution among the universities involved was Hong Kong Polytechnic University.

[3] U. Islam, A. Alshammari, Z. Alzaid, A. Ahmed, D. Abdullah, S. Iftikhar, S. Bawazeer, and M. Izhar, "Enhancing Blockchain Security Against Data Tampering: Leveraging Hybrid Model in Multimedia Forensics and Multi-Party Computation for Supply Chain Data Protection:

The work introduces a hybrid framework employing Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), secure multi-party computation (MPC), and differential privacy mechanisms to enhance the privacy and accuracy of blockchain supply chain systems. The method enhances transaction data privacy and identifies media tampering. Performance comparisons demonstrate the hybrid technique surpasses conventional methods such as SVM, KNN, and Random Forest with a 0.95 accuracy. Although it introduces computational overhead, the model preserves decent efficiency and balances privacy and data utility well.

[4] Amelie Verlinden, Lieselot Boone, Wouter De Soete, Jo Dewulf, "Environmental impacts of drug products: The effect of the selection of production sites in the supply chain"

In this study, the environmental effect of a drug for prostate cancer is assessed by analyzing its whole value chain with an emphasis on carbon and resource prints. The unit carbon footprint is 34 kg CO_2-eq, 96% of which is due to the manufacture of intermediate pharmaceutical ingredients (IPIs) and active pharmaceutical ingredients (APIs). The resource footprint is 647 MJ/declared unit, 93% of which is due to IPI and API manufacture. Geographical differences in production site were investigated, with European production having the least impact, but Chinese production raising the carbon footprint by 49%. The research highlights the significance of proper supplier information to evaluate environmental footprints.

[5]Y. Xue, S. Ji, G. Zhu, and P. Zhao, "Solving the Sustainable Automobile Production-Distribution Joint Optimization in the Physical Internet-Enabled Hyperconnected Order-to-Delivery System by I-NSGAIII":

The paper introduces a Physical Internet (PI)-based hyperconnected order-to-delivery (OTD) system for green supply chains that incorporates Internet of Things (IoT) technology to enhance manufacturing communication with other functions. The system is formulated with multi-objective mixed-integer-nonlinear programming to evaluate sustainability. An enhanced genetic algorithm, I-NSGAIII, is formulated to tackle large-scale scheduling problems in PI-enabled production-distribution systems, which employs sophisticated optimization methods. Systematic experiments verify the performance benefits of I-NSGAIII and the sustainability advantages of the PI-H system.

[6] P. Idayakumar, S. Mahadik, I. Paul, and S. Chaure, "Vaccine Supply Management using Blockchain:

This work is concerned with recent developments in deep learning have inspired efforts to make medical data more available for healthcare quality and patient care enhancement. Deep learning models are capable of dealing with big data, but privacy, ownership, and legal limitation issues come up with clinical data centralization in healthcare organizations. Federated Learning addresses these challenges by providing a platform to train machine learning models over multiple data centres without having to share sensitive data. This systematic review of the literature offers the existing research and application of Federated Learning in healthcare and how it can be used to improve data-driven healthcare solutions with privacy and security.

[7] R. Singh, Thakkar, and J. Warraich, "Blockchain in Supply Chain Management," European Journal of Engineering and Technology Research:

This article highlights the growing relevance of blockchain technology within the competitive and dynamic supply chain environment. The potential of blockchain technology to enhance transparency, flexibility, and security has transformed it into a valuable tool for firms to react towards the shifting market landscape. The research suggests that firms invest in blockchain in order to improve trust among supply chain actors. It further states the positive implications and potential of blockchain in facilitating collaboration and integration within the supply chain.

[8]M. R. Amin, M. F. Zuhairi, and M. N. Saadat, "Transparent Data Dealing: Hyperledger Fabric Based Biomedical Engineering Supply Chain:

This research suggests applying Hyperledger Fabric Blockchain technology to enhance the Biomedical Engineering Supply Chain (BESC) for the supply of critical medical devices such as Covid-19 test kits and PPE. Centralized platforms are susceptible to data security breaches and tampering, but blockchain offers a decentralized, unchangeable solution with data transparency and integrity. Blockchain technology in BESC protects and traces biomedical products to prevent data alteration and overall supply chain security.

[9] S. E. Chang and Y. Chen, "When Blockchain Meets Supply Chain: A Systematic Literature Review on Current Development and Potential Applications"

The current situation, possible applications, and future evolution of blockchain technology to supply chain management are examined in the paper. The main benefits and drawbacks, i.e., traceability, transparency, collaboration between parties, and embedding into the supply chain, are highlighted on the basis of a review of 106 articles. Blockchain and smart contracts are considered as groundbreaking technologies that can improve supply chain performance, governance, and process automation. The research also points out significant areas of future work such as technical adoption, integration, and social effects of blockchain to supply chains.

[10] D.Shakhbulatov, J. Medina, Z. Dong, and R. Rojas-Cessa, "How Blockchain Enhances Supply Chain Management: A Survey": This paper investigates the application of blockchain technology to solve most critical issues in supply chains, including transparency, trust, and effective operations. It reviews current blockchain frameworks and explains their constituents, motivations, and how they address supply chain problems. The article points out the strengths and weaknesses of these models and summarizes existing literature with a comparative overview. It further summarizes the key characteristics for effective adoption of blockchain in future supply chains, with an identification of the remaining challenges and the scope for future development.

Key Technologies used:

The Key Technologies that are utilized to implement the Blockchain technologies in the Ecommerce platform that enhances security and standardisation so you (the user) is not ever in a scenario of not being aware of intransparency and duplication.

•**Hardhat Software**. Hardhat software is a development framework and environment for building, testing, deploying and debugging Smart Contracts. The Smart Contracts Transactions are created in a manner that establishes mutual agreement reached with the parties involved. The Hardhat framework conveniently looks after the complete lifecycle surrounding Smart Contract development.

•**Public Key Infrastructure.** Public Key Infrastructure (PKI), provides secure communication through a secure asymmetric cryptographic system with public/private key pairs. Identity is bound to a public key by using Digital certificates signed using trusted Certificate Authorities (CAs). Registration Authorities (RAs) are utilized to help with identity verification and there are standards for methods of revocation, like CRL and OCSP, that can provide certificate validity. Trust is established through a chain of trust connecting certificates to a root CA.

•**Smart Contract**. A smart contract is a self-executing program which has also been described as the fastest and most reliable program which operates on a blockchain. Usually when smart contracts are created, they do not use a Turing complete programming language, meaning that they are not able to build systems which are infinitely recursive. Smart contracts run automatically when conditions in the code are met. Smart contracts can happen without a trustworthy intermediary to rely upon to build each step of the smart contract transaction as the rules for executing a smart contract have to be automated. Once a smart contract has been deployed, it can not be manipulated afterwards and can be trusted to provide transparency, security and automated services.

• **Escrow Platform:** An escrow platform acts as a third party holder of funds or property for a transaction between two parties until the complete terms are agreed upon and fulfilled. When the buyer has received good, or services, the escrow platform releases the payment to the seller. Escrow platforms, build trust in internet transactions and minimize fraud. In addition, escrow systems are now computerized by utilizing smart contracts to provide security and transparency.

The project utilizes hardhat as a development environment for creating, testing and deploying the smart contracts to manage lifecycle effectively. In addition, the project applies Public Key Infrastructure (PKI), to secure communication based on the use of digital certificates and asymmetric cryptography. Smart contracts facilitate the enforcement, and execution of agreements using a distributed ledger technology with no intermediaries which is transparent and trustworthy. The escrow process will have an escrow platform built in to hold the funds, and release funds based on contract enforced consequences within the smart contracts increasing security and minimizing fraud are automated.

Research Methodologies used

Research Methodologies utilized

Research Methodologies utilized

Blockchain, smart contracts, and PKI are utilized in this research and methodology to create a secure, transparent, and user-centric e-commerce escrow platform to overcome the limitations of conventional online delivery system as follows.

1. Analysis of Existing Delivery Systems

A detailed analysis of existing online delivery platforms was carried out to determine primary limitations including:

•Transparency lacking during delays.

•Centralized control over delivery time.

•Limited user participation in logistics.

•Poor accountability mechanisms.

2. Blockchain and Smart Contract Technologies Evaluation

The capabilities of Blockchain and Smart Contracts were researched with emphasis on:

•Immutability and decentralization.

•Automated agreement enforcement.

•Models of staking tokens to incentivize reliability.

3. Cryptographic Security through Public Key Infrastructure (PKI)

PKI research was conducted to assess whether it can be used for:

•Protecting user information.

•Making transactions confidential and their integrity assured.

•Secure user authentication and digital signatures support.

4. User-Centric Delivery models

Research into user-configurable user engagement in scheduling delivery:

•Simplicity in allowing users with delivery time and locations.

•Investigating how user-based logistics influences user satisfaction and system efficacy.

5. System Design and Architecture

•Block chain: the use of a decentralized ledger (i.e.. Ethereum) to capture transactions.

•Smart Contracts: programing smart contracts to allow for bid-based contracts, stake locking, and autopilot delivery enforcement.

•PKI: asymmetric encryption to protect user identities and transaction information.

6. Stake-Based Bidding Structure

•A two-stake model meaning users and producers both place a digital token or currency as their commitment.

•Smart contracts determine whether stakes are released or forfeited as per delivery contract.

73. Delivery Customization Interface

•A user interface was developed to allow users to specify:

o Delivery days

o Delivery times and locations (even time-sensitive)

•Backend logistics informed dynamically based on user adjustments.

7. Simulation and Testing

• We simulated various delivery scenarios such as a delay of delivery, delivery ahead of schedule, and auctions based on bids.

• The performance of the system was tested with respect to:

o the security of the transactions

o the correctness of the delivery, regardless of the user transaction

o the satisfaction of the user for all transactions and delivery correctness

o the reliability of enforcement of the contract.

8. Security Validation

• Penetration tests and encryption audits were used to confirm the effectiveness of PKI.
• The integrity of the smart contracts was tested to confirm that they were tampering- and abuse-resistant.

Challenges

Following are some of the main challenges with current online delivery systems:

1.No Transparency: There is minimum or no transparency in case of delays, frustrating users and making them unsure about the status of their orders.

2. No Responsibility for Delay: Organizations are rarely held responsible for failing to meet delivery schedules which diminishes consumer confidence.

3. Incorrect delivery predictions: Static models do not take into account dynamic factors like weather, traffic, and logistical problems, resulting in incorrect delivery estimates.

4. Homework doesn't leverage technology. Most platforms do not leverage advanced technologies (like AI, blockchain and real time tracking) to improve some efficiencies, security, or customer experience.

5. Passive customer experience: Customers have minimal to no control on how delivery options are deliverd or how the elements of the logistics are executed, ultimately reducing customer satisfaction.

Gaps to be Addressed

1. Real-Time Transparency

As delivery systems seldom provide real-time insight concerning the whereabouts of a shipment, particularly in case there are delays, customers sometimes face frustration when they do not know where their shipment is, when it will arrive, or why they are experiencing a delay. To address these issues, real-time tracking systems will offer constant updates to provide in-transit shipment updates and status notifications with limitations. This may include GPS-based updates for shipments in-transit, status notifications from the platform to inform users of the delay, or proactive notifications from the platform to give insight on when the user may anticipate a notice of delays. This process will ideally improve user confidence by having greater control over the users delivery experience.

2. Accountability Mechanisms

In the present model, any shortcomings in anticipated delivery times by either the platform or logistics partner do not usually incur any punishment. No accountability builds mistrust and frustration because customers have limited recourse when promises are not kept. In a gap filler model, an expanded accountability model will be needed in which both the platform and manufacturers can be accountable for upholding end users delivery promises. Customers should be reimbursed for delays or the delivery fee refunded when delivery time(s) have been outsized. Customers should also have clear escalation paths.

3. Dynamic Delivery Estimates

Most conventional delivery systems implement a static model to forecast delivery times, ignoring variables occurring in real time. Static models do not account for dynamic variables such as weather, traffic, or other crises that disrupt the supply chain, therefore the estimates generated from a static model can be stale or inaccurate. Artificial Intelligence (AI) based algorithms can be implemented to devise dynamic delivery plans that update in an ongoing manner as tasks are completed along the way. The programs would use data from many inputs, such as live traffic updates, weather forecasts, and anticipated delays in logistics to create the best versions of the estimates in terms of delivery times.

1. Next-Level Technology Integration

Most systems still rely on some aspect of the previously mentioned technologies like AI, blockchain, or IoT. AI can be used to optimize routes and to predict what trends might look like from the delivery perspective, while blockchain provides transparency and traceability throughout the supply chain process while giving organizations an overall security that could reduce fraud. IoT devices can monitor shipments as they move in real time, making tracking by businesses and, in turn, consumers, more accurate, and can also accommodate those sensitive to temperature. The confluence of these technologies will significantly increase efficiencies, enhance security, and enhance reliability; thus improving the customers' experience.

5. User Control and Customization

Consumers have little control over the delivery process nowadays. In general, a customer cannot modify their delivery request after they have made a purchase or determined the time of the delivery or the delivery method. Improving end user customization can mean a preferred window for delivery, a preferred location for deliveries (Such as at work or with a neighbor), and even a method of delivering the goods (alternate route if required). This

flexibility would increase customer satisfaction, particularly for those with time-sensitive and special deliveries.

6. Improved Security and Fraud Prevention

As the volume of online transactions grows, security becomes a growing concern. Many current systems do not use any encryption systems or methods, which puts the information at risk of being shared or hacked. Use of strong encryption, such as a Public Key Infrastructure (PKI), blockchain based authentication, and secure payment processors are some ways to increase security and protection from fraud. For example, blockchain can be used to maintain the integrity and immutability of transaction data, while PKI can be used to protect both communications and identity of users. By utilizing these technologies, online delivery systems can help reduce the incidence of fraud and the mishandling of sensitive information resulting in greater trust in the platform.

Existing System

Today's online delivery systems often have a typical process, where customers navigate the site to select products, order to acquire products, and finally receive estimated times of delivery based upon logistics and their location. There are serious concerns with the current online delivery systems because they offer very little transparency in real-time, they do not hold any accountability for delays, and they utilize antiquated prediction models. The ones we reviewed do not use current technologies such as AI, blockchain technologies, or any type of geo-tracking. Furthermore, customers do not have many options, which limits their control over the process. With this all combined, we have found that trust, security, and customer satisfaction continue to be 'gaping holes' in the transactional process.

1. Standard Functions of Online Delivery Systems

Most of the modern online delivery systems allow users to:

•Browse or select products.

•Place the product in a virtual shopping cart.

•Purchase the product through various embedded payment mechanisms.

When a customer makes their purchase, the system generally provides an estimated date for delivery based upon the location and available logistics.

2. Process of Delivery Estimation

The side managing the shipment provides the estimated delivery date. The estimation is intended only to give the user a general idea of when to expect the product to be delivered. It is neither necessarily reliable nor accurate.

3. Unsatisfactory Communication About Delay Management

All of these systems are unsatisfactory at transparently communicating and managing unexpected delivery delays. When unexpected delays happen:

• Limited or no communication at all to the user.

• Limited mechanism for early notifications and/or cooperation with customers.

This leads to poor user experience and lower user satisfaction.

4. Little Accountability for Timeline Shortfalls

Organizations are not normally accountable for failing to meet the projected delivery timelines. This lack of accountability:

• Makes users trust the system even less.

• Limits consumer options when services expectations are not met.

5. Over-dependence on Underlying Estimation Models

Existing systems regurgitate underlying models on delivery estimation, models that:

• Do not update for live conditions like status of weather, traffic, and supply chain problems.

• Result in less accurate and less responsive delivery scheduling.

6. No Long-term Integration of Modern Technologies

Many current platforms do not incorporate:

• AI: To deliver predictive delivery optimizations,

• Blockchain: To bring secure and transparent tracking of transactions,

• Real Time Tracking: To give users current visibility into deliveries

This technological gap prevents the platform from building user trust and satisfaction.

Disadvantages of Existing Systems

While standard and early automated test question generation systems have been utilized in educational assessment processes, there are a number of related disadvantages that restrict their use.
consumer-friendly.

1. Delivery options inflexible

Most systems offer fixed delivery time slots with little room for users to change time slots or addresses. This ends up in a very high rate of avoided delivery or inconvenience. Only periodic potentially flexible features such as preferred time windows or alternative addresses exist.

2. Delivery costs expensive

Freight fees are often high, especially for urgent, expedited, and/or shipping out of the United States and all of its territories. Many systems have hidden costs in shipping costs, and they become evident during a checkout process that creates buyer dissonance. There are little or no incentives or discounts for repeat or loyal customers

3. Don't require serious environmental impacts

Delivery systems are often based on old ways of moving products which depend on using excessive packaging, as well as high-fuel-use transportation modes. This way of selling is very damaging to our planet in significant ways, including environmental harm and carbon footprint, and few systems on the market today offer eco-friendly or sustainable options.

4. Limited - does not provide valuable delivery tracking capability

Most systems offer out-of-date, or rudimentary, tracking options. Users have no idea what is the actual current location or status of the parcel for delivery. Mistaken updates on the parcel day and time for delivery detract from user trust and satisfaction for all delivery systems.

5. Inadequate Customer Support for Delivery Issues

When customers experience slow delivery or a delivery issue, they will often receive unhelpful or delayed support feedback. In fact, there are few customer support systems that deal with delivery-related issues separately. This leads to unresolved issues and loss of brand trust.

6. Delivery Security Risks

At the moment, packages are generally left unattended at customer doorsteps so they are a target for theft, especially high-value deliveries. Most systems do not offer secure drop-off points or tamper-evident delivery options.

7. Inadequate or Wrong Delivery Information

Address entry mistakes, and/or a simple miscommunication with the technology, are typical causes of failed or delayed deliveries. Users are stuck following a long and tedious process to remedy the errors. These consequences severely impact user experience and operational efficacy.

8. No Personalization

Generally, delivery services can not be personalized to the requirements of each user. For example, preferences for delivery time, handling instructions or how items are packaged will not have the option to specify. The lack of personalization espoused by a one-size-fits-all approach diminishes customer satisfaction.

9. Blind Third-Party Logistics

Most platforms assign delivery to 3rd party providers that do not have the same level of service for all users. This prohibits the e-commerce company to have control over the entire end-to-end delivery experience. 3rd party delays, issue management or management of mishandled deliveries can negatively impact your customer perception of the delivery service.

10. Returns and Exchanges Difficulties

Traditionally, return and exchange processes are typically tedious along with being time-consuming. Users may encounter ambiguous policies, excessive return shipping fees and prolonged refunds. This affects future purchases and diminished the user's confident in the environment.

Conclusion

The Ecommerce Escrow Platform provides an innovative delivery service solution that combines Blockchain technology with Smart Contracts and Public Key Infrastructure (PKI), resolving security and reliability issues. Smart Contracts will ensure that users and producers will engage with the same terms for each transaction at the same time, as mandated by the Smart Contract. PKI will enhance security by encrypting and decrypting all data, upholding private data during delivery. The platform offers a bidding process for product prices allowing pricing negotiations between producers and consumers, ultimately coming to an agreement on prevailing price. The interaction of all these attributes will make delivery processes easier and more effective as well as providing transparency, security, and accountability, thereby assisting to strengthen relationships between consumers and producers.

Key Learnings

1. New Age Delivery Service Solution

The Ecommerce Escrow Platform represents a new age solution to delivery services by incorporating advanced technologies to offer a next generation delivery experience. The issue is to address the longstanding issues of security, transparency and reliability in e-commerce transactions.

2. Blockchain Technology Inclusion

By logging transactions on a decentralized database, blockchain reinforces the platform by providing a tamperproof way to see the steps needed to complete the delivery and transaction process. Transparency, traceability, and trust are the advantages of blockchain technology in e-commerce.

3. Smart Contracts

The smart contracts are required to ensure the buyers and sellers comply with the agreement they signed. The contracts go into effect once criteria are met and lessen the role of dispute by human intervention, and ensure that all parties in the transaction process adhere to what they had mutually agreed upon.

4. Public Key Infrastructure (PKI) for Security

PKI includes another level of encryption that protects communication and data transported on the platform, while keeping all private information private by ensuring that sensitive data is encrypted and/or decrypted as it is delivered.

5. Bidding Dynamic Price

The platform includes a bidding/dynamic price model where producers and consumers negotiate prices. The dynamic price model is responsive in real time market-based pricing, for mutual benefit by collaborating in an open and fair negotiation.

6. Efficiency, Transparency, and Accountability

By incorporating blockchain, smart contracts, PKI, and dynamic pricing:
the platform increases the efficiency of operation, it builds trust in a transparent and secure end-to-end process, and it encourages long-term relationships between producers and consumers by fostering accountability throughout

Future Scope

The systems we discussed can always be improved upon and expanded on, going forward project iterations should consider the following:

Disrupting E Commerce and Logistics

The Ecommerce Escrow platform has the possibility to disrupt the concepts of security, transparency and reliability for e-commerce transactions and deliveries. With protection in place for both the buyer and seller, it is more efficient and assures trust in online trading.

Accepting the Blockchain

The Blockchain serves as a public, immutable book for all transaction. By enabling all parties involved to share transparency and accountability, and limit fraud, the Blockchain provides a dissemination method for all parties to confirm states and legitimacy of a transction.

The Functions of Smart Contracts

Smart Contracts will automated the entailment of terms or agreements, in which a payment is made only when conditions are met. For instance, confirming that the delivery has occurred before making the payment. Smart contracts reduces the amount of reliance on intermediaries, which simplifies and

expedites the processing of transacations.

Public Key Infrastructure

Public Key Infrastructure (PKI) protects communications and digital identities. PKI is the framework through which the confidentiality, integrity, and authentication of the data in the application is realized.

Improvements via DApps and IoT

Decentralized Applicaitons (DApps) provide peer-to-peer interaction without the control of a central organization. DApps provide both redundancy and transparency.

The Internet of Things (IoT)

provides a physical as well as a data visibility and accountability mechanism, and a way to update software automatically to help enforce the physical integrity of the package while it is flowing through the supply chain.

Machine Learning and Predictive Analysis

Machine learning algorithms facilitate the use of historical data to:

Predict delivery dates with more accuracy.

Enhance routing and inventory management.

Enhance bidding to service providers.

REFERENCES

[1] Sarra Fekih Romdhane, Kaiwen Zhang, Luis Antonio de Santa-Eulalia, “Towards Efficient and Fine-Grained Traceability for a Live Lobster Supply Chain using Blockchain Technology”,2025.

[2] Detcharat Sumrit, Orawan Jongprasittiphol, “An integrated multi-stage decision model for upstream supply chain disaster management readiness assessment”, 2025.

[3] Jonas Crowell, Charles Turkson, Manoj Dora, Fred Amofa Yamoah, Digital technologies for traceability and transparency in the global supply chains: A systematic review and future directions, 2025.

[4] Elia Henrichs, Meta Leonie Boller, Johnathan Stolz, Christian Krupitzer, “Overview of Blockchain Technology for Product Authentication in Food and Pharmaceutical Supply Chains”, 2025.

[5] Dudczyk, J. Dunston, and G. Crosby, "Blockchain Technology for Global Supply Chain Management: A Survey of Applications, Challenges, Opportunities & Implications”, 2024.

[6] G. Alkan, B. Yilmaz, and C. Kocabaş, "The Use of Blockchain Technology in Logistics and Supply Chain Management (SCM): A Systematic Review", 2024.

[7] U. Islam, A. Alshammari, Z. Alzaid, A. Ahmed, D. Abdullah, S. Iftikhar, S. Bawazeer, and M. Izhar, "Enhancing Blockchain Security Against Data Tampering: Leveraging Hybrid Model in Multimedia Forensics and Multi-Party Computation for Supply Chain Data Protection”, 2024.

[8] Amelie Verlinden, Lieselot Boone, Wouter De Soete, Jo Dewulf, " Environmental impacts of drug products: The effect of the selection of production sites in the supply chain", 2024.

[9] Minghao Qiaoa, Xuanchang Chena, Yangping Zhoua and P. Y. Moka,”Blockchain-Driven Innovation in Fashion Supply Chain Contractual Party Evaluations As An Emerging Collaboration Model”,2024.

[10] Muhammad Ikram, Robert Sroufe, “A novel sequential block path planning method for 3D vehicle routing in sustainable supply chains”, 2024.

[11] Y. Xue, S. Ji, G. Zhu, and P. Zhao, "Solving the Sustainable Automobile Production- Distribution Joint Optimization in the Physical Internet-Enabled Hyperconnected Order- to-Delivery System by I-NSGAIII”, 2023.

[12] V Pradeep, R Yajnesh, Shreyas Moolya, Sheetty Yash, Thirtha, “A review of Blockchain_Based Supply Chian Management: Applications, Challenges and Research Opportunities”, 2023.

[13] Hesham Magd, Mohammad Sultan Ahmad Ansari, and Saurav Negi, “Impact of Blockchain Technology on Operations and Supply Chain Management Performance”, 2023.

[14] Ruli Liu, Wenxue Ran, and Shiwen Liu, “Blockchain Technology Applied to Supply Chain Management: A Systems’ Analysis”, 2023.

[15] P. Idayakumar, S. Mahadik, I. Paul, and S. Chaure, "Vaccine Supply Management Blockchain," 2022.

[16] Singh, R. Thakkar, and J. Warraich, "Blockchain in Supply Chain Management," European Journal of Engineering and Technology Research,

Vol. 7, No. 5, 2022.

[17] M. R. Amin, M. F. Zuhairi, and M. N. Saadat, "Transparent Data Dealing: Hyperledger Fabric Based Biomedical Engineering Supply Chain," 2021.

[18] Wang, H.,Zhang, M., Ying, h. and Zhoa, X., 2021. "The impact of blockchain technology on consumer behaviour: A multimethod study. Journal of Management Analytics", 2021.

[19] S. E. Chang and Y. Chen, "When Blockchain Meets Supply Chain: A Systematic Literature Review on Current Development and Potential Applications",2020.

[20] D. Shakhbulatov, J. Medina, Z. Dong, and R. Rojas-Cessa, "How Blockchain Enhances Supply Chain Management: A Survey", 2020.